Chapter 5. ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

5.1 Introduction

This chapter describes the ecological and economic criteria developed to analyze the impacts of Marine Protected Area (MPA) networks in the Channel Islands National Marine Sanctuary (Sanctuary). The proposed project is analyzed following the discussion of the criteria for potential impacts to the natural and human environment. The same criteria are used for the alternative marine reserve networks described in Chapter 6.

The establishment of the ten proposed State Marine Reserves and two proposed State Marine Conservation Areas would result in no significant adverse environmental impacts. The proposed project is expected to have beneficial effects on the environment and both beneficial long-term and adverse short-term effects on certain human uses in the area. These short-term effects would primarily be displacement of fishing effort outside MPAs. Displacement of effort to areas outside the proposed Marine Protected Areas (MPAs) could potentially impact the environment through congestion of fishing into smaller areas. The proposed MPA network comprises 19 percent of the ~~592~~ **682** square nautical miles of State waters within the Sanctuary. If 19 percent of State waters is closed to fishing and all existing effort is shifted to the remaining 81 percent of State waters it could cause increases in the relative fishing pressure on certain species. This displacement could cause congestion of effort and a potential negative environmental impact outside MPAs. The proposed project attempts to limit this potential by specific area choices limiting the direct impacts to fishing activities. Potential displacement of effort may also be offset by the potential beneficial effects caused by increased production and spillover from the proposed MPAs. In addition existing harvest controls (e.g., size limits, bag limits, seasons) will continue to control take outside MPAs and other regulatory processes limiting total effort of fisheries in the area are underway.

Potential economic impacts of the proposed project would primarily involve the removal of areas of coastal waters from extractive (consumptive) uses involving fishing and diving. Prohibiting fishing in this area is expected to cause a maximum potential loss of 11.8 percent ($3,307,652) in annual ex-vessel value of landings to all commercial fisheries combined (ranging from 2.8 percent to 16.4 percent for individual fisheries) and 13 percent ($3,235,394) in annual income to all consumptive recreational uses combined.

Non-consumptive activities (e.g., diving, kayaking, sightseeing, and eco-tourism) are generally expected to benefit or see no change economically from the establishment of MPAs. Currently non-consumptive activities represent $1,385,756 in annual income within the project area. This income is expected to increase further over time by an unknown amount as demand for non-consumptive activities and quality of experience increase or to remain unchanged as environmental conditions improve.

When reviewing the potential benefits of the proposed project with respect to potential impacts described above, no net adverse environmental impacts are expected. Impacts to existing uses will occur, but these impacts are seen as short-term losses that will be balanced by the long-term health of the environment and stability of marine populations (Table 5-1). These short-term economic losses are not expected to lead to adverse environmental impacts.

TABLE 5-1. COMBINED DIRECT EFFECTS OF PROPOSED LOCATIONS FOR STATE WATERS

CATEGORIES	Santa Barbara SMR	Anacapa SMR	Anacapa SMCA	Scorpion SMR	Painted Cave SMCA	Gull Island SMR	Carrington SMR	Skunk Pt. SMR	South Pt. SMR	Harris Pt. SMR	Judith Rock SMR	Richardson Rock SMR	Combined Effects
FISH AND WILDLIFE HABITAT	+	+	+	+	+	+	+	+	+	+	+	+	+
AIR QUALITY													
WATER QUALITY													
OIL AND MINERAL RESERVES	No effect. New drilling prohibited by NOAA	No effect. New drilling prohibited by NOAA.	No effect. New drilling prohibited by NOAA.	No effect. New drilling prohibited by NOAA	No effect. New drilling prohibited by NOAA	No effect. New drilling prohibited by NOAA	No effect. New drilling prohibited by NOAA	No effect. New drilling prohibited by NOAA	No effect. New drilling prohibited by NOAA.	No effect. New drilling prohibited by NOAA.	No effect. New drilling prohibited by NOAA	No effect. New drilling prohibited by NOAA	
ARCHEOLOGICAL SITES AND SHIPWRECKS	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	No effect. Removal or damage prohibited by NOAA	
NOISE													
COMMERCIAL FISHING [1]	Maximum Loss of income estimated $981,113	Maximum Loss of income estimated $852,481	Maximum Loss of income estimated $1,128,087	Maximum Loss of income estimated $486,396	Maximum Loss of income estimated $363,259	Maximum Loss of income estimated $1,505,173	Maximum Loss of income estimated $1,873,542	Maximum Loss of income estimated $62,006	Maximum Loss of income estimated $1,225,324	Maximum Loss of income estimated $1,058,575	Maximum Loss of income estimated at $476,990	Maximum Loss of income estimated at $39,762	Maximum Loss of income estimated $10,052,708
CONSUMPTIVE RECREATION[2]	Maximum Loss of income estimated $263,852	Maximum Loss of income estimated $441,746	Maximum Loss of income estimated $418,164	Maximum Loss of income estimated $220,651	Maximum Loss of income estimated $51,519	Maximum Loss of income estimated $379,423	Maximum Loss of income estimated $308,770	Maximum Loss of income estimated $59,068	Maximum Loss of income estimated $164,243	Maximum Loss of income estimated $407,426	Maximum Loss of income estimated $113,406	Maximum Loss of income estimated $407,126	Maximum Loss of income estimated $3,235,394
NON-CONSUMPTIVE RECREATIONAL USE	+	+	+	+	+	+	+	+	+	+	+	+	+
SCIENTIFIC USE	+	+	+	+	+	+	+	+	+	+	+	+	+
NAVIGATION													

KEY:+ (Positive Effect) — (Negative Effect) (No Effect) NOAA (National Oceanic and Atmospheric Administration)

[1] Losses indicated are the Maximum Potential Loss to annual income derived during step 1 economic analysis. Income is total income, including multiplier impacts. Baseline Average for commercial fishing, 1996-1999 for the entire Channel Islands National Marine Sanctuary, is equal to $82,913,552. See Section 5.4 for details.

[2] Losses indicated are the Maximum Potential Loss to annual income derived during step 1 economic analysis. Income is total income, including multiplier impacts. Baseline Average consumptive recreational income for 1999 is equal to $24,686,919. See Section 5.4 for details.

5.2 Physical Environment

5.2.1 Air Quality

The following significance criteria levels are used in analyses to determine whether significant air quality effects occur. They are modeled after significance criteria used by the Minerals Management Service for offshore activity analyses.

- HIGH effects occur If the proposed project causes or contributes to a violation of Federal or State ambient air quality standards and exceeds threshold emission levels that have been determined to result in significant effects to air quality.
- MODERATE effects occur when the project does not result in any violation of Federal or State ambient standards, it does exceed threshold emission levels that have been determined to result in significant effects to air quality. Impacts that are moderate are considered significant but can be mitigated to less than significant.
- LOW effects result from no exceedances of California or Federal ambient standards and do not exceed threshold emission levels.

There would not be a significant change in air quality if the proposed MPAs were adopted. There is a possibility for a minor reduction in fishing vessel exhausts or potential increase in research or non-consumptive vessel exhausts within MPAs. These changes would tend to offset one another, leading to no net change. The potential displacement of fishing vessels outside MPAs could increase exhaust in a very small scale, localized area. This increase would only be present on the scale of a few miles, within many tens of miles total area. The overall effect would be no change.

5.2.2 Water Quality

The following significance criteria levels are used in analyses to determine whether significant water quality effects occur. They are modeled after significance criteria used by the Minerals Management Service for offshore activity analyses.

- HIGH effects occur if the proposed project causes or contributes to a violation of State water quality standards or criteria, and acute toxicity is noted, such that enforcement by governing agencies occurs.
- MODERATE effects occur when a discharge degrades water quality on a short-term basis, lasting less than one day, and no acute toxicity is noted.
- LOW effects are when a discharge does not result in deleterious effects to aquatic organisms.

There would not be a significant change in water quality if the proposed MPAs were adopted. Point source discharge is already prohibited within the boundaries of the Sanctuary (15 CFR Section 922.71). Establishing the proposed network would not result in any changes in point and non-point source discharge to the proposed sites, or land use changes which could affect discharges or runoff to the proposed reserve.

Ocean Waste Disposal

Municipal Dischargers

The proposed project is located well away from any point (municipal and industrial outfalls) and non-point (harbors, grazing lands) source of discharges into State waters (Section 4.3.4.2). In addition, the proposed MPAs are all within existing Areas of Biological Significance (ASBS) which were established by the State Water Resources Control Board (SWRCB) in the late 1970's to protect the water quality of these areas. SWRCB regulations which control point and non-point source discharges currently exist and prevent the establishment of future point source discharges in the vicinity of the ASBSs.

Dredge Disposal, and Non-Dredge Material Dumpsites

There are no active dredge disposal or non-dredge material dumpsites within any of the proposed reserve locations. The Sanctuary Regulations do not allow for the discharge or depositing of any materials including the dumping of Dredge and Non-Dredge materials. For this reason, the creation of the proposed MPAs would have no effect on dredge disposal.

The Sanctuary regulations provide additional protection from discharge into the area. Thus, no new sources of discharge are anticipated in these areas. This project does not alter regulations on discharge into the water. The proposed MPAs do not effect water quality, discharges, or dredge disposal.

5.2.3 Geology

There would be no effects of the proposed project on geological resources or processes.

5.2.4 Oceanography

There would be no effects of the proposed project on oceanographic processes.

5.3 Biological Environment

Plants and animals are highly dependent on the quantity and quality of their habitat (Ricklefs 1979; Wilson and Togstad 1983; Beverton 1992; Saldanha 1992). The removal or degradation of these habitats may eventually lead to declines in species abundance, species diversity, and functional diversity within an ecosystem (Thorne-Miller and Catena 1991; Edwards et al. 1982). Marine Protected Areas are one way to help protect habitats and the species within them not only from removal of individuals, but from destructive fishing gears that may alter or disturb habitats.

5.3.1 Threshold of Significance for Biological Impacts

The threshold of significance used to determine whether negative biological impacts would occur from the proposed project and alternatives was taken directly from CEQA. This threshold is any impact that has the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare, or threatened species, or eliminate important examples of the major periods of California history or prehistory. Due to MPAs' inherent protective nature, and the subsequent increase in protection to plants, animals, and habitats brought about through the establishment of MPAs the proposed project does not meet the threshold of significance for negative biological impacts. The potential benefits of MPAs are analyzed based on the following criteria.

5.3.1.1 Biological Criteria for Comparisons of MPA Benefits

The Science Advisory Panel (See Chapter 2) developed a set of ecological criteria that provides a scientific framework for reserve design and allows comparative analyses of potential MPA benefits. The ecological criteria are based on the goals for biodiversity conservation and sustainable fisheries developed by the MRWG. The Science Advisory Panel recommended that MPAs that meet the following ecological criteria would contribute to biodiversity conservation and sustainable fisheries in the Sanctuary. These criteria are summarized at the end of this section in Table 5-2:

- Reserve size
- Biogeographical representation
- Habitat representation and heterogeneity
- Vulnerable habitats
- Species of special concern and critical life-history stages
- Targeted species
- Monitoring sites
- Human threats and natural catastrophes
- Connectivity

Reserve Size

One of the most important questions in designing MPAs is how much area they should encompass. To address this question, the Science Advisory Panel evaluated the status of fishery resources in the planning region and the goals for conservation and fisheries management. For conservation, the benefit of a reserve increases with size. The Science Advisory Panel noted that reserves that included all of the Sanctuary would provide the greatest benefit for conservation. However, for fisheries, the benefit of a reserve does not increase directly with size. The maximum benefit of no take reserves for fisheries, in terms of sustainability and yield, occurs when the reserve is large enough to export sufficient larvae and adults, and small enough to minimize the initial economic impact to fisheries (Guenette et al. 1998). Data from harvested populations indicate that species differ greatly in the degree to which they can be reduced below normal carrying capacity before they are not self sustainable in the long term (Mace and Sissenwine 1993). If reserves are designed for fisheries enhancement and sustainability, the vast majority of studies indicate that protecting 20 percent to 50 percent of fishing grounds will minimize the risk of fisheries collapse and maximize long term sustainable catches (NRC, 2001). The Science Advisory Panel recommended protecting between 30 percent to 50 percent of each of the representative marine habitats in each of the three biogeographical zones of the Sanctuary to achieve the fisheries and conservation established by MRWG. Given the size of the Sanctuary (1,252 square nautical miles), the total area recommended for inclusion in marine reserves varies from approximately 375 to 625 square nautical miles (or approximately 0.4 to 0.7 percent of the Southern California Bight). It is important to note, however, that although individual habitats (e.g., hard bottom shallower than 30 meters) may be represented at a level above 20 percent, the total representation area within the Sanctuary could be less. When comparing alternatives it becomes necessary to determine which habitat types may require higher levels of representation. **The following discussion shows how, depending on the overall goal, the percent set aside recommended may vary. The Department chose to follow the majority of published literature in establishing the following criteria to compare the various alternatives (note these criteria were moved from page 5-12 in the Draft ED):**

- WELL represented habitats were those with 30 percent or more of the total habitat protected in MPAs, as recommended by the Science Advisory Panel.
- ADEQUATELY represented habitats were those with between 20 and 29 percent of the total habitat protected. While this level of representation does not meet the Science Advisory Panel recommendation, it was considered a baseline that may provide benefits to many species.
- INADEQUATELY represented habitats were those with between 10 and 19 percent of the total habitat protected in MPAs. At this level of representation many habitats may not be sufficiently protected.
- POORLY represented habitats, those with insufficient levels of protection of a specific habitat type, were those with 9 percent or less of the total habitat protected in MPAs .

Fisheries recommendations on reserve size

In 1990, the Reef Fishery Plan Development Team (RFPDT 1990) recommended protection of 20 percent of the continental shelf off the southeastern United States. In 2000, the U.S. Coral Reef Task Force (USCRTF 2000) recommended that 20 percent of coral reefs and associated habitats receive protection in reserves. Although the 20 percent figure is widely quoted, it is often criticized as being "arbitrary" and "unscientific" (NRC 2001). Justification for the recommendation of 20 percent set-aside requires the assumption that 20 percent of the target habitat is equivalent to 20 percent of the unfished stock, and that the stock will persist at 20 percent of its natural carrying capacity.

The rationale for protecting 20 percent comes from a fishery model indicating that recruitment overfishing could be avoided by maintaining stocks at or above 20 percent of their unfished biomass (Goodyear et al. 1993). However, the accuracy of this target is limited by several sources of uncertainty. First, it is difficult to determine the true size of an unexploited stock. Second, the estimates of fishing mortality may be inaccurate, especially if target species are caught as bycatch in other fisheries (Guenette et al. 1998). Third, not all species will persist when populations are reduced to 20 percent of their natural carrying capacity. For some species (e.g., lobster), the proportion required to sustain the population may be lower. For other species (e.g., rockfish), the proportion required to sustain the population may be substantially higher. This is especially true in sedentary species like abalone, that may not be able to reproduce at low densities. Because of the uncertainty associated with these fisheries statistics, protecting 20 percent of a stock or habitat may not be sufficient to sustain exploited or bycatch species. Several studies suggest that stocks should be maintained at 60-75 percent of their natural population size if reserves are to be used as the primary management approach (Hannesson 1998; Lauck et al. 1998).

Reserves may be used to provide insurance against the uncertainty associated with conventional management, environmental stochasticity, and other unforeseeable events (Ballantine 1991; Guenette et al. 1998; NRC 2001). Several studies (Roughgarden and Smith 1996; Roughgarden 1998; Lauck et al. 1998) showed that irreducible uncertainties in estimates of population size and fishing mortality make it difficult for managers to maintain stocks above critical target levels. Large closures provide a "risk-averse" strategy for meeting management objectives (NRC 2001; Allison et al. in press). Models developed by Mangel (2000) indicate that, for stocks that are initially heavily fished, reserves of 20 to 30 percent guarantee a high level of persistence for time horizons of 20 or 100 years and provide higher levels of cumulative catch than management with no reserves. Dahlgren and Sobel (2000) modeled the percent of biomass in fished and unfished areas in the Dry Tortugas to estimate the size of the reserve needed to meet specific management objectives. Results from their model indicate that a no-take reserve

protecting 30-40 percent of the region of influence is needed to elevate overexploited stocks to sustainable target levels. Models developed by Lauck et al. (1998) incorporate uncertainties in controlling targeted quotas that lead to variable harvests, which are inherent in most traditional fisheries management schemes. Results from their modeling show that when harvests are moderately variable (±20 percent to 50 percent of the targeted quota), the chances that an initially unfished population will remain in the region of optimal sustainability (defined as > 60 percent of carrying capacity by the Marine Mammal Protection Act and the Magnuson Fishery Management and Conservation Act) for a 20 year time horizon rapidly drops from 1 once the fraction of the total area available for fishing becomes greater than 30 percent to 40 percent. When variability in harvests exceed 60 percent of the targeted quota the chances that the stock will remain in the region of optimum sustainability are less than 1 even when only 5 percent of the area is available for harvest.

Reserves are likely to support increased yields for overexploited fisheries, but large areas must be protected to achieve fisheries benefits (NRC 2001). As fishing pressure increases outside reserves, the size of the area in reserves must also increase to sustain the population. A marine reserve constituting 40 percent or more of a fisheries management area, according to Nowlis and Roberts (1999), would enhance catches and reduce annual catch variability in surrounding fishing grounds for species whose young (i.e., larvae) freely cross reserve boundaries, but whose adults do not. Guenette and Pitcher (1999) recommend setting aside at least 30 percent to provide a larger spawning biomass for cod and Foran and Fujita (1999) recommend protecting 25 percent in reserves to rebuild reproductive output of an overfished species (Pacific Ocean Perch). In general, most models suggest that reserves covering between 20 and 50 percent of management areas would support increased yields for overexploited fisheries (NRC 2001).

If the reserve area is too large, however, fisheries benefits may be reduced. The Science Advisory Panel's review of studies showed that reserve sizes greater than 50 percent rarely lead to increased yields. Gerber et al. (2002) take a slightly different approach than other models of marine reserve impacts on conservation and fisheries. Rather than attempting to find the optimal solution, which is the approach used in nearly every other modeling study, these authors try a wide range of solutions based on random combinations of life history and fishing parameters. The results of this model indicate that reserves of larger size have a negative effect on total annual yield (Gerber et al. 2002). It is important to note, however, that a substantial fraction of 5120 simulated parameter combinations representing different harvest rates and life histories went extinct in the absence of a reserve (Gerber pers. comm.). Extinction would obviously have a greater effect on fisheries than reduced yields. Gerber et al. (2002) base their conclusion that the fishing community will want to keep reserves small by their model's indication that fewer than 10 percent of the combinations that did not go extinct without a reserve generated higher fishery yields. Their parameters for reserve size, however, range from 5 percent to

95 percent. As discussed above, reserve areas less than 20 percent and greater than 50 percent rarely show increased yields in other studies (NRC 2001). Using reserve models similar to Gerber et al. (2002), Hastings and Botsford (1999) demonstrated that optimal yields through effort control and reserve control are largely equivalent.

Other modeling approaches have incorporated networks of reserves, rather than single reserves, with more sophisticated treatments of larval dispersal. These new approaches suggest that conservation benefits of reserve networks can be substantial (Botsford et al. 2001), while at the same time, fisheries yields from reserve control can be substantially higher than yields from effort control over a broad range of reserve sizes and configurations (Gaines et al. In Press). The Science Advisory Panel used these, and other theoretical models and empirical data, to identify the appropriate range of reserve sizes for fisheries management.

Conservation recommendations for reserve size

Larger reserves will contain more species and larger populations are more likely to survive periodic disturbances (Roberts and Hawkins 2000). Ward et al. (1999) suggest that habitats and species assemblages can be used as surrogates for biological diversity when designing marine reserves. Simulations showed that the number of species protected in a reserve design increased with the levels of representation within the surrogates (e.g habitats or species assemblages). When habitat was used as a surrogate, approximately 40 percent protection of all habitats included more than 93 percent of the species of concern. Bustamante et al. (1999 in Roberts and Hawkins 2000) developed a reserve design for protecting coastal habitats in the Galapagos archipelago whose objective was to protect sites for tourism and sites of high biological importance. Their design included representing all coastal habitat types in each of five biogeographical zones encompassed by the archipelago in the reserve. They estimated that it was necessary to protect 36 percent of the region from fishing to achieve the conservation objective. Using data from Turpie et al. (2000), Roberts and Hawkins (2000) estimated that setting-aside 10-36 percent of the coast of South Africa would maximize long-term persistence of coastal fish species. A system covering 10 percent of the South African coast could be designed to represent over 95 percent of the species. However, this system would not represent a number of narrowly distributed, endemic species. A reserve system covering 29 percent of the coast would represent all species and a reserve system of at least 36 percent would protect all species at the core regions of their ranges (a common goal for conservation). Even small reserves are effective for rebuilding and enhancing populations of fished species within the reserve (Halpern in press). However, human threats and environmental catastrophes might wipe out entire populations within small reserves (Allison et al. in press).

Most scientists agree that preserving the same species and habitats through replication in several different sites (e.g., in a network of reserves) increases the benefits of marine

reserves for conservation (RFPDT 1990; Bohnsack 1996; NRC 2001). Conservation of migratory species, or conservation of interacting assemblages of species may require interconnected reserve networks (e.g., in adjacent biogeographic regions). Species that depend on other populations for recruitment will require networks of reserves that have high connectivity (NRC 2001). If management outside reserves is not effective, larger reserves will be needed to sustain species of concern (NRC 2001). In general, data and models suggest that a network of interacting reserves covering between a minimum of 10 percent and 40 percent of all marine habitats is needed to contribute to conservation of ecosystem biodiversity (NRC 2001).

Even with excellent management of non-reserve areas, a reserve system would improve the conservation of ecological communities, provide insurance against uncertainty, and allow monitoring of natural versus human impacts (NRC 2001). With less effective management outside reserves, large reserves may be needed to achieve conservation goals. These size recommendations, however, may need to be altered when taken in the context of whole stocks within the Southern California Bight, as opposed to populations within the project area.

Biogeographical representation

Roberts et al. (2001) proposed that there should be an autonomous marine reserve network for each distinct biogeographical region contained within a planning region. The complex geography of the California Channel Islands influences ocean circulation (Browne 1994) and, consequently, the distributions of habitats and species (Dailey et al. 1993). Three main biogeographical regions emerged when the area was subdivided according to physical and biological differences using existing information (Valentine 1966; Horn and Allen 1978; Littler 1980; Ebling et al. 1980; Kanter 1980; Murray et al. 1980; Seapy and Littler 1980; Apt et al. 1988; Engle 1993; Dugan et al. 1995, 2000). Bathed by the California Current, San Miguel and northern Santa Rosa Island lie in the Oregonian Bioregion, supporting biotic assemblages characteristic of central and northern California, Oregon, and Washington (Murray et al. 1980; Seapy and Littler 1980). Anacapa and the eastern tip of Santa Cruz Island are surrounded most of the year by temperate waters characteristic of the Californian Bioregion (Murray et al. 1980; Seapy and Littler 1980). Sea surface temperature maps suggest that Santa Barbara Islands and southern Santa Rosa and Santa Cruz Islands represent a transition between cooler and warmer temperate waters (ICESS 2001).

It is important to consider the dynamic nature of this transition between two major biogeographical provinces. Persistent thermoclines may shift tens of miles, or more, during environmental fluctuations such as El Nino-Southern Oscillation (McGowan et al. 1998). For the planning process, however, explicit biogeographical boundaries were required. The Science Advisory Panel used available information on sea surface temperature (ICESS 2001) for rough guidance and, in the areas of sharpest transition,

drew biogeographical boundaries that followed the deepest bathymetric contour (under the assumption that these might provide a significant boundary to movement of some species, especially nearshore species that rarely enter pelagic waters). Following guidelines established in Roberts et al. (in press), the Science Advisory Panel recommended one to four MPAs be designated within each of the three biogeographical regions, comprising approximately 30-50 percent of the area in the Sanctuary.

Habitat representation and heterogeneity

The goal of conserving ecosystem biodiversity requires protection of representative and unique marine habitats within each biogeographical region (Roberts et al. 2001). To address the goals for habitat conservation in the design process, it is necessary to define the representative and unique marine habitats in the planning region. The Science Advisory Panel recommended a simple, multidimensional habitat classification, using depth, exposure, substrate type, dominant plant assemblages, and a variety of additional features. An important ecological criterion for reserve design was the protection of a suitable amount (e.g., 30-50 percent,) of each habitat type within each biogeographical region.

The Science Advisory Panel used existing maps and sediment samples taken throughout the Sanctuary. These included a Shoreline Inventory Database (MMS 2000) that describes a variety of coastal features in Santa Barbara County, a series of maps of over 5000 sediment grabs around the Channel Islands (Amuedo and Ivey 1967), a database of soft sediment samples in the northern Channel Islands (USGS unpublished data) and substrate maps of the sea floor around Channel Islands (MMS 1984). These sources were combined using a geographic information system (GIS) to develop a comprehensive substrate map of the Sanctuary, divided into soft substrate (e.g., mud, sand, gravel) and hard substrate (e.g., rock, boulder, bedrock). A bathymetric map of the Channel Islands (Waltenberger 1995) was used to distinguish habitat types at the following depth intervals: shoreline, euphotic zone (intertidal-30 m), upper continental shelf (30-100 m), lower continental shelf (100-200 m), continental slope (>200 m).

Dominant plant species, including giant kelp (*Macrocystis pyrifera*), form marine habitats used by diverse groups of invertebrates, fish, mammals and seabirds (Anderson et al. 1993). The potential distribution of giant kelp around the northern Channel Islands and Santa Barbara Island was determined from aerial photographs of the region between 1980 and 1989 (Ecoscan 1989). Most of the kelp (approximately 17.2 square nautical miles) occurred on the southwestern coasts of San Miguel and Santa Rosa Islands.

The Science Advisory Panel recommended setting aside at least 30 percent, and possibly 50 percent of each marine habitat in each biogeographical region of the Sanctuary. Because organisms often use more than one habitat, it is important to include several habitats within each reserve in the network (Carr and Reed 1993).

Vulnerable habitats

Vulnerable marine habitats, such as rocky intertidal area and seagrasses, require protection from human threats and catastrophic events. To ensure that such habitats will be represented adequately in MPAs, vulnerable habitats were considered explicitly in the Channel Islands reserve network siting process. These seagrasses provide several essential ecological functions, including substrate stabilization, primary production, and nutrient cycling (Phillips 1984) as well as habitat and food for a variety of plants, invertebrates, and fishes (McConnaughey and McRoy 1979). Seagrass meadows are vulnerable to activities that disturb the sea floor, such as anchoring and construction, and catastrophic events, such as oil spills. Unlike slime-producing algae, marine grasses have non-mucilaginous leaves that cannot shed oil effectively (Engle et al. in prep.). In addition to direct impacts to seagrasses, there are several adverse effects of oil spills on invertebrate communities associated with seagrasses (e.g., Dean et al. 1996). Hydrocarbons persist and the recovery time is longer in seagrass meadows than in other marine habitats (Dean et al. 1996). Eelgrass beds have been mapped at six sites on Santa Cruz Island and two sites on both Anacapa and Santa Rosa Islands (Engle et al. 2000). Intertidal surfgrass beds were mapped for the Bureau of Land Management using helicopter surveys (Littler and Littler 1979).

The scarcity and relatively small size (6 m^2 to 12 ha) of eelgrass meadows in the Channel Islands restricted the potential range of reserve locations. Given the criteria that MPAs should include at least 30 percent of existing eelgrass meadows, and that large and contiguous MPAs are most effective for conservation (Margules et al. 1988; Dayton et al. 2000), potential reserve sites should include at least 4 of the 10 eelgrass meadows in the Channel Islands. Because the waters around San Miguel Island do not support eelgrass, several (3-4) MPAs on Santa Rosa, Santa Cruz, and Anacapa Islands should include eelgrass habitat.

Species of special concern and critical life-history stages

One of the goals for MPAs is to protect populations of special concern, which include species of economic importance, keystone species, declining, threatened or endangered species, and habitat-forming species. The MRWG identified 119 species of special concern in the Channel Islands, including plants, invertebrates, fish, seabirds, and marine mammals (Appendix 4). The final species list was agreed to by consensus of all MRWG members. The list of species of special concern does not include highly mobile species (all cetaceans, some pinnipeds, and many birds) whose distributions greatly exceed the Sanctuary boundaries.

Targeted species

Although the majority of the southern California commercial landings of fin fish are from offshore fisheries such as Pacific mackerel (*Scomber japonicus*), Pacific bonito (*Sarda*

chiliensis), Pacific sardine (*Sardinops sagax*), and anchovy (*Engraulis mordax*) (Cross and Allen 1993), the proportion of landings of nearshore species for commercial fisheries has been increasing (Dugan and Davis 1993). The overlap of northern species [e.g., yellowtail rockfish (*Sebastes flavidus*), and lingcod (*Ophiodon elongatus*)] with southern species [e,g., California sheephead (*Semicossyphus pulcher*), white seabass (*Atractoscion nobilis*), and spiny lobster (*Panulirus interruptus*)] contributes to the large variety of nearshore recreational and commercial fisheries in the Channel Islands (more than 100 fish and more than 20 invertebrate species). Many targeted species, particularly the nearshore groundfishes, could benefit from no-take marine reserves through the protection of critical habitats, increased productivity, and restoration of whole ecological communities (Yoklavich 1998; Parrish et al. 2000; NRC 2001). Additionally, MPAs have the potential to benefit depleted fisheries through export of larvae (e.g., Palsson and Pacunski 1995, Sluka et al. 1997) and spillover of adult fish into non-reserve areas (e.g., Atwood and Bennett 1994, Johnson et al. 1999, Murawski et al. 2000).

Monitoring sites

The Channel Islands National Park (CINP) Kelp Forest Monitoring Program has studied 16 monitoring sites for the past 20 years (Davis et al. 1994). These sites are monitored annually for a variety of characteristics including algae cover and invertebrate and fish population levels and diversity. These data provide a baseline against which to evaluate MPAs. Other monitoring efforts (e.g., Department abalone surveys and National Park Service Intertidal Monitoring) will also provide baseline data to compare with future monitoring inside and outside MPAs. The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), a research consortium involving marine scientists from four West Coast universities, also began monitoring 6 subtidal sites in the Channel Islands in 1999. They have been looking at the marine community structure at these sites and plan to add sites in the future. The Science Advisory Panel recommended that some monitoring sites be included both inside and outside MPAs to allow researchers to track changes associated with protection over time.

Human threats and natural catastrophes

Most marine habitats are vulnerable to both natural and anthropogenic disturbances (e.g., large storms and oil spills). Over sufficiently long temporal and large spatial scales, severe disturbances in marine ecosystems are relatively common (Allison et al. in press). Oil exploration, drilling, production and transport all occur in the Channel Islands region and these activities are associated with a variety of potential threats. For example, projected oil development in the Point Conception and Santa Maria Basin areas could result in downstream contamination of the northern Channel Islands via the prevailing California Current. High levels of site-specific threats might preclude certain areas from inclusion in a reserve network.

The risk of shipwrecks contributing to spilled oil or other contaminants is substantial in the Channel Islands region. A major shipping lane lies in the Santa Barbara Channel along the

northern shores of the northern Channel Islands. A study of commercial shipping between Point Conception and Long Beach, California reported 8,500 vessels or 23 trips per day for 1987, of which 80 percent were cargo vessels and 20 percent were oil tankers (Anderson et al. 1993) with a projected doubling in traffic and vessel size by the year 2000. Minor events such as releases of oil or petroleum contaminants from transiting vessels may occur relatively frequently, but are often unidentifiable as such due to the quantity of natural oil seeps in the area (Wilson pers. comm.). Major shipwrecks have been infrequent in the area, though minor groundings along the Channel Islands occur regularly and may contribute to small amounts of released oil (Wilson pers. comm.)

The threat of an oil spill or other catastrophic event in the Channel Islands has a number of implications for reserve siting. A simple way to increase effectiveness of a reserve network is to allow for the impacts of catastrophic events by increasing the percentage of area in MPAs. The minimum effective size of a reserve network is the size necessary to meet the goals for the reserve (e.g., conservation) in a stable environment multiplied by an "insurance factor" that takes into account the frequency of severe disturbance to the environment (Allison et al. in press). Based on the possibility of oil spills in the Channel Islands, the insurance factor was estimated as 1.2-1.8 times the size of a reserve network that meets the reserve goals in a stable environment (Allison et al. in press). To achieve goals for conservation and fisheries, the Science Advisory Panel recommended a minimum reserve size of 30-50 percent of the Sanctuary, multiplied by an insurance factor of 1.2-1.8, requiring minimum protection of approximately 36-54 percent of the Sanctuary. To minimize the likelihood that the total reserve area will be impacted simultaneously by a catastrophic event, the Science Advisory Panel recommended placing multiple MPAs in each biogeographical province in the Sanctuary.

Connectivity

Network design should consider dispersal distances (Ruckelshaus and Hays 1998) and protection of larval habitat (Carr and Reed 1993). Populations in isolated MPAs will only be self-sustaining where there is significant retention of offspring. In contrast, there must be substantial export of offspring for fishery enhancement to occur. High fecundity of most marine species increases the probability that offspring may be exported to replenish fishing grounds.

In places where currents are strongly directional, MPA sited in upstream locations would be more likely to supply recruits to the rest of the management area than those in downstream locations. Where currents are complex, or reversing, a more even spread of reserve locations provide better protection for species of interest.

In the Channel Islands, the patterns of surface current flow are complex. The California Current moves towards the equator offshore and west of San Miguel Island. During the spring, strong offshore winds displace surface waters to the west of Santa Barbara Channel, enhancing upwelling of nutrient rich waters, particularly in the region south of Point Conception. Upwelling persists throughout the spring when the primary movement of

water is towards the equator on the California Current. During the upwelling period, the predominant current in the Channel flows eastward across the northern Channel Islands.

Environmental conditions, biological interactions, and complex oceanographic processes may reduce connectivity between distinct biogeographical provinces. Consequently, locations within the same biogeographical region would be much more likely to exchange materials (including larvae and adults of species of interest) than locations in adjacent regions.

The Science Advisory Panel recommended establishing between one and four MPAs in each biogeographical region. For example, the largest biogeographical region in the Sanctuary, the Oregonian Province, is approximately 650 square nautical miles. The recommendation to set-aside at least 30-50 percent of all representative habitats in each biogeographical region leads to a network of several MPAs, each of approximately 60-160 square nautical miles, in the Oregonian Province. Table 5-2 shows how the various ecological criteria apply to the project area.

Table 5-2. Application of ecological criteria for marine reserve design.

Ecological Criteria (Roberts et al. in press)	**Application to the Channel Islands**
Biogeographical representation	Three major biogeographical regions were identified using data on biota and SST.
Habitat representation	Representative and unique marine habitats in each biogeographical region were classified using depth, exposure, substrate type, dominant plant assemblages, and a variety of additional features.
Vulnerable habitats	To insure adequate representation, vulnerable habitats were considered unique habitat types.
Species of special concern and critical life history stages	Island coastlines and emergent rocks were weighted according to the distributions of pinniped haul-outs and seabird colonies. The algorithm selected areas of high pinniped and bird diversity. Other species were not weighted due to insufficient data on their distributions.
Targeted species	Habitats likely to support targeted species, especially rockfishes (e.g., emergent rocks and submerged rocky features), were included for specific representation.
Human threats and natural catastrophes	The reserve size needed to meet reserve goals in a stable environment (30-50 percent) was multiplied by a factor that accounts for the frequency of severe disturbances (1.2-1.8). No areas were excluded from the process because of high levels of threat.
Size and connectivity	At least one, and no more than four, MPAs should be placed in each of the three biogeographical regions. For one region (650 nm^2), 2-3 MPAs (~60-160 nm^2 each) was recommended.

At the June 2001 Pacific Fishery Management Council (PFMC) meeting the Science and Statistical Committee (SSC) offered to create an SSC ad-Hoc Marine Reserve Committee to review the Science Advisory Panels size recommendation. They presented their conclusions as an independent peer review of the size recommendation in a written report to the PFMC. In this report the SSC states that "given the mandate of the Science Panel and the constraints under which they conducted their deliberations, the SSC is generally supportive of their reserve size recommendation as it relates to the biodiversity and sustainable fisheries goals...Beyond that context, however, the methodology used...will require substantial modifications and extensions to be more broadly useful to the Council..." (SSC 2001). The SSC goes on to state that it endorses the use of reserves as a management tool, but they should be carefully integrated with traditional fishery management (SSC 2001).

With regards to the Science Advisory Panel's conclusions that protecting representative habitats would protect biodiversity, the SSC felt it was a reasonable approach (SSC 2001). This was particularly true given the large number and diversity of species the Science Advisory Panel was asked to consider (SSC 2001). The Science Advisory Panel noted that biodiversity benefits increase with reserve size, and thus could not be used as an upper bound for their recommendation. Thus, the fisheries goal became the limiting factor for the upper bound.

The SSC noted the Science Advisory Panel's recommendation for reserve size to restore and sustain fisheries was based on the existing models of reserves as fisheries management tools. Many of the models require the assumption of limited fisheries controls prior to establishment of reserves (SSC 2001). The Science Advisory Panel determined that, for some species, particularly those species with low reproduction and delayed maturity, the assumption that there is little or no effective protection from traditional management strategies may be reasonable. The SSC noted that the size recommendation for fisheries "appears to ignore the trade-off between reserves and traditional fisheries management." (SSC 2001). The SSC noted that in the forum of the PFMC, socioeconomic constraints would be considered along with a scientific recommendations. This mirrors the process that occurred within the Department in developing the proposed project and is demonstrated through the socioeconomic analysis in Chapter 5.4.

Potential for Congestion

It has been suggested that congestion of fishing effort and the resulting impacts on populations outside MPAs may have negative environmental impacts. This possibility has not been documented in other areas. Even so, the potential impacts of congestion outside MPAs may be considered.

Fishing effort may become concentrated around reserves for several reasons. One concern is that establishment of reserves will displace and concentrate

existing fishing effort into surrounding waters. Alternately, effort may be attracted to the edges of reserves in order to benefit from potential increases in catch or catch per unit effort. It is suggested that either of these types of congestion could lead to negative population and habitat impacts outside the reserve boundary.

The key question regarding congestion is whether the expected increase in export from reserves can compensate for the increased fishing pressure in non-reserve areas. If it does, fishery yields will show a net increase or remain the same despite the displaced effort. Moreover, populations of fished species may be more abundant outside the reserve boundary despite the concentration of fishing effort.

A simple calculation estimates how much fishing effort will increase from a closure of a given size. If R is the fraction of area in reserves, then fishing intensity outside the reserve will increase by a factor 1/(1-R) if there is no reduction in effort. For example, if 25% of the habitat is closed to fishing in reserves, the intensity of fishing outside would increase by 1/(1-.25) = 1.33. If the same number of users were fishing in the remaining 75% of the habitat, the fishing intensity would be 33% higher than before. In the short term, this displacement would increase mortality rates outside the reserve. If, however, reserves enhance populations beyond their boundary either through movement of adults or young, these increases can be offset or eliminated by reserve benefits. The increased production within the reserve boundary necessary to counter the increased fishing intensity outside is 1+ [1/(1-R)]. For the example above, this equals 2.33. This means that production inside the boundary of the reserve must increase by a factor of 2.33 to just balance the added losses outside the reserve. The comprehensive reviews of reserve impacts by Halpern (2002) and Palumbi (2002), suggest that production increases inside reserves are considerably larger. Solely using increases in biomass, which underestimates increases in total production, existing reserves worldwide show a four fold increase (a factor of 4.00) in average production. These empirical data suggest that enhanced production within reserves can more than compensate for the effects of congestion outside for reserve areas as high as 50%.

These conclusions are supported by empirical data outside existing reserves. There is increasing evidence that models accurately predict the direction of change in fisheries yields associated with marine reserves. As the number and biomass of individuals increase within reserves, many species will move out of reserves into fishing grounds, enhancing stocks in fished areas through spillover of adults and export of larvae. Biomass of five commercially important species doubled in fishing areas adjacent to the Soufriere Marine Management Areas off Saint Lucia within a few years after reserve establishment (Roberts et al. 2001). Scientists documented the movement of four species

of sport fishes from the Merritt Island National Wildlife Refuge to adjacent fished areas (Stevens and Sulak 2002). The movement of these fishes from the refuge to adjacent areas has been identified as primary factor responsible for the increase in numbers of catches of world record fishes in the vicinity of Merritt Island. Since 1985, all new Florida records for black drum, and most records for red drum, have been won for fish caught adjacent to the Merritt Island refuge (Roberts et al. 2001). Four years after closed areas were established on the Georges Bank, scallop (*Placopecten magellanicus*) biomass increased 14-fold within the closed areas (Murawski et al. 2000). Satellite tracking shows that scallop fisheries are now concentrated near reserves, and total landings are 150% of 1994 levels. McClanahan and Kaunda-Arara (1996) found a 110% enhancement of catch per unit effort in fishing grounds close to the Mombasa Marine National Park in Kenya. Ratikin and Kramer (1996) found highest catches and catch per unit effort inside the Barbados Marine Reserve and catches increased outside the reserve along a gradient approaching the boundary from both the north and the south. Russ and Alcala (1996b) found a gradual increase in densities of fish outside Apo Island reserve in the Philippines.

Data from existing reserves show that, in spite of the increased effort around reserves, the abundance of targeted species is highest in reserves and declines in proportion to distance from reserves. If the concentrated fishing effort around reserves caused local declines, the abundance of targeted species would be high within and distant from reserves, but low at the edges of reserves. Numerous reserves have been studied worldwide and this pattern has not been detected (e.g., Roberts and Hawkins, 2000). Thus, the positive effects of reserves on abundance appear to counteract potential negative effects of displacement or concentration of boats around reserves.

Displaced or concentrated fishing effort at the edges of reserves also could impact habitat quality around reserves. If concentrated fishing at the edges of reserves reduces habitat quality, one would expect a corresponding decrease in abundance and diversity of species adjacent to reserves. As indicated above, this trend is not observed at the edges of reserves, which consistently support higher abundance and diversity of fishes and invertebrates than other sites distant from reserves. No published data on existing MPAs have shown negative environmental impacts. Even in the absence of published data on existing MPAs, the Department does not anticipate any project related negative environmental impacts.

In addition, ongoing fisheries management processes may reduce the total effort in the project area. Examples include the Nearshore Fishery Management Plan (which suggests reducing overall effort), the Squid Fishery Management Plan (which suggests reducing overall fleet size from 236 permitted vessels and light boats to 52 vessels and 52 light boats), and the spot prawn trap fishery (which is reducing total effort). These long-term management plans are combined with short-term harvest reductions in current regulations. These reductions include shortened fishing seasons (e.g. rockfish and lingcod closure from November - February, inclusive, in this region), reduced bag limits, and other

restrictions. The net effect of reducing effort, while closing some areas to fishing, should limit the possibility for congestion outside MPAs.

5.3.2 Biological Impacts

The establishment of the proposed project would result in no significant adverse impacts related to the natural environment. The proposed project is expected to have beneficial effects on the natural environment. The proposed project protects a portion of all bioregions in the Sanctuary. The State water area within **marine reserves** in the proposed project is approximately ~~114~~ **132** square nautical miles, or 19 percent of State waters within the project area.

5.3.2.1 Impacts of the Proposed Project

Habitat Representation

Six **no take** MPAs, comprising a total area of ~~68.8~~ **79.6** square nautical miles, are located in the cool water region (the Oregonian Bioregion) around the northwestern Channel Islands. Three **no take** MPAs, comprising a total area of ~~26.4~~ **22.1** square nautical miles, are located in the warmer water (the California Bioregion) around Anacapa and Santa Cruz Islands. Three **no take** MPAs, comprising a total area of ~~19.2~~ **30.6** square nautical miles are located in the transitional zone between warm and cool waters. The existing Cowcod Conservation Area below 120 ft around Santa Barbara Island supplements the protection for deep-water habitats and species in the Transition Zone.

Highly productive rocky coast is well represented in the Oregonian Bioregion in proposed project (Table 5-3). Protected rocky coast is well represented in the Californian Bioregion, but inadequately represented in the Transition Zone. Exposed rocky coast is adequately represented in the Transition Zone, but poorly represented in the Californian Bioregion. Sandy coast is well represented in the Transition Zone, adequately represented in the Oregonian Bioregion, but poorly represented in the Californian Bioregion. In total, all coastline habitats are well represented. Nearshore emergent rocks are well represented in both the Transition Zone and Californian Bioregion, inadequately represented in the Oregonian Bioregion, and adequately represented overall (Table 5-3).

All sediment types (mud, sand, gravel, boulder, and bedrock) in the euphotic zone (0-30 m) are well or adequately represented in the proposed project (Table 5-3). Rocky and sandy sediments on the shallow continental shelf (30-100 m) are adequately represented in the Oregonian Bioregion and sandy sediments are very well represented in the Californian Bioregion (Table 5-3). In contrast, all sediments, including mud, sand, gravel, boulder, and bedrock, on the shallow continental shelf are poorly represented in the Transition Zone. The Cowcod Conservation Area below 120 ft around Santa Barbara Island, however, is closed to bottom fishing, thus protecting additional habitat in the Transition Zone. Deeper

habitats are found less frequently within State waters. Soft sediments on the continental shelf (100-200 m) are adequately represented in the Transition Zone, but inadequately represented in other areas (Table 5-3). Deeper habitats are poorly represented in all regions due to their absence in State waters. Offshore emergent rocks are well represented in the Oregonian region but poorly represented in others (Table 5-3).

Marine plants provide food and shelter for numerous organisms. A variety of marine fishes spawn in the vicinity of eelgrass and surfgrass beds where larval and juvenile fishes shelter and grow. Sea urchin, an economically important species, eats kelp. Giant kelp attracts a diversity of marine fishes, including rockfishes that find shelter in kelp forests. High productivity associated with kelp forests attracts large numbers of marine mammals and seabirds. Giant kelp is well represented in the Transition Zone, though inadequately represented in the Oregonian and Californian Bioregions (Table 5-3). Eelgrass is well represented and surfgrass adequately represented in the Oregonian Bioregion. While Surfgass is well represented in the Transition Zone, eelgrass is poorly represented. Eelgrass and surfgrass both have inadequate representation in the Californian Bioregion. In total all three plant and algae habitats are adequately or well represented in the proposed project (Table 5-3).

NOTE: For the purposes of comparative size analysis in the Draft Environmental Document, the project area was considered to be a "planning unit" area encompassing 1500 square miles (1133 square nautical miles) which could be easily described in a Geographic Information System database. In order to more specifically and accurately represent reserve size, total square nautical miles is used in this Final Environmental Document. This does not change the percentage areas or comparative analyses nor does it alter the environmental impact analysis or Department's conclusions as to the potential impacts of the proposed prosed project.

Table 5-3. Total and percent representation of ecological criteria protected in each bioregion in the proposed project.

Ecological Criteria	Oregonian	Transition	Californian	Total
Reserve Size (nm^2)	**79.6**	**30.6**	**22.1**	**132.3**
(Percent of Habitat in Sanctuary Waters)				**(10%)**
1. Sandy Coast (mi)	6.7 (27%)	6.9 (50%)	0.2 (4%)	**13.8 (32%)**
2. Rocky Coast (protected) (mi)	9 (32%)	1.6 (14%)	9.2 (47%)	**19.8 (34%)**
3. Rocky Coast (exposed) (mi)	10.6 (39%)	2.7 (20%)	<0.01	**13.3 (31%)**
4. Soft Sediment (0-30 m) (nm^2)	15.3 (39%)	6.3 (21%)	7 (42%)	**28.6 (34%)**
5. Hard Sediment (0-30 m) (nm^2)	7.8 (23%)	2 (28%)	3.7 (56%)	**13.5 (28%)**
6. Soft Sediment (30-100 m) (nm^2)	52 (25%)	5.8 (9%)	18.8 (34%)	**76.6 (23%)**
7. Hard Sediment (30-100 m) (nm^2)	6.8 (29%)	0.8 (7%)	0	**7.6 (20%)**
8. Soft Sediment (100-200 m) (nm^2)	23 (14%)	12.4 (20%)	3.5 (13%)	**38.9 (16%)**
9. Hard Sediment (100-200 m) (nm^2)	-	-	-	**-**
10. Soft Sediment (>200 m) (nm^2)	4 (2%)	4.1 (2%)	0	**8.1 (1.4%)**
11. Hard Sediment (>200 m) (nm^2)	-	-	-	**-**
12. Emergent Rocks (nearshore) (no.)	33 (15%)	65 (35%)	38 (40%)	**136 (27%)**
13. Emergent Rocks (offshore) (nm^2)	5 (42%)	2 (7%)	1 (<1%)	**8 (20%)**
14. Submarine Canyons (nm^2)	0	7 (23%)	0	**7 (19%)**
15. Kelp Forest (nm^2)	2.8 (17%)	2.1 (35%)	0.2 (11%)	**5.1 (21%)**
16. Eelgrass (nm^2)	0.2 (47%)	0.01 (1%)	0.02 (13%)	**0.2 (35%)**
17. Surfgrass (nm^2)	3.9 (29%)	2.1 (31%)	0.4 (13%)	**6.4 (28%)**

MPA Sites within the proposed Project

The following descriptions list habitats and species that would be protected by the proposed project. As noted above, the protection of habitats correlates to the protection of species and important species-habitat interactions.

Santa Barbara Island State Marine Reserve

Santa Barbara Island SMR is located at the southeast side of Santa Barbara Island. The reserve includes one nautical mile of shoreline from South Point to the eastern point of the

island. The reserve boundaries extend east and south to the State waters boundary. The Santa Barbara Island SMR contains 13.**2** square nautical miles. A subsequent Federal waters addition would add 46.3 square nautical miles for a cumulative total of 59.**5** square nautical miles.

Santa Barbara Island, Sutil Island, and Shag Rock support major seabird and marine mammal colonies. Santa Barbara Island supports breeding colonies of numerous seabirds, including the endangered California brown pelican, western gull, black oystercatcher, black storm-petrel, Leach's storm-petrel, Brandt's cormorant, pelagic cormorant, Cassin's auklet, pigeon guillemot and Xantus's murrelet. California sea lions haul out on sandy beaches on the southeastern side of Santa Barbara Island. Harbor seals and northern elephant seals occasionally haul out in the same place.

The exposed rocky shoreline along Santa Barbara Island is interspersed with occasional cobble beaches (10-12 m wide) in protected coves. The rocky intertidal habitat descends steeply to patchy reefs in large areas of sand. Patchy populations of surfgrass grow on subtidal rocks (15-20 m). Populations of giant kelp on reefs around Santa Barbara Island have declined relative to historical data. Red and purple sea urchins and brittle stars (*Ophiothrix*) dominate the rocky subtidal habitats around Santa Barbara Island. Spiny lobsters are abundant in rocky subtidal habitats in the vicinity of South Point and large mussel beds can be found in the rocky intertidal habitats on the southeastern side of Santa Barbara Island.

The continental shelf drops to approximately 200 m less than ½ mile from shore, and continues to drop to 400 m within 3 miles of Santa Barbara Island. In the past, populations of white, green, pink, and black abalone inhabited intertidal and subtidal rocky habitats. The reserve includes rocky subtidal habitats, from approximately 25-66 m, that may contribute to the recovery of the endangered white abalone. Sandy subtidal habitats support halibut populations near the northern border of the Santa Barbara Island SMR. California sheephead have been observed near South Point.

Anacapa Island, State Marine Reserve

The Anacapa Island SMR is located on the northeast side of Anacapa Island. The reserve includes 3.3 nautical miles of shoreline from the eastern point of West Island (Frenchy's Cove) to the eastern point of East Island at Arch Rock. The reserve extends three nautical miles north from Frenchy's Cove and Arch Rock to the State waters boundary. The Anacapa Island SMR contains 11.7 square nautical miles. A subsequent Federal waters phase would add 2.2 square nautical miles for a cumulative total of 13.9 square nautical miles.

Historically (early 1980s) kelp beds off Anacapa Island extended offshore to approximately ½ mile. Today, rocky reefs that once supported extensive kelp beds are now barren. Sea urchins and brittle stars cover rocky areas around most of northern shoreline of Anacapa Island. Where urchins and brittle stars invade rocky reefs, other species decline, including

Corynactis anemones, sponges, and tunicates. Remnant populations of giant kelp occur close to shore in the Anacapa Natural Area, the only area in the Channel Islands that has been fully protected from fishing since 1978.

The Anacapa Natural Area supports a lush kelp forest and a diverse assemblage of associated species. Surfgrass is found on rocks in the subtidal, particularly in protected inlets (e.g. Cathedral Cove). Eelgrass is not currently found along the north shore of Anacapa Island, but historical records indicate that this area once supported eelgrass populations.

The protected rocky shoreline along the north side of Anacapa Island is interspersed with occasional gravel beaches (e.g. Frenchy's Cove). The rocky intertidal habitat, broken by occasional patches of coarse sand, extends to approximately 40 ft. Numerous nearshore emergent rocks provide roosting sites for seabirds and protective cover for nearshore fishes and invertebrates. Muddy sloping terrain near "Rickett's Rock" supports populations of various invertebrates and is a site for squid spawning. At approximately 60 ft, the continental shelf extends to low relief rubble and compacted sand. A large boulder field extends from approximately 80-100 ft.

Spiny lobsters populations are higher and lobster and sea urchin populations are more stable inside the Anacapa Natural Area than in fished areas (Lafferty and Kushner 2000). Some pink abalone can be found in the Anacapa Natural Area, but populations are very small relative to historical sizes (Rogers-Bennett et al. in press). Kelp bass, California sheephead and numerous rockfish species have declined relative to historical levels (Kushner pers. comm.). Common fishes include blacksmith, senorita, and kelp rockfish.

Mean densities of fished species, including kelp bass and barred sand bass, are significantly larger in the Anacapa Natural Area than in fished areas nearby (Beers unpublished data). Densities of California sheephead are greater in the Natural Area, but the differences are not significant. Similarly, the spawning biomass of some fished species is significantly larger in the Anacapa Natural Area than in fished areas. In contrast, mean densities of species that are not fished, including rock wrasse, señorita, and garibaldi, are not significantly different in fished areas and the protected Natural Area.

Size distributions of fished species, including kelp bass, barred sand bass, and California sheephead, are larger in the Anacapa Natural Area than in fished areas. In contrast, size distributions of species that are not fished, including rock wrasse, señorita, and garibaldi, are not significantly different in fished areas and the Natural Area. The data from Ancapa Natural Area suggest that this region can benefit greatly from protection within a marine reserve, in terms of density, spawning biomass, and individual size. These changes could contribute to increased production of species targeted for commercial and recreational fisheries.

Leopard sharks breed off the north shore of Anacapa Island. Middle Anacapa Island includes a unique aggregation of giant (black) seabass, a large-bodied, long-lived species that has declined to low numbers in the last 25 years. Harbor seals haul out on Middle Anacapa Island. Occasionally California sea lions visit the protected areas on the eastern end of the island.

Anacapa Island supports breeding colonies of numerous seabirds, including western gull, black oystercatcher, brown pelican, Cassin's auklet, pigeon guillemot, pelagic cormorant, and Xantus's murrelet.

Anacapa Island, State Marine Conservation Area

The Anacapa Island SMCA is located on the northwest side of Anacapa Island. The proposed conservation area is an extension of the North Anacapa SMR to provide additional habitat and species protection. The reserve includes 2.2 nautical miles of shoreline from the west end of West Island to Frenchy's Cove at the east end. The reserve extends three nautical miles north of West Island to the State waters boundary. The Anacapa Island SMCA contains 8.1 square nautical miles. A subsequent Federal waters phase would add 1.4 square nautical miles for a cumulative total of 9.5 square nautical miles. Commercial lobster and recreational lobster and pelagic finfish take would be allowed in the conservation area. Pelagic finfish are defined as northern anchovy (*Engraulis mordax*), barracudas *(Sphyraena sp*.), billfishes* (family Istiophoridae), dolphinfish (*Coryphaena hippurus*), Pacific herring (*Clupea pallasi*), jack mackerel (*Trachurus symmetricus*), Pacific mackerel (*Scomber japonicus*), salmon (*Oncorhynchus spp*.), Pacific sardine (*Sardinops sagax*), blue shark (*Prionace glauca*), salmon shark (*Lamna ditropis*), shortfin mako shark (*Isurus oxyrinchus*), thresher shark (*Alopias vulpinus*), swordfish (*Xiphias gladius*), tunas (family Scombridae), and yellowtail (*Seriola lalandi*). *Marlin is not allowed for commercial take.

The high relief rocky shoreline is increasingly exposed toward the west of Anacapa Island. The eastern shoreline of West Anacapa Island is rocky, descending to broken reef and boulder fields in the subtidal zone (approximately 80 ft). The western shoreline of West Anacapa Island is rocky, descending rapidly to a steep muddy slope. High wind and wave action on West Anacapa Island create mixing and upwelling, increasing the amount of nutrients in the water. Nearshore rocky habitats on West Anacapa support patchy populations of giant kelp and surfgrass. A steep rocky reef off the western tip of Anacapa Island supports sea fans, anemones and sponges. Large populations of spiny lobster are found in rocky reefs off northwestern Anacapa Island. Squid aggregate over the muddy slope north of west Anacapa Island. Waters around West Anacapa Island support a high diversity of fishes, including California sheephead, garibaldi, kelp bass, blacksmith damsel, and numerous nearshore rockfish species. Harbor seals haul out on West Anacapa Island, but they are more common on the south side of the island. California sea lions are attracted to northwestern Anacapa Island when squid are present.

The Anacapa Island SMCA is adjacent to breeding sites for numerous seabirds, including the endangered California brown pelican, western gull, black oystercatcher, Brandt's cormorant, double-crested cormorant, pelagic cormorant, pigeon guillemot, and Xantus's murrelet. The conservation area encompasses one of only two brown pelican breeding and fledgling areas in North America.

Scorpion Rock State Marine Reserve

The Scorpion Rock SMR is located on the northeast side of Santa Cruz Island. The reserve includes 3.3 nautical miles of shoreline from the west side of Potato Harbor to the east side of Little Scorpion Rock. The reserve extends north three nautical miles to the State waters boundary. The Scorpion Rock SMR contains 10.3 square nautical miles entirely within State waters.

Rocky shoreline within the Scorpion Rock SMR extends from Cavern Point to Potato Harbor. There is a small sandy beach at Scorpion Anchorage. Some emergent nearshore rocks and caves provide breeding and roosting sites for seabirds, including western Gull, black oystercatcher, Brandt's cormorant, pelagic cormorant, pigeon guillemot, Cassin's auklet, Leach's storm-petrel, and Xantus's murrelet.

The intertidal habitat in Scorpion SMR is primarily rocky with some mixed sand and gravel beaches. Subtidal habitats are mixed sand and gravel sediments with a few patch reefs off Cavern Point. Sandy and muddy subtidal habitats support eelgrass populations. Nearshore sandy habitats support populations of geoduck clams. Feather boa kelp and surfgrass are also found in the area. Giant kelp is found within the proposed Scorpion SMR, but populations are not stable. Because kelp populations are reduced, Scorpion SMR does not support large populations of kelp-associated fishes. Rocky subtidal habitats are dominated by purple sea urchins.

Tall pinnacles and high relief rocky features are associated with caves and submerged rocky cliffs along the coast. Pinnacles support populations of mussels, and attract fish, such as opaleye and perch. Spiny lobster are found in the rocky subtidal and on pinnacles around Cavern Point to Potato Harbor. Terraced reef habitats may support juvenile lobsters. Scallops and sea fans are found in deeper waters on pinnacles. California sheephead are found in deeper waters. Lizardfish, various flatfish species, and sand dabs are found in sand and gravel habitats around Scorpion Anchorage.

Harbor seals are resident and California sea lions have been observed around Scorpion Anchorage, but the area does not support large populations of marine mammals. Killer whales have been sighted frequently in the vicinity of Scorpion Anchorage.

Painted Cave State Marine Conservation Area

The Pained Cave SMCA is located on the north side of Santa Cruz Island. The reserve includes 2 nautical miles of shoreline and an area of 2.1 square nautical miles entirely

within State waters. Recreational fishing for lobster would be allowed in the conservation area.

Painted Cave is reputedly the largest sea cave of the coast of North America. The rocky cliffs around Painted Cave drop steeply into the ocean. There is a narrow intertidal zone and steep rocky walls characterize the subtidal habitat. The bottom of Painted Cave is mostly sand and rocky cobble. The steep rocky walls support some sea urchins, scallops and encrusting invertebrates. Pinnipeds, Risso's dolphin, and cetaceans, including gray, blue, and humpback whales are often observed on the north shore of Santa Cruz Island. The Painted Cave SMCA includes suitable breeding habitat for numerous seabirds, including western gull, black oystercatcher, Brandt's cormorant, pelagic cormorant, leach's storm-petrel, and pigeon guillemot.

Gull Island, Santa Cruz Island State Marine Reserve

The Gull Island SMR is located on the southwest side of Santa Cruz Island. The reserve includes 2.9 nautical miles of shoreline from Morse Point to the point along the shore at 33° 58' N, 119° 48' W. The reserve extends south approximately three nautical miles to the State waters boundary. The Gull Island SMR contains 16.2 square nautical miles. A subsequent Federal waters phase would add 22.1 square nautical miles for a cumulative total of 38.3 square nautical miles.

Historically, Gull Island supported a diverse and abundant marine fauna. Although these populations are reduced, the habitat supports a variety of species. Fish populations in the vicinity of Gull Island are likely to respond to protection within a reserve through increased density, individual size, and reproductive potential. The Gull Island SMR would protect a variety of different habitat types from the nearshore to the continental slope. Sand beach is the predominant shoreline habitat at the border of the Gull Island SMR. Endangered snowy plovers may occur there and the beach supports one of the few populations of pismo clams at the islands. The remaining shoreline is covered with cobble beaches.

Subtidal habitats in the Gull Island SMR are mixed sand and rocky reefs. Red and green algae dominate inshore areas. Gull Island supports an intermittent population of giant kelp, but the kelp populations are reduced. Subtidal habitats support patchy populations of surfgrass. Rocky intertidal and subtidal habitats once supported populations of red, pink, white, and black abalone, but only a small population of red abalone, and very few black abalone have been observed recently. The Gull Island area supports large populations of purple urchins. Rocky subtidal habitats from Gull Island to Laguna Point support populations of spiny lobster. Purple hydrocoral (*Allopora*) is found in deeper rocky reefs around Gull Island.

Shallow rocky habitat extends offshore to Gull Island. Nearshore reefs support populations of various rockfish species. However, rockfish are not as diverse in this region because of physical changes associated with the mixing of warmer waters from the California Counter Current with cooler waters from the California Current. Southern species such as

California sheephead and wrasses are relatively common in the Gull Island region. The region also supports spawning populations of white seabass and halibut. Thresher and mako sharks are fished in the deeper waters near stronger currents.

A number of nearshore and offshore emergent rocks, including Gull Island itself, provide roosting habitats for seabirds, and shelter for fish and invertebrates. Gull Island provides roosting sites for western gull, black oystercatcher, pelagic cormorant, pigeon guillemot, Cassin's auklet, and Xantus's murrelet. California sea lions and harbor seals haul out on Gull Island.

Carrington Point, Santa Rosa Island, State Marine Reserve

The Carrington Point SMR is located on the north side of Santa Rosa Island. The reserve includes 5.3 nautical miles of shoreline from the point at 34° 01.2' N, 120° 05.2' W to the pier at Becher's Bay. The reserve extends south approximately 1.5 nautical miles north and east. The Carrington Point SMR is 13.3 square nautical miles all within State waters.

The shoreline around Carrington Point is exposed and rocky. Some protected sand beaches and rocky shoreline is found from Carrington Point to Bechers Bay. Numerous seabirds, including California brown pelican, western gull, black oystercatcher, Brandt's cormorant, pelagic cormorant, and pigeon guillemot roost at the end of Carrington Point.

Rocky reefs with a few patches of sand characterize the intertidal habitat within the Carrington Point SMR. Red and brown algae grow on rocky intertidal sites in Bechers Bay. Purple and red sea urchins dominate the rocky habitats around Carrington Point.

Low relief rocky reefs mixed with sand extend into the subtidal habitat. The Carrington Point SMR includes rocky subtidal habitat around Beacon Reef and part of Rodes Reef. Giant kelp occurs in the rocky subtidal around Carrington Point, but populations are not stable. Several rock crab species and spiny lobster also live in the rocky subtidal habitats. Historically, the region supported a large black abalone population and a smaller population of green abalone. Rocky subtidal habitats on the southeast side of Carrington Point once supported red (and possibly pink) abalone. The abalone populations are now very low.

Sandy subtidal habitats southeast of Carrington Point support patchy populations of surfgrass and populations of *Pachythione* cucumbers, and sand castle worms (*Phragmatopoma*). A productive eelgrass population in Bechers Bay provides protection and nutrients for juvenile fish and invertebrates. Waters around Carrington Point support a diverse assemblage of fishes, including various species of nearshore rockfish, white seabass, California sheephead, and shark species. Sandy subtidal habitats support populations of halibut. Harbor seals, California sea lions, and blue whales are often found in waters around Carrington Point.

Skunk Point, Santa Rosa Island State Marine Reserve

The Skunk Point SMR is located on the east side of Santa Rosa Island. The reserve includes 2.7 nautical miles of shoreline from Skunk Point to Abalone Point. The reserve extends east approximately 0.5 to 1 nautical miles. The Skunk Point SMR is 1.4 square nautical miles all within State waters.

Onshore, the region between Skunk Point and Abalone Point supports the only lagoon in the northern Channel Islands. Lagoons are known as important habitats for juvenile fishes. Several endangered plant species are found on the beaches around the Santa Rosa Island lagoon, including *Dudleya blockmanii, Dudleya gnoma* and *Gilia hoffmanii*. The shoreline between Skunk Point and Abalone Rocks is sandy. These sand beaches support the largest populations of breeding snowy plovers in the Channel Islands. Populations of Pismo clams are also known to occur here.

Shale ridges extend out from east Santa Rosa Island to form scattered rocky reefs separated by large patches of sand. Persistent populations of giant kelp are found in the rocky subtidal habitat between Abalone and East Points. There are extensive populations of surfgrass south of Skunk Point toward East Point.

Surfgrass provides nursery grounds for fish and invertebrate species, including grass rockfish, halibut and crab. Sand castle worms (*Phragmatopoma*) are found in localized patches in approximately 10-15 ft of water. Pachythione sea cucumbers are common in some areas from Skunk Point to East Point. Halibut are found in sandy subtidal habitats around Skunk Point.

Harbor seals haul out on the rocks around Abalone Point. South of Abalone Rocks, the subtidal habitat is mostly hard bottom. Rocky reefs support dense and stable populations of red urchins, but populations are skewed toward smaller sizes. Rocky reefs once supported populations of scallops, but these populations have declined under fishing pressure. The rocky subtidal habitat from Abalone Point to East Point supports populations of several nearshore rockfish species. White seabass populations can be found in waters off of east Santa Rosa Island at approximately 60 ft deep.

South Point, Santa Rosa Island, State Marine Reserve

The South Point SMR is located on the south side of Santa Rosa Island. The reserve includes 3.8 nautical miles of shoreline from the point at 33° 55' N, 120° 10' W to the tip of South Point. The reserve extends south approximately three nautical miles to the State waters boundary. The South Point SMR contains 10.8 square nautical miles. A subsequent Federal waters phase would add 5.4 square nautical miles for a cumulative total of 16.2 square nautical miles.

A rocky coastline with isolated sandy coves dominates the southwest coast of Santa Rosa Island. The coast is moderately exposed and may receive strong surge in summer months. Northern elephant seals recently have expanded their range to include sandy beaches along the southwestern coast of Santa Rosa Island (especially China Camp). In the past, the protected sandy beaches on the southwestern side of Santa Rosa Island supported breeding and wintering Snowy Plovers. No recent sightings have been made. In the intertidal zone, rocky reefs are interspersed with sandy alleys. The subtidal habitat is mixed rocky reef with sand. The South Point SMR supports healthy and stable populations of giant kelp. Rocky subtidal habitats support a variety of algal species, including *Eisenia, Pterygophora,* and *Laminaria*. Surfgrass is found in the subtidal habitats around South Point and a patchy population of eelgrass grows in Johnson's Lee. Giant kelp forests support a diverse assemblage of nearshore rockfish. White seabass occur in the vicinity of South Point.

Crevices in the reefs provide natural refuges for invertebrates. Red sea urchins are abundant in rocky subtidal habitats. Rocky intertidal and subtidal habitats once supported populations of black abalone. Rocky subtidal habitats support remnant populations of red abalone which have low recruitment potential. The nearshore shelf drops off to sandy plateaus at approximately 70 ft. There are two deeper reefs off of South Point, at 90 ft and 120 ft.

<u>Harris Point, San Miguel Island, State Marine Reserve</u>

The Harris Point SMR is located on the north side of San Miguel Island. The reserve includes 6.3 nautical miles of shoreline from the marker in the middle of Simonton Cove to Cardwell Point. The reserve does not include the popular anchorage at Cuyler Harbor. The reserve extends north to the State waters boundary. The Harris Point SMR contains 18.2 square nautical miles. A subsequent Federal waters phase would add 43.6 square nautical miles for a cumulative total of 61.7 square nautical miles.

Exposed sandy beaches cover the shore from the marker poles in Simonton Cove to Harris Point. The subtidal habitat off Simonton Cove is mostly sandy, with a few offshore reefs. These sand beaches and intertidal habitats may support a population of pismo clams. During the summer months, spiny lobster move inshore toward Simonton Cove. Halibut are found in the sandy subtidal habitats to the northwest of Harris Point. The shoreline from Harris Point to Bat Rock is predominantly exposed rocky habitat with a few sandy coves. The subtidal habitat from Harris Point to Bat Rock is expansive rocky bottom with a few high relief rocks and pinnacles. Giant kelp persists around Bat Rock and inside of Harris Point, but populations are smaller in recent years. The rocky subtidal habitat from Harris Point to Bat Rock is dominated by red sea urchins.

There is heavy recruitment of red abalone in the rocky subtidal, but few adults. The rocky habitat between Harris Point and Bat Rock once supported populations of black abalone,

but these populations are now depleted. Subtidal rocky features support numerous invertebrate species, including kelp corals, anemones, and worms. The rocky subtidal habitats from Harris Point to Bat Rock and around Prince Island support populations of cold-water rockfish species, including copper, gopher, black and yellow, blue, black, and vermilion rockfish. Lingcod and cabezon also are common in these rocky subtidal habitats.

The shoreline of Prince Island is rocky and exposed. Prince Island and the rocky shoreline from Harris Point to Bat Rock provide breeding and roosting habitats for numerous seabirds, including western gull, black oystercatcher, Brandt's cormorant, double-crested cormorant, pelagic cormorant, ashy storm-petrel, black storm-petrel, Leach's storm-petrel, Cassin's auklet, common murre, pigeon guillemot, rhinoceros auklet, tufted puffin, and Xantus's murrelet. The rocky intertidal around Prince Island descends quickly to a rocky subtidal habitat. Persistent populations of giant kelp and surfgrass are found around Prince Island. Red and purple urchins also are abundant in this region. Waters offshore from Prince Island support substantial populations of white seabass and halibut.

Richardson Rock, San Miguel Island, State Marine Reserve

The Richardson Rock SMR is located in open waters around Richardson Rock to the northwest of San Miguel Island. The Richardson Rock SMR contains 32.2 square nautical miles in State waters. A subsequent Federal waters phase would add 32.7 square nautical miles for a cumulative total of 64.9 square nautical miles.

Richardson Rock is the most remote exposed offshore pinnacle in the region. The rock is located in the highly productive region southeast of the major upwelling center near Point Conception. Cool, nutrient rich waters in the region support high local productivity, attracting a diverse assemblage of fishes, marine mammals and seabirds. A few emergent offshore rocks provide roosting habitats for seabirds, and shelter fish and invertebrates below the water's surface. The subtidal habitat is mixed sand and rock. Richardson Rock supports populations of vulnerable species, including black and red abalone, and numerous cold-water rockfish species.

Judith Rock, San Miguel Island, State Marine Reserve

The Judith Rock SMR is located on the southwest side of San Miguel Island. The reserve includes 1.4 nautical miles of shoreline from Adams Cove to Judith Rock. The reserve extends south approximately 3 nautical miles to the State waters boundary. The Judith Rock SMR is ~~4.8~~ **5.1** square nautical miles entirely within State waters.

The shoreline from Adams Cove to Judith Rock is mixed rock and sand with moderate to high exposure. Judith Rock provides some protection from surge and wind. California sea lions, harbor seals, and northern elephant seals haul out on beaches around Point

Bennett, including the region adjacent to the proposed Judith Rock SMR. The reserve is adjacent to breeding and roosting sites of numerous seabirds including western gull, black oystercatcher, Brandt's cormorant, pelagic cormorant, Cassin's auklet, and pigeon guillemot.

The rocky intertidal habitat in Judith Rock SMR is highly productive. The subtidal habitat is mixed rock and sand with moderate relief. Rocky reefs are interspersed with sand alleys. Rocky reefs provide suitable habitat for red and purple sea urchin. Rock crab live in sheltered areas along the sand alleys. The Judith Rock SMR includes populations of red abalone, but red and black abalone have been depleted in nearshore habitats. Giant kelp populations between Adams Cove and Judith Rock are healthy and stable. *Laminaria* is found in deeper waters (approximately 70-90 ft). Patches of surfgrass grow in the subtidal. The lush kelp forest habitat supports diverse populations of nearshore rockfish.

Monitoring Sites

One of the benefits of establishing MPAs is the opportunity to conduct research and monitoring within areas of controlled human use. The proposed MPAs, as a basis for research and monitoring, would enrich the understanding of the coastal nearshore environment and provide the opportunity to determine the effects of fishing on fished populations. MPAs also would allow direct comparisons of fished and unfished areas to distinguish the impacts of fishing from those of environmental fluctuation. Increased awareness of these factors would play an important role in the management of California's marine resources.

The potential benefits and costs of MPAs can only be determined if sufficient monitoring efforts follow establishment of MPAs. "No-take" MPAs are necessary in order to determine the impacts of fishing on marine organisms. Existing monitoring sites are particularly important in the design and siting of MPAs because baseline data collected at monitoring sites would help scientists determine how populations within MPAs have changed over time. It would be possible to evaluate the effects of MPAs in the proposed project using data from existing monitoring sites. ~~Nine~~ **Seven** of 16 National Park Service kelp forest monitoring sites are located within MPAs proposed by the proposed project. One out of five monitoring sites is protected in the Oregonian Bioregion, ~~five~~ **three** out of six in the Transition Zone, and three out of five in the California Bioregion.

Human Threats and Natural Catastrophes

It is unlikely that all MPAs in the proposed project would be impacted simultaneously by catastrophic events, such as oil spills or large storms, because MPAs are widely distributed across the Sanctuary. The proposed project includes multiple MPAs on the north and south sides of each island in the Sanctuary. However, catastrophic events could impact populations in one or several of the reserve areas. The impacts of catastrophic

events could be reduced by adding area to sites in the existing design or by adding additional MPAs. The design of the proposed project does not incorporate the "insurance factor", a multiplier required to account for the effects of catastrophic events, recommended by Allison et al. (in press). Other mechanisms are available to prevent and respond to threats from spills or ~~other~~ human catastrophes. The distribution of MPAs in multiple areas around the islands is designed to limit the impacts of **a** single event~~s~~ on all reserves at once. **These other mechanisms include spill response plans and traffic separation schemes to limit the chance of large tanker collisions.**

Connectivity

Marine organisms often exhibit dispersal during at least one life history stage. Protecting multiple habitats, either in one large reserve or in several small but interconnected MPAs, may be important for growth and reproduction of marine organisms. In the Channel Islands, the strongest currents transport organisms across the northern Channel Islands from west to east, often forming strong counterclockwise recirculation in the Santa Barbara Channel. The patterns of circulation suggest that source populations may be located in productive areas on the north sides of San Miguel, Santa Rosa, and Santa Cruz Islands. A region of low current flow, and potentially high larval retention occurs off northeastern Santa Cruz Island. There is excellent potential connectivity among MPAs in the proposed project. The probability that larvae and adults would disperse to adjacent MPAs is relatively high because the total area covered by MPAs is large, and MPAs are located in the predominant current across the north sides of Santa Rosa, Santa Cruz, and Anacapa Islands. Larvae and adults may disperse between MPAs because distances between MPAs are relatively small and individual MPAs are relatively large.

Potential for Congestion

The proposed project is in the middle of the range of the alternative MPA networks in both size and potential impact on commercial fishing and kelp. There would be a medium probability of relocating effort and a low probability of crowding and congestion effects resulting from the proposed project (Leeworthy and Wiley 2002). **It is important to note that displaced activity may not be accurately estimated by a simple proportional-area calculation. That is, a 25% set-aside may not represent a 33% increase in effort in non-reserve areas, for example, because effort may not have been uniformly distributed before reserve establishment. If reserves are placed in areas of high fishing activity, the displacement could be greater than a proportional-area calculation would indicate, while the opposite would be true if potential reserve areas are used less than expected by chance.**

In 57 days of observation between July 1997 and February 2002, 3,116 boats, or 55 boats per day, were counted in the project area (CINMS SAMSAP unpublished data). Using this

number within the ~~1,132~~ **1,252** square nautical mile project area, the overall density of boats is ~~0.05~~ **0.044** boats per square nautical mile per day, or one boat in every ~~21~~ **23** square nautical miles. Removing the area encompassed by the proposed project (~~114~~ **132** square nautical miles) would only raise the density of boats by .~~004~~ **0.005** boats per square nautical mile per day or one boat in every ~~18.5~~ **20** square nautical miles. These numbers can also be split into commercial and recreational vessels. In the northern part of the Sanctuary (excluding Santa Barbara Island) there were 59 recreational boats per day on average and 29 commercial boats (CINMS SAMSAP unpublished data). On Santa Barbara Island the numbers averaged only 4 recreational boats per day and 3 commercial boats (CINMS SAMSAP unpublished data).

These data can also be analyzed spatially to determine the actual number of boats observed within the proposed MPA boundaries. In order to get an estimate of maximum potential displacement, the single day with the largest number of vessels observed for a variety of fishing activities was compared to the proposed project's MPAs. While seasonal differences in effort could conceivably lead to higher numbers of vessels in a given area, this analysis represents the highest concentrations over more than four years of monitoring. Table 5-3A Shows the potential for displacement based on the actual use on the day with the highest concentration of vessels observed. In the case of Lobster fishing number of traps observed was used rather than vessels. This more accurately depicts the potential congestion in a trap fishery, as the vessel position does not necessarily represent the fishing location on a given day. Note that both the percent potentially displaced, ranging from 2.3% (11 of 487) for lobster to 20% (1 of 5) for trawlers, and the total numbers of displaced vessels are relatively low. This suggests that simple proportional-area calculations overestimate the impact of reserves on potential displacement of fishing activity in the Sanctuary.

Table 5-3A. Numbers of boats or traps potentially displaced by the proposed project on the day of highest use recorded by the Sanctuary's aerial monitoring program (SAMSAP). Data show the total number of boats or traps observed, along with the total number of boats or traps seen in proposed reserve areas.

	Urchin	Lobster[1]	Trawl	Comm. Fishing	CPFV[2]	CPDB[3]	Unknown Sport[4]	Sport Fishing
Date of Maximum	10/28/97	9/30/99	3/25/02	1/4/99	4/25/99	10/18/98	10/01/01	3/9/02
Total Observed	60	487	5	49	16	6	103	66
Total Displaced from:								
East Anacapa SMR					1		8	1
West Anacapa SMCA								
Scorpion SMR						1	1	3
Painted Cave SMCA								
Gull Island SMR	2	10		1			5	
Footprint SMR								
Santa Barbara Island SMR								
Skunk Point SMR		1					1	
Carrington Point SMR	3		1	1			1	
South Point SMR	2							
Harris Point SMR								
Richardson Rock SMR								
Judith Rock SMR								
Total Displaced	7	11	1	2	1	1	16	4

[1]For lobster fishing a trap count from Department aerial surveys was used because numbers of lobster boats do not adequately represent effort. The data used in this table were for the first day of a season, representing a high total number of traps, but not necessarily describing the locations used throughout the year.

[2]Commercial Passenger Fishing Vessels (Party Boats).

[3]Commercial Passenger Dive Boat (Party Dive Boats).

[4]Sport power boats where the observer was unable to determine the activity.

Summary

Protecting the MPAs in the proposed project could contribute to increasing biomass, individual size, and reproductive potential of organisms within the reserve areas, particularly for species with low dispersal and high reproduction. The proposed project would likely achieve the goal for conservation of ecosystem biodiversity established by the MRWG because the reserve areas include all habitat types in all bioregions, encompassing at least some portion of the ranges of most species of interest.

While a potential for fisheries congestion outside the MPAs exists, this would be balanced by ongoing capacity reduction and potential export from the reserves themselves. Protecting the MPAs in the proposed project could help sustain various fished populations, and provide areas of significantly higher reproductive capacity. Increased reproduction within the MPAs may lead to long term fisheries benefits outside their boundaries.

5.3.2.2 Cumulative Impacts of the Proposed Project and Federal Waters Phase

The Federal waters phase would add one offshore MPA to the network as well as additional offshore area to most of the MPAs in the proposed project. This additional area would have additional beneficial impacts to the biological environment through the addition of habitat representation. The total area within the proposed project and subsequent Federal waters phase is approximately ~~279~~ **322** square nautical miles, or 25 percent of the Channel Islands National Marine Sanctuary.

Footprint State Marine Reserve

The Footprint SMR is located in open waters in the passage south of Santa Cruz and Anacapa Islands. The Footprint SMR is 28.6 nm^2, **6.4 square nautical miles of which would be within State waters and the rest** ~~entirely~~ within Federal waters. It is described and analyzed here as a part of the entire recommendation, but not the decision before the Fish and Game Commission. The majority of the proposed Footprint SMR is sand or gravel between 90-900 ft. The Footprint includes several submerged rocky features, including pinnacles and submarine canyons that once supported large population of numerous rockfish species. Today, the rockfish populations around the Footprint are severely depleted from intensive recreational and commercial fishing in the region. Although populations are depleted, the habitat supports a variety of species, including bocaccio and cowcod, both recognized as overfished by the PFMC. Fish populations in the vicinity of the Footprint are likely to respond to protection within a reserve through increased density, individual size, and reproductive potential.

Cumulative Habitat Representation

There is no cumulative change to nearshore habitats with the addition of a Federal waters phase (Table 5-4). These habitats are not found in the area outside State waters within the Sanctuary. Similarly, shallow habitats in the euphotic zone and coastal plants and algae would not receive additional representation (Table 5-4).

Soft and hard sediments on the shallow continental shelf (30-100 m) become cumulatively well represented in the Oregonian Bioregion with the addition of a Federal waters phase. Soft sediments in the Californian region also become cumulatively well represented (Table 5-4). Soft sediments on the deep continental shelf (100-200 m) in the Oregonian Bioregion are cumulatively well represented and in the Californian Bioregion adequately represented (Table 5-4). Soft sediments (sand, silt, mud) on the deep continental shelf (100-200 m) are cumulatively well represented in the Oregonian Bioregion and adequately represented in the Californian Bioregion and Transition Zone. Soft sediments along the continental slope (>200 m) are cumulatively well represented in the Transition Zone. Soft sediments on the continental slope become adequately represented in the Californian Bioregion and inadequately represented in the Oregonian Bioregion (Table 5-4). Little is known about the distribution of hard sediments on the deep continental shelf and slope in the Oregonian and California Bioregions. The representation of emergent offshore rocks increases to 67 percent. While this is well represented, it is above the level recommended by the Science Advisory Panel.

Table 5-4. Cumulative total and percent representation of ecological criteria protected in each bioregion in the proposed project and the Federal waters phase.

Ecological Criteria	Oregonian	Transition	Californian	Total
Reserve Size (nm^2)	**161.5**	**98.9**	**61.7**	**322**
(Percent of Habitat in Sanctuary Waters)				**(25%)**
1. Sandy Coast (mi)	6.7 (27%)	6.9 (50%)	0.2 (4%)	**13.8 (32%)**
2. Rocky Coast (protected) (mi)	9.0 (32%)	1.6 (14%)	9.2 (47%)	**19.8 (34%)**
3. Rocky Coast (exposed) (mi)	10.6 (39%)	2.7 (20%)	<0.1	**13.3 (31%)**
4. Soft Sediment (0-30 m) (nm^2)	15.3 (39%)	6.3 (21%)	7.0 (42%)	**28.6 (34%)**
5. Hard Sediment (0-30 m) (nm^2)	7.8 (23%)	2.0 (28%)	3.7 (56%)	**13.5 (28%)**
6. Soft Sediment (30-100 m) (nm^2)	67.7 (32%)	5.8 (9%)	25.8 (46%)	**99.3 (30%)**
7. Hard Sediment (30-100 m) (nm^2)	7.1 (30%)	0.8 (7%)	<0.1 (<1%)	**7.9 (21%)**
8. Soft Sediment (100-200 m) (nm^2)	54.0 (34%)	12.4 (20%)	5.5 (20%)	**71.9 (29%)**
9. Hard Sediment (100-200 m) (nm^2)	-	-	-	**-**
10. Soft Sediment (>200 m) (nm^2)	20 (9%)	53.2 (31%)	24.5 (15%)	**97.7 (17%)**
11. Hard Sediment (>200 m) (nm^2)	-	-	-	**-**
12. Emergent Rocks (nearshore) (no.)	33 (15%)	65 (35%)	38 (40%)	**136 (27%)**
13. Emergent Rocks (offshore) (nm^2)	8 (67%)	2 (7%)	1 (<1%)	**11 (28%)**
14. Submarine Canyons (nm^2)	<0.1 (<1%)	7 (23%)	5 (<1%)	**12 (33%)**
15. Kelp Forest (nm^2)	2.8 (17%)	2.1 (35%)	0.2 (11%)	**5.1 (21%)**
16. Eelgrass (nm^2)	0.2 (47%)	0.01 (1%)	0.02 (13%)	**0.2 (35%)**
17. Surfgrass (nm^2)	3.9 (29%)	2.1 (31%)	0.4 (13%)	**6.4 (28%)**

5.4 Human Environment

The following sections provide a description of the potential impacts on the human environment from implementation of the proposed project, including impacts to commercial fishing, recreational fishing, scientific use and education, navigation, and non-consumptive uses. CEQA requires project analysis to determine whether any economic effects would lead to a potential environmental impact.

5.4.1 Socioeconomic Methods and Criteria

The Socioeconomic Panel (See Chapter 2) report to the MRWG focused on the potential costs associated with each alternative (Leeworthy and Wiley 2002). Socioecononomic information was gathered and analyzed on the range of impacts associated with the use of the natural resources and non-consumptive uses of the project area for all alternatives. Cost estimates were provided for commercial fishing, kelp harvesting, recreational fishing, and consumptive diving. The analysis of potential costs was quantitative and based on baseline data gathered for the MRWG process over two years. A qualitative characterization of potential benefits for non-consumptive users (sports divers and wildlife viewers), non-users and passive users, scientific and education values, and consumptive users of the project area was also provided in the report.

The Socioeconomic Panel analysis was based on an economic impact model that uses baseline information for 1996-1999 for the commercial fishing industry and kelp harvesting (Leeworthy and Wiley 2002). It also provided a profile of fishermen of the Tri-county area from data collected from contractors, Dr. Barlotti and Dr. Pomeroy, and ethnographic data collected and described by Kronman et al. (2000). The Tri-county area includes San Luis Obispo, Santa Barbara, and Ventura counties. The analysis provided an analysis of consumptive recreational activities based on data collected for 1999 (Leeworthy and Wiley 2002). The recreational analysis used an economic impact and valuation model that includes expenditure profiles. In addition, the Socioeconomic Panel included brief overviews of consumer's surplus, ethnography, and a characterization of baseline estimations. Profiles of the direct recreational users and all the suppliers of recreational services were not available.

Overall, the socioeconomic analysis is not a comparison of potential costs and benefits because there are limited data and scientific studies related to consumptive and non-consumptive values of the project area. However, the data collected and generated by the Socioeconomic Panel represents an important step toward the development of baseline information and analyses.

Chapter 4 describes the socioeconomic setting for the analysis of the proposed project. It is important to note that the Socioeconomic Panel did not conduct a comprehensive comparison of all potential costs and benefits that may be associated with the establishment of MPAs within project area. As a consequence, the socioeconomic analysis is limited by a degree of uncertainty with respect to the potential social and economic costs and benefits of MPAs.

A number of diverse data sources and methods were used to estimate both the total amount and spatial distribution of usage for both the Federal and State waters of the proposed project area. These data include both existing information (e.g., catch statistics)

and surveys conducted specifically for this project. The Socioeconomic Panel relied on the following sources of information:

1) California Department of Fish and Game (Department) commercial fishing data showing where fish are caught and the ports where fish are landed,

2) Surveys of squid and wetfish fishermen to determine squid processing locations,

3) Kelp harvesting and processing information (obtained from ISP Alginates),

4) Surveys of recreational "for hire" operators, and

5) National Marine Fisheries Service, Marine Recreational Fishing Statistics Survey for intercept/access points for those fishing from private household boats.

Analytical Approach

The socioeconomic analyses were based on a two-step approach. The Step 1 Analyses described the potential impacts of each alternative and a comparison of impacts of alternatives for commercial fisheries and fishermen, and for consumptive recreational activities for the project area (Leeworthy and Wiley 2002). The analyses also provided an aggregate consumptive impact assessment for Step 1 Analyses. Step 2 analyses are less quantitative. The Step 2 Analyses qualitatively described factors that contribute to potential costs and, when possible, the benefits of the establishment of MPAs within the project area (Leeworthy and Wiley 2002). The Socioeconomic Panel could not forecast all the factors such as human responses, the ecological-biological responses, or the interaction of the human and ecological/biological systems that may result from the network of MPAs and change step 1 estimates. All the benefits and costs of MPAs cannot be quantified, and so a formal benefit-cost analysis was not conducted.

The Step 1 analyses were very quantitative and included an aggregation of all the activities displaced from marine reserve areas, with the assumption that all is lost, because there is no mitigation or offsets through behavioral responses. Substitution or relocation of activities to another area, replenishment effects (biological effects such as spillover), the effects of other regulations, the current and future status of fishing stocks, and the potential benefits of MPAs are not addressed in Step1 analyses. The Socioeconomic Panel labeled the Step 1 analyses as "maximum potential loss". In cases where congestion effects occur due to displacement and relocation of fishing effort, actual losses could exceed estimates of maximum potential loss or losses may be overestimated where offsetting factors such as effort reduction are instituted.

The Step 2 Analyses focused on the potential costs of each alternative for commercial fishing and kelp harvesting and consumptive recreational activities. The analyses also

included a general qualitative overview on potential benefits to non-use or passive use values associated with the project area, such as wilderness, natural, scientific, and education values as well as long-term benefits to consumptive users. A number of diverse theoretical models from socioeconomic literature were used by the Socioeconomic Panel to guide the Step 2 analyses and establish under what conditions and to identify future costs and benefits associated with the reserve alternatives.

Overall, the analyses provided extensive profiles of the potential economic costs to commercial and recreational fishermen, measures of their dependency on Sanctuary resources, the extent of potential impacts on individual fishermen surveyed, and information relevant to assessing the ability of users to adapt to change.

Economic Rent

Another measure listed as a possible benefit or cost was economic rent. Economic Rent is a return on an investment over and above a normal rate of return on investment. A normal rate of return on investment is that rate of return in which incentives are such that capital will neither outflow or inflow into the industry. To estimate economic rents requires detailed information on the costs and returns and investment by fishermen. The Panel attempted to obtain this information in both the commercial fishing and squid and wetfish samples but were only partially successful. Fishermen were reluctant to reveal their full costs and earnings. This prevented the Panel from evaluating the existence or extent of potential impact on economic rents.

Ethnographic Data Survey

At the beginning of the Sanctuary's five-year management plan revision process, the Sanctuary conducted an ethnographic data survey (Kronman et al. 2000). Forty-three mariners were surveyed, fifteen of whom were professional fishermen interviewed about their opinions on the current status of various species and habitats, whether the status of the species and habitats have changed, environmental cycles observed, changes in climate, changes in equipment used for fishing, changes in regulations and when and/or if they affected their operations, changes in domestic and/or export markets for their products or changes in distributions of boats and fisheries and when and/or if these changes affected their operations. This ethnographic information was used in developing some of the Panel's catch distributions.

Commercial Fishing Operations

The information and analysis generated during the socioeconomic investigation represents an important baseline study of the various use values associated with the project area. The Socioeconomic Panel gathered and synthesized available social and economic information from a number of current programs, studies, and sources

(Leeworthy and Wiley 2001; Leeworthy and Wiley 2002). Socioeconomic information and analysis were generated over a two-year time period from a number of other surveys described below that were funded as part of the MRWG process.

Two contractors were selected by NOAA to gather information for the commercial fisheries in the Sanctuary. Dr. Craig Barilotti of Sea Foam Enterprises, Inc. collected information from all commercial fisheries, except squid and wetfish (e.g., anchovies, sardines, and mackerel). Dr. Caroline Pomeroy of the University of California, Santa Cruz analyzed squid and wetfish data gathered for a California Sea Grant research project.

Three maps developed from the squid and wetfish fisheries are used in the socioeconomic impact analyses. These maps compare ex-vessel value from specific sites within the project area. Maps and tables summarizing a comparison of the 1999 population and sample distributions for each fishery, in terms of fishing operations (vessels) and annual ex-vessel value of catch, are provided in Leeworthy and Wiley (2001).

The commercial fishing sample included 59 fishermen. The squid and wetfish sample included 29 purse seine boats and 8 light boats. Profiles of purse seine boats and light boats were presented separately. Fishermen were asked to provide information including experience (years of commercial fishing and years fishing in the Sanctuary, age, years of education, percent of Income from fishing, percent of fishing revenue from Sanctuary waters, number of crew and family members supported directly by the fishing operation, ownership/Investment value of boats and equipment, residence (state and city), and ports used (home port, main tie-up port, and main landing port). Not every fisherman supplied complete information. More detail was available from the squid and wetfish fishermen than the other commercial fishermen. The sample did provide a broad range of types of fishermen and represents fishermen responsible for the majority of the catch in Sanctuary waters. This sample was used for assessing potential adverse impacts and difficulties of adapting to change.

The commercial fishing sample accounted for 25 percent of the 1996-1999 average annual ex-vessel value of catch from the Sanctuary. Together with the squid and wetfish sample, the analysis included 96 fishing operations which represent 13 percent of the fishing operations that fished in the Sanctuary, but accounted for 79 percent of the total ex-vessel value of catch from the Sanctuary.

In addition, the Socioeconomic Panel obtained summary tables of information from a study done by Utah State University researchers (Ron Little and Joanna Endter-Wada) under contract to the U.S. Department of the Interior, Minerals Management Service. In 1996, the Utah State University researchers conducted a survey of 248 commercial fishermen who live in the Tri-County area: 95 of the 248 fishermen fished in the Sanctuary, and 60 of the 96 fishermen in the samples lived in the Tri-county area. Very few of the squid and wetfish fishermen from the samples lived in the Tri-County area.

A characterization of the ex-vessel value of the commercial fisheries in the Sanctuary for 1999 and for the average of years 1996-1999 is provided in Chapter 4. In 1999, the top 14 species/species groups accounted for 99.7 percent of the commercial landings from the Sanctuary, and for the years 1996-1999 the top 14 accounted for 98.7 percent of the commercial landings from the Sanctuary. As a result the top 14 species/species groups were included in the socioeconomic analyses for the commercial fisheries along with kelp.

Kelp was treated differently because it is harvested by only one company, ISP Alginates, located in San Diego, California. Harvested value equivalent to ex-vessel value was not available. Instead, ISP Alginates supplied the Socioeconomic Panel with the processed value of kelp (1996-1999 average of $5,991,367). The Panel constructed a separate economic impact model for kelp with the help of Dale Glantz of ISP Alginates. All the economic impact from kelp occurs in San Diego County where it is landed and processed.

After reviewing the trends in catch and value from 1988-1999, the Socioeconomic Panel decided that the average of years 1996-1999 would be the most representative estimate for extrapolating future impacts. The trends in catch, value of catch and prices for the project area and for the entire State are included in the analysis (Leeworthy and Wiley 2002).

The commercial fishery economic impact model translates annual ex-vessel value of landings into total annual income and employment impacts on local economies. Distributions of catch by species/species group from the Sanctuary and port where landed were multiplied by figures from the Fishery Economic Assessment Model (FEAM) that translate annual ex-vessel value of landings by species/species groups at a given port to total annual income generated in the local county economy (Leeworthy and Wiley 2002).

Commercial Consumer's Surplus

The Socioeconomic Panel also described the possibility of losses to consumers if the supply of commercial seafood products were reduced enough to have impacts on prices to consumers or a gain to consumers, if MPAs resulted in increased supplies and lower prices to consumers. To estimate consumer's surplus requires access to econometric demand and supply models for each of the fisheries. The Panel was not able to find any such research for California seafood products, except sea urchins (Reynolds 1994). As a result the Panel was not able to provide estimates of potential impacts on consumers from possible price changes.

Recreational Uses

Recreation was divided into consumptive activities and non-consumptive activities for the purposes of the socioeconomic analysis. Recreational consumptive includes recreational fishing from a charter/party boat, fishing from a private household/rental boat, consumptive diving from a charter/party boat and consumptive diving from a private household/rental

boat. Non-consumptive recreation includes non-consumptive diving, whale watching, sailing and kayaking/sightseeing from for hire or charter/party boats.

Non-consumptive recreational users are potential beneficiaries of MPAs. Because the Panel was not able to obtain existing information on non-consumptive activities from private households and rental boats, non-consumptive uses are undercounted. A comprehensive benefits analysis was not part of the Panel's assessment and was beyond the scope of the Panel's investigation. Recreational consumptive users may potentially experience both costs and benefits of MPAs under various conditions. As described earlier, the potential benefits from MPAs are determined by the size and location of MPAs which vary among alternatives. Because data on non-consumptive users accessing the Sanctuary from private household and rental boats are not available, non-consumptive benefits of MPAs are underestimated.

The Socioeconomic Panel include an analysis of information for years 1993 to 1998 from the NMFS's Marine Recreational Fisheries Statistics Survey (MRFSS) (Leeworthy and Wiley 2000). MRFSS data show a downward trend in fishing trips and catch for southern California over this period. Total trips had declined 26.4 percent. For the top 20 species, in terms of total number of fish caught, 10 had downward trends, 7 had no trend and 3 had upward trends. These trends were contrasted with the trends for the years 1991 and 1996, for all of California, based on the U.S. Fish and Wildlife Survey of Fishing, Hunting and Wildlife Associated Recreation (USFWS 1991 and 1996). This latter survey showed a slight decrease in the number of recreational anglers (less than one percent), but an increase in the number of angler days (27.88 percent). Although the definitions of the populations covered are different between the surveys, the Panel was not able to reconcile the differences in trends because the MRFSS Northern California data also showed a downward trend.

The Socioeconomic Panel's recreational data included information organized into consumptive and non-consumptive activities and within each of these categories whether the activity was done from a charter/party boat or guide service (for hire operation) of from a private household owned boat. The charter/party boat or guide service activity was obtained through a contract with Dr. Charles Kolstad of the University of California, Santa Barbara. Dr. Kolstad was able to census, or contact all those who operated in the Sanctuary in 1999. Information was obtained on person-days of activity, by activity type along with revenues, operating and capital costs and profits associated with each activity. Person-days of activity, by type of activity, were mapped in 1-minute by 1-minute cells for all the cells in the Sanctuary. For private household boat use, data were obtained from multiple sources, explained below.

Charter/Party Boat or Guide Service – For Hire Operations

A total of 51 operators of charter/party boat or guide services were identified as having operated in the Sanctuary in 1999. Operators often engaged in providing multiple activities, sometimes both consumptive and non-consumptive activities. Therefore, the

addition of the number of operators across activities will add to more than 51. Person-days of activities, revenues, costs and profits are not double counted across activities.

Nautical charts with the 1-minute by 1-minute cell grid overlaid were provided to the Kolstad team by NOAA. Person-days of activity, by type of activity, were mapped for each operation and entered into spreadsheets and a Geographical Information System (GIS) database. The GIS database allowed various alternatives to be compared on in a spatial and graphical format. Person-days of activity, by type of activity, were then summed across operations. Since a census of operations was achieved, the sum of the sample represents the population estimate. Information on the recreational fishing industry by type of activity is found in Chapter 4.

Economic Impact and Valuation Model for Recreational Fishing Operation

The model estimated person-days of activity for each of the consumptive and non-consumptive recreation activities for year 1999. The person-days were mapped in 1-by-1 minute grid cells for the area within the Sanctuary. The mapped data were included in the GIS database.

Expenditure Profiles

The next step in the economic impact model was the development of expenditure profiles for each recreation activity. The Panel reviewed the literature and most of the studies found were related to fishing in southern California with one study for all of California party boat fishing (NMFS 1980; Wegge et al. 1983; Rowe et al. 1985; Hanemann et al. 1991; and Thompson and Crooke 1991).

The Panel supplemented this information with a visitor's study for Santa Barbara County (Santa Barbara County Conference and Visitors Bureau and Film Commission 1999) for lodging and food and beverage expenditures, and a study on diving in Northwest, Florida for some dive related costs (Bell et al. 1998). Also, from the charter/party operations the Panel derived the boat fee per person-day. From all this information the Panel constructed expenditure profiles. Because the Panel relied on mostly regional studies, the expenditure profiles do not differ by county, except the charter/party boat fees.

Most recently, the Socioeconomic Panel received a recently released study by NOAA's National Marine Fisheries Service entitled "*Marine Angler Expenditures in the Pacific Coast Region, 2000"* (Gentner et al. 2001). This study provided updated spending profiles for charter/party boat fishing and private household/rental boat fishing in Southern California. The new expenditure profiles were incorporated into the analysis. The new estimates are lower than those previously used in analyses by Leeworthy and Wiley (2001) for the MRWG. The derivation of the spending profiles are provided in Leeworthy and Wiley 2002.

The next step for calculating potential economic impact was to multiply the person-days of activity by the expenditures per person-day to get total direct sales impact. These direct sales estimates by expenditure category were mapped into the appropriate standard industry categories in the 1997 Economic Census of Business for each county. Direct sales estimates were translated into direct wages and salaries impact by multiplying the direct sales estimate by the appropriate wages-to-sales ratio specific to each category in each county. Estimated direct wages and salaries were divided by the wages-to-employment ratios specific to each category in each county to get an estimate of the direct number of full and part-time employees directly supported.

Direct wages and salaries were translated into total direct income by multiplying direct wages and salaries by the ratio of total income to wages and salaries income specific to each county. This adjustment accounts for proprietor's income. The ratio of proprietor's income to proprietor's employment was used to derive proprietor's employment, which was added to wages and salaries employment to get total direct employment supported.

The final step was to calculate the multiplier impacts. Because the Panel did not have estimates of the proportion of local residents to nonresidents in each activity in each county, they used a range of 2.0 to 2.5 for income multipliers and 1.5 to 2.0 for employment multipliers. These ranges of multipliers are consistent for economies in the impact area. Direct income and direct employment applied to the multipliers yields estimates of the total income impacts. Only direct impacts are counted for residents, but much of these impacts are double counting because they represent part of the multiplier impacts of other basic or export industries. Leeworthy and Wiley 2002 use the import substitution argument to justify including direct impacts of residents. The net effect is to overstate the impacts of Recreational consumptive users.

When the Panel reports only one estimate for annual income or employment, it is the upper range estimate, which was used to develop a maximum potential loss estimate in Step 1 analyses of marine reserve alternatives.

Consumer's Surplus

The Panel also conducted a review of literature for studies that estimated the consumer's surplus values for the various recreational uses in the Sanctuary. Five studies were obtained for California or southern California, however only two of these provided enough information on values that could be used (both were for fishing). The average value for all studies was $11.58 per person-day. The Panel used this value as a rough approximation for all consumptive and non-consumptive recreation activities. There is no differentiation between consumptive and non-consumptive recreation activities for this measurement, which limited the Panel's ability to analyze trade-offs in maximizing the economic value of Sanctuary resources. This would not be adequate information for a formal benefit-cost analysis.

Thresholds of Significance - Socioeconomic impacts

A threshold is a quantitative or qualitative standard or set of criteria for a particular resource. This standard is used to compare the environmental setting of the resource or consumptive use with or without the project impact to determine whether the impact is significant. The threshold of significance under CEQA is established by the lead agency.

Determining the character of economic and social impact is predicated on the scale used in analysis. Overall, there exist administrative definitions of "significance". Presidential Executive Order 12866 defines a significant impact for Federal Regulations as any impact on the economy of $100 million or more annually. When the impact of a Federal Regulation is expected to have impacts of $100 million or more, then the requirement is that the Federal agency proposing the regulation must conduct a benefit-cost analysis of the regulation. There is no specific State definition for significant economic impact.

Another way to examine impact is to view the impact with respect to the total economy of the region. As the Socioeconomic Panel showed, if MPAs were to result in the elimination of 100 percent of the current uses in the Sanctuary, then a full benefit-cost analysis would be required (Leeworthy and Wiley 2002). However, none of the six alternatives in this document result in that level of economic impact. Although the Panel estimated a maximum potential impact of $172 million to annual personal income, this is less than four one-hundredths of one percent (a small fraction of one percent) of the entire seven-county area (Leeworthy and Wiley 2002). If all the activities in the Sanctuary were prohibited, it would not have a significant impact on the total economy of the seven-county region. Here the use of significant impact is limited to the relationship between the activities in the entire economy of the region. The highest impact is in Ventura County, which depends on about eight-tenths of one percent of its employment from activities in the Sanctuary.

The Socioeconomic Panel noted that they were not able to conclude that there would or would not be significant impacts on certain individuals or groups. The Panel had no basis for judging significance at the personal scale and context. The Socioeconomic Panel did conclude that there would be no significant macroeconomic or fiscal impacts from MPAs in the Sanctuary (Leeworthy and Wiley 2002). According to CEQA economic and social changes resulting from a project shall not be treated as significant effects on the environment [Section 15064 (e)]. These effects may be used, however, to determine if they might lead to a negative environmental impact. The threshold of significance for these impacts is determined by whether they would necessarily lead to a direct, measurable, impact on the environment as described in Section 5.3.

5.4.2 Impacts to Commercial Fishing

The establishment of the proposed MPAs would eliminate all commercial fishing activities within Marine Reserves, unless they are conducted as part of an approved scientific research program, and most commercial fishing activities within State Marine Conservation Areas. Impacts from the proposed State waters phase, the Federal phase, and the total cumulative impacts are presented below.

Step 1 Analysis

The proposed project would potentially impact more than $3**.3** million in annual ex-vessel revenue or nearly 11**.8** percent of all ex-vessel revenue within the Sanctuary (Table 5-5). The cumulative impacts from the Federal waters phase would result in a maximum potential impact of approximately $3**.5** million in annual ex-vessel revenue, or ~~11.6~~ **12.5** percent of all ex-vessel revenue in the Sanctuary. All of the potential impact on harvest of kelp and catch of urchins, spiny lobsters, crab, California sheephead, and sea cucumbers would be in the State waters portion of the Sanctuary. Most of the potential impact on tuna and wetfish, and about half the potential prawn impact, are in Federal waters.

The socioeconomic analysis is constrained to potential economic impacts. As a percent of total Sanctuary catch, the highest maximum potential impacts to fisheries are on sea cucumber (16.5 percent), California sheephead (16.4 percent), spiny lobster (16.2 percent), and rockfish (16 percent). The smallest potential impact is on tuna (2.8 percent) and kelp (5.6 percent). With the addition of the Federal waters phase, cumulative impacts are higher for several species. The highest cumulative maximum potential impacts to fisheries are on rockfish (21.4 percent), wetfish (~~19.9~~ **20.5** percent), prawn (16.7 percent), and sculpin and bass (as defined by Leeworthy and Wiley 2002) (16.7 percent). Kelp impacts remain unchanged as the smallest total potential impact but tuna increases to 13.3 percent and prawn to 16.7 percent (Table 5-5).

Table 5-5. Commercial Fishing & Kelp: Impact of Proposed Project on Ex-Vessel Value by Species Group - Step 1 Analysis

Species Group	State Waters Value	% [1]	Federal Waters Value	%	Total Value	%
Squid	$ 1,660,718	12.73	$ 51,230	0.39	$ 1,711,948	13.12
Kelp [2]	$ 332,794	5.55	$ -	0.00	$ 332,794	5.55
Urchins	$ 830,464	15.77	$ 2,687	0.05	$ 833,151	15.82
Spiny Lobster	$ 149,133	16.17	$ -	0.00	$ 149,133	16.17
Prawn	$ 58,615	8.34	$ 58,832	8.37	$ 117,447	16.70
Rockfish	$ 87,985	16.02	$ 29,653	5.40	$ 117,638	21.42
Crab	$ 50,139	14.59	$ -	0.00	$ 50,139	14.59
Tuna	$ 8,544	2.80	$ 31,991	10.47	$ 40,535	13.26
Wetfish	$ 28,511	9.46	$ 33,162	11.00	$ 61,673	20.46
CA Sheephead	$ 38,622	16.37	$ -	0.00	$ 38,622	16.37
Flatfishes	$ 22,652	12.32	$ 3,000	1.63	$ 25,652	13.95
Sea Cucumbers	$ 27,731	16.54	$ -	0.00	$ 27,731	16.54
Sculpin & Bass	$ 6,865	11.38	$ 3,189	5.29	$ 10,054	16.67
Shark	$ 4,879	14.04	$ 720	2.07	$ 5,599	16.11
Total	$ 3,307,652	11.77	$ 214,463	0.76	$ 3,522,116	12.53

1. Percents are the amount of each species/species groups ex-vessel value impacted by an alternative divided by the Study Area Total for the species/species group.
2. Kelp is processed value from ISP Alginates in San Diego.

The proposed project attempted to further limit potential impact on the commercial fisheries by including one State Marine Conservation Area (Anacapa Island State Marine Conservation Area). This State Marine Conservation Area would allow commercial take of spiny lobster. The potential impact on annual ex-vessel revenue without these exemptions would have been more than $3.5 million or 12.6 percent of all ex-vessel revenue from the Sanctuary. The exemption resulted in a reduction of potential impact of this alternative by ~~about eight~~ **less than one** percent.

The greatest potential impact of the proposed project, in terms of percent of annual total ex-vessel revenue by port, is on Santa Barbara ($1 million or 12 percent) (Table 5-6). Port Hueneme would potentially lose the greatest dollar value (nearly ~~$1.2~~ **$1.4** million or 10 percent of all annual ex-vessel revenue of landings). Channel Islands Harbor would potentially lose about $166 thousand or 3.4 percent of its landing revenue. Ventura Harbor would potentially lose 2.7 percent of its annual ex-vessel value, while San Pedro would potentially lose about 1 percent (Table 5-6). Although these potential losses represent between 1 and 12 percent of ex-vessel revenue, the percentage loss in total port revenue would be less because revenue from activities other than fishing would continue in the port areas. All the other ports would potentially lose extremely small amounts. The cumulative

potential losses with the addition of the Federal waters phase would result in the same distribution of impacts, with increases in dollar values (Table 5-6).

Table 5-6. Commercial Fishing & Kelp: Impact of Proposed Project on Ex-Vessel Value by Port - Step 1 Analysis

Port	State Waters Value	% 1	Federal Waters Value	%	Total Value	%
1. Moss Landing	$9	N/A	$10	N/A	$19	N/A
2. Morro Bay	$63	1.23	$0	0.00	$63	1.23
3. Avila/Port San Luis	$40	0.00	$5	0.00	$45	0.00
4. Santa Barbara	$1,050,864	12.23	$31,396	0.37	$1,082,260	12.60
5. Ventura Harbor	$146,603	2.72	$10,240	0.19	$156,843	2.91
6. Channel Islands	$165,905	3.39	$52,642	1.08	$218,547	4.47
7. Port Hueneme	$1,384,342	10.15	$73,517	0.54	$1,457,859	10.69
8. San Pedro	$158,937	1.14	$11,445	0.08	$170,382	1.22
9. Terminal Island	$46,683	0.26	$30,688	0.17	$77,371	0.43
10. Avalon & Other LA	$252	0.01	$8	0.00	$260	0.01
11. Newport Beach	$9	0.00	$24	0.00	$33	0.00
12. San Diego	$4,538	0.13	$194	0.01	$4,732	0.14

1. Percents are the amount of ex vessel value as a percent of the total ex-vessel value of landings at the Port (1996-1999 Average Annual Value).

The potential impact on total annual income is slightly more than $10 million across all seven counties in the impact area (Table 5-7). Most of the potential impacts are concentrated in Ventura and Santa Barbara counties (more than $7 million), with about $1 million in both Monterey and Los Angeles counties (Table 5-7). The proposed project's broader potential impact is largely due to the potential impacts on squid. The potential impact in San Diego County is primarily from kelp. Potential employment impacts mirror the annual income impacts with 296 full and part-time jobs potentially impacted (Table 5-8). The cumulative effect of the Federal waters phase would potential create additional impact to both jobs and income (Table 5-8). A summary of step 1 potential impacts for each proposed site is given in Table 5-9.

Table 5-7. Commercial Fishing & Kelp: Impact of Prosed Project on Total Income By County - Step 1 Analysis

County	State Waters Income	Federal Waters Income	Total Income
1. Monterey	$1,207,845	$37,284	$1,245,129
2. San Luis Obispo	$17,914	$5,688	$23,602
3. Santa Barbara	$2,085,917	$44,332	$2,130,249
4. Ventura	$5,102,153	$390,763	$5,492,917
5. Los Angeles	$1,174,655	$52,264	$1,226,918
6. Orange	$23	$54	$77
7. San Diego	$535,173	$606	$535,779
All Counties	$10,123,680	$530,992	$10,654,672

Table 5-8. Commercial Fishing & Kelp: Impact of Proposed Project on Total Employment By County - Step 1 Analysis

County	State Waters Employment	Federal Waters Employment	Total Employment
1. Monterey	36	1	37
2. San Luis Obispo	1	0	1
3. Santa Barbara	68	1	69
4. Ventura	155	12	167
5. Los Angeles	31	1	32
6. Orange	0	0	0
7. San Diego	5	0	5
All Counties	296	16	312

Table 5-9. Commercial Fishing and Kelp - Summary of Impacts by Individual Reserves - Step 1 Analysis

	State		Federal		Total	
Measure/Reserve	Value	%[1]	Value	%	Value	%
Ex Vessel Revenue[2]						
Anacapa	$ 217,431	0.77%	$ 5,607	0.02%	$ 223,038	0.79%
Carrington Point	$ 598,164	2.13%	$ -	0.00%	$ 598,164	2.13%
Footprint	$ 21,872	0.08%	$ 24,386	0.09%	$ 46,258	0.16%
Gull Island	$ 535,011	1.90%	$ 5,119	0.02%	$ 540,130	1.92%
Harris Point	$ 358,471	1.28%	$ 30,247	0.11%	$ 388,718	1.38%
Judith Rock	$ 256,199	0.91%	$ 4,663	0.02%	$ 260,862	0.93%
Painted Cave	$ 92,059	0.33%	$ -	0.00%	$ 92,059	0.33%
Richardson Rock	$ 29,950	0.11%	$ 26,555	0.09%	$ 56,505	0.20%
Santa Barbara	$ 261,289	0.93%	$ 83,000	0.30%	$ 344,289	1.22%
Scorpion	$ 130,290	0.46%	$ 13,784	0.05%	$ 144,074	0.51%
Skunk Point	$ 30,102	0.11%	$ -	0.00%	$ 30,102	0.11%
South Point	$ 490,581	1.75%	$ 12,807	0.05%	$ 503,388	1.79%
West Anacapa	$ 286,233	1.02%	$ 8,294	0.03%	$ 294,527	1.05%
Income[3]						
Anacapa	$ 852,481	1.03%	$ 11,310	0.01%	$ 863,791	1.04%
Carrington Point	$ 1,873,542	2.26%	$ -	0.00%	$ 1,873,542	2.26%
Footprint	$ 70,973	0.09%	$ 43,614	0.05%	$ 114,587	0.14%
Gull Island	$ 1,505,173	1.82%	$ 12,112	0.01%	$ 1,517,285	1.83%
Harris Point	$ 1,058,575	1.28%	$ 56,027	0.07%	$ 1,114,602	1.34%
Judith Rock	$ 476,990	0.58%	$ 5,526	0.01%	$ 482,516	0.58%
Painted Cave	$ 363,259	0.44%	$ -	0.00%	$ 363,259	0.44%
Richardson Rock	$ 39,762	0.05%	$ 30,908	0.04%	$ 70,670	0.09%
Santa Barbara	$ 981,113	1.18%	$ 275,766	0.33%	$ 1,256,879	1.52%
Scorpion	$ 486,396	0.59%	$ 27,121	0.03%	$ 513,517	0.62%
Skunk Point	$ 62,006	0.07%	$ -	0.00%	$ 62,006	0.07%
South Point	$ 1,225,324	1.48%	$ 51,898	0.06%	$ 1,277,222	1.54%
West Anacapa	$ 1,128,087	1.36%	$ 16,710	0.02%	$ 1,144,796	1.38%
Employment[4]						
Anacapa	25	1.08%	<1	0.01%	25	1.08%
Carrington Point	57	2.47%	-	0.00%	57	2.47%
Footprint	2	0.09%	1	0.04%	3	0.13%
Gull Island	42	1.82%	<1	0.01%	42	1.82%
Harris Point	32	1.39%	2	0.09%	34	1.47%
Judith Rock	13	0.56%	<1	0.01%	13	0.56%
Painted Cave	11	0.48%	-	0.00%	11	0.48%
Richardson Rock	1	0.04%	1	0.04%	2	0.09%
Santa Barbara	29	1.26%	8	0.35%	37	1.60%
Scorpion	15	0.65%	1	0.04%	16	0.69%
Skunk Point	2	0.09%	-	0.00%	2	0.09%
South Point	32	1.39%	2	0.09%	34	1.47%
West Anacapa	34	1.47%	1	0.04%	34	1.47%

1. Percents are the percent of total baseline 1996-1999 impacted.
2. Ex vessel Revenue received by fishermen and processed value of kelp, Baseline Annual Average 1996-1999 for the entire CINMS is equal to $28,111,179.
3. Income is total income, including multiplier impacts. Baseline Annual Average 1996-1999 for the entire CINMS is equal to $82, 913,552.
4. Employment is total employment, including multiplier impacts. Baseline Annual Average 1996-1999 for the entire CINMS is equal to 2,307.

Step 2 Analysis

The proposed project is in the middle of the range of the alternative MPA networks in both size and potential impact on commercial fishing and kelp. Because there would be a medium probability of relocating effort and a low probability of crowding and congestion effects, the net effect is more likely to be a decrease in costs relative to the Step 1 analysis. The ability to catch tuna and wetfish in surrounding areas lowers Step 1 analysis costs by ~~3.09~~ **1.12** percent. The proposed project has medium potential impact on the squid fishery (12.7 percent) and a relatively low potential impact on kelp harvesting (5.6 percent) (Table 5-5). The ability of kelp harvesters to relocate effort elsewhere, or replace take with that in other areas can not be estimated. Uncertainty exists whether squid harvest could be increased in outside areas enough to fully offset the losses from this alternative. This alternative has the lowest potential impact among all alternatives on prawn fishermen (8.3 percent in the proposed project and cumulative impact of 16.7 percent with the addition of the Federal phase). If half the squid losses could be replaced from other areas, it is possible that the Step 1 analysis estimates could be reduced by about 25 percent, even in the short-term.

In the long-term, the replenishment effects are of high likelihood since the MPAs cover about 19 percent of the State waters within the Sanctuary, with 14 of the 17 habitat types in the Science Panel report receiving representation levels of 20 percent or higher (Table 5-3). Submarine canyons are represented at 19 percent. The only two not receiving this high level of representation are the very deep sediments (greater than 200 meters), which are not generally found within State Waters. Six habitat types are represented at 30 percent or more, including all nearshore substrates, emergent rocks, and eelgrass. The cumulative effects with the addition of a Federal waters phase would raise the level of representation of many deeper water habitats. The benefits to areas outside the MPAs are lower than the benefits from alternatives 4 and 5, but higher than those from alternatives 1, 2 and 3. The long-term mitigation of costs would be expected to be lower than those for Alternatives 4 and 5, but greater than those for alternatives 1, 2 and 3. Whether replenishment effects are greater than crowding or congestion effects will determine if this alternative's long-term costs can be transformed into long-term benefits.

Negative economic impacts have not been observed in other areas where relatively large MPAs and MPA networks have been established. While fishing effort does seem to increase adjacent to MPAs, this is mainly due to the beneficial effects of MPAs. In places where there are enforced MPAs, "fishing the line" or fishing close the reserve boundaries, becomes increasingly prevalent. There are growing numbers of examples of fishing the line in different places in the world. Recreational anglers were frequently observed fishing the edge of the Merritt Island National Wildlife Refuge in Florida (Johnson et al. 1990). Since 1985, all new Florida records for black drum, and most records for red drum have been won for fish caught within 100 km of the Merritt Island refuge (Roberts et al. 2001). Conch and lobster fishermen in Belize preferentially fish close to the edge of the Hol Chan marine reserve (Polunin and Roberts 1993). In Spain, fishermen report 50-85 percent higher catches close to the Tabarca marine reserve after 6 years of protection (Ramos-

Espla and McNeill 1994). Fishing patterns show that spillover does happen and it does benefit local fishermen.

5.4.3 Impacts to Recreational Fishing

The aggregate maximum potential loss to annual income for all recreational consumptive activities from the proposed project is approximately $3.3 million dollars (Table 5-10), or 13 percent, of the of the $24.7 million in annual income generated by recreational consumptive activities in the project area. The cumulative impact of the Federal waters phase is potentially $4.3 million (Table 5-10), or 17 percent, of the $24.7 million in annual income.

Table 5-10. Summary: Recreational Consumptive Activities – Proposed Project - Step 1 Analysis

	Total	State Waters		Federal Waters	
Person-days	77,908	63,322	81.3%	14,586	18.7%
Market Impact					
Direct Sales	$ 6,139,074	$ 4,824,499	78.6%	$ 1,314,575	21.4%
Direct Wages and Salaries	$ 2,429,728	$ 1,876,605	77.2%	$ 553,123	22.8%
Direct Employment	76	59	78.0%	17	22.0%
Total Income					
Upper Bound	$ 4,252,025	$ 3,284,059	77.2%	$ 967,966	22.8%
Lower Bound	$ 3,644,593	$ 2,814,908	77.2%	$ 829,685	22.8%
Total Employment					
Upper Bound	114	89	78.0%	25	22.0%
Lower Bound	95	74	78.0%	21	22.0%
Non-Market Impact					
Consumer's Surplus	$ 902,077	$ 733,184	81.3%	$ 168,893	18.7%
Profit[1]	$ 70,419	$ 52,125	74.0%	$ 18,294	26.0%

1. Profit is used as a proxy for producer's surplus.

The magnitude of potential impact varies by activity depending upon whether it is expressed in terms of direct usage (person-days) or economic impact (i.e. income). In terms of person-days, the activity that would potentially be most impacted by the proposed project is private boat fishing with a maximum potential loss of 30,148 person-days, followed by charter/party boat fishing with ~~25,767~~ **18,312** person-days, private boat diving with ~~18,312~~ **11,625** person-days and ~~private~~ **charter** boat diving with ~~11,625~~ **3,236** person-days. In terms of total annual income, the activity that would potentially be most impacted is charter/party boat fishing with a maximum potential loss of $1.9 million, followed by private boat fishing with $616 thousand, charter/party boat diving with $458 thousand and private boat diving with $295 thousand (Table 5-11). Cumulative impacts with the addition of the Federal phase would increase both potential losses in person-days of activity and income. In terms of person-days, the activity that would potentially be most impacted by cumulative effects is private boat fishing with a maximum potential loss of 36,381 person-days. In terms of total annual income, the activity that would potentially be

most impacted by cumulative effects is charter/party boat fishing with a maximum potential loss of $2.7 million (Table 5-12).

Table 5-11. Recreational Consumptive Activities – Proposed Project - State Waters - Step 1 Analysis

	Charter Boat Fishing		Charter Boat Diving		Private Boat Fishing		Private Boat Diving	
	Boundary Alternative	% of Study Area	Boundary Alternative	% of Study Area	Boundary Alternative	% of Study Area	Boundary Alternative	% of Study Area
Person-days	18,312	11.53%	3,236	18.05%	30,148	14.09%	11,625	24.63%
Market Impact								
Direct Sales	$ 2,387,756	11.57%	$ 545,336	18.12%	$ 1,252,048	14.09%	$ 639,359	24.63%
Direct Wages and Salaries	$ 1,094,442	11.55%	$ 261,768	18.06%	$ 352,032	14.09%	$ 168,364	24.63%
Direct Employment	32	11.68%	9	18.06%	12	13.96%	6	24.91%
Total Income								
Upper Bound	$ 1,915,274	11.55%	$ 458,094	18.06%	$ 616,055	14.09%	$ 294,636	24.63%
Lower Bound	$ 1,641,663	11.55%	$ 392,652	18.06%	$ 528,047	14.09%	$ 252,545	24.63%
Total Employment								
Upper Bound	49	11.66%	13	18.06%	18	14.07%	9	24.92%
Lower Bound	41	11.67%	11	18.06%	15	14.03%	8	24.51%
Non-Market Impact								
Consumer's Surplus	$ 212,035	11.53%	$ 37,472	18.05%	$ 349,077	14.09%	$ 134,600	24.63%
Profit [1]	$ 44,074	11.71%	$ 8,051	18.30%	n/a	n/a	n/a	n/a

1. Profit is used as a proxy for producer's surplus.

Table 5-12. Recreational Consumptive Activities – Proposed Project – Cumulative Total Including Federal Waters Phase - Step 1 Analysis

	Charter Boat Fishing		Charter Boat Diving		Private Boat Fishing		Private Boat Diving	
	Boundary Alternative	% of Study Area	Boundary Alternative	% of Study Area	Boundary Alternative	% of Study Area	Boundary Alternative	% of Study Area
Person-days	25,767	16.23%	3,579	19.95%	36,381	17.00%	12,182	25.81%
Market Impact								
Direct Sales	$ 3,354,260	16.25%	$ 603,913	20.07%	$ 1,510,907	17.00%	$ 669,994	25.81%
Direct Wages and Salaries	$ 1,539,350	16.25%	$ 289,218	19.96%	$ 424,830	17.00%	$ 176,330	25.80%
Direct Employment	45	16.35%	10	19.95%	14	16.77%	6	26.33%
Total Income								
Upper Bound	$ 2,693,862	15.83%	$ 506,132	18.70%	$ 743,453	16.63%	$ 308,578	23.90%
Lower Bound	$ 2,309,024	15.92%	$ 433,827	18.96%	$ 637,245	16.71%	$ 264,496	24.29%
Total Employment								
Upper Bound	68	15.90%	14	18.90%	22	16.77%	9	24.30%
Lower Bound	57	16.05%	12	19.00%	18	16.84%	8	24.68%
Non-Market Impact								
Consumer's Surplus	$ 298,345	16.23%	$ 41,435	19.95%	$ 421,248	17.00%	$ 141,049	25.81%
Profit [1]	$ 61,443	16.33%	$ 8,977	20.40%	n/a	n/a	n/a	n/a

1. Profit is used as a proxy for producer's surplus.

Reserve Types

The proposed project includes 12 individual MPA sites, with two types of MPAs. Ten of these MPAs are “State Marine Reserves,” where no consumptive activity of any kind is allowed. One of the MPAs, Anacapa Island, is a “Marine Conservation Area” which allows the recreational take of spiny lobster and pelagic finfish (as described in section 5.3.2, Anacapa Island) and the commercial take of spiny lobster. Although recreational fishing or consumptive diving data by species were not collected, the Recreational Fisheries Information Network (RecFIN), which adds fishing location to the Marine Recreational Fisheries Statistics Survey (MRFSS) data, was used to estimate the proportion of recreational pelagic finfish by California Department of Fish and Game fish block. Using this proportion to eliminate pelagic finfish from the analysis, the model only takes into account prohibited species of finfish for this alternative. Unfortunately, the RecFIN sample

did not include data for recreational take of spiny lobsters. As a result, this analysis may be an overestimate of actual maximum potential impact because lobster catch could not be excluded. One of the MPAs, Painted Cave, is a "State Marine Conservation Area" where no consumptive activities are permitted except for the recreational take of spiny lobster and pelagic finfish. As was stated above, the data do not include specific information on the distribution of spiny lobster, therefore this analysis may be an overestimate of actual maximum potential impact.

Step 2 Analysis

The proposed project is in the middle of the range of the alternative MPA networks in both size and potential impact to recreational consumptive activities. It includes 25 percent of the Sanctuary waters. In the short-term, complete replacement of value by substituting or relocating activities to alternative sites is not likely for the proposed project because the proposed MPAs encompass areas of intense use. Substitution of effort to alternative sites is less likely for the proposed project in comparison to Alternatives 1, 2, and 3 (Chapter 6) because of its relative size and because it encompasses areas of more intense use. The portions of the proposed project to the north of Anacapa Island and on the northeast side of Santa Cruz Island, as well as the area to the immediate southeast of Santa Barbara Island, encompass a particularly high usage areas for consumptive activities. Substitution of effort to alternative sites is more likely for the proposed project in comparison to Alternatives 4 and 5 (Chapter 6) because those alternatives encompass more area.

In the Santa Barbara Island area, the Cowcod Conservation Area completely encompasses the study area. In addition to the Rockfish and Lingcod Management Area regulations, the Cowcod Conservation Area prohibits the catch of certain species in waters 20 fathoms or deeper. Several of these species were in the top twenty recreational species in terms of catch in 2000 (NMFS, MRFSS). The proposed project would re-open a portion of the Cowcod Conservation Area to the northeast of Santa Barbara Island. Because catch data are not available by species, the socioeconomic effect of this proposed action can not be quantified. It is, however, expected that this would have a positive effect on the ability of users to find an adequate substitute site. Additionally, the two special use areas (West Anacapa and Painted Cave) would be an additional mitigating factor. The re-opening of a portion of the Cowcod Conservation Area is expected to have a long-term positive influence on impact to consumptive users, and the allowance for the take of certain recreational species in the Anacapa Island State Marine Conservation Area and the Painted Cave State Marine Conservation Area would also lessen the long term potential impact.

One other potentially mitigating factor is the existing Anacapa Island Ecological Reserve and Santa Barbara Island Ecological Reserve, which prohibit the take of invertebrates in three specific areas. The proposed project would re-open two of these invertebrate closures. This will have a positive effect on the ability of consumptive divers to relocate to adequate substitute sites.

In the long-term, the possibility of net benefits to consumptive users in the establishment of the proposed project depends upon consumptive users' success in finding substitute sites and the long-term resolution of potential crowding/congestion effects. As mentioned above, no take areas result in benefits that extend beyond the reserve boundaries (Roberts et al. 2001).

The number of interacting variables in marine ecosystems precludes accurate predictions of the magnitude of potential changes in abundance of target species. However, preliminary attempts to model ecosystems with reserve management have suggested that large MPAs provide significantly greater benefits to target species than small MPAs and limited-take zones (Salomon et al. 2002). MPAs established in areas of high recreational use are most likely to provide benefits to target species and long-term benefits to recreational fisherman. When intense fishing pressure is reduced in areas of high productivity, target species in MPAs are likely to increase rapidly in abundance and individual size, leading to significantly higher reproductive potential. Increases in density and reproductive potential may contribute to export of larvae and spillover of adult fish that may help to offset the loss of recreational fishing grounds.

5.4.4 Non-Consumptive Uses

Non-Consumptive Recreation

The total baseline annual income associated with all non-consumptive activities in the ~~proposed~~ project area is about ~~$88 thousand~~ **$6 million. The baseline for non-consumptive activities within the proposed MPAs is about $955** thousand (Table 5-13). In terms of annual income, the activity with the highest baseline is whale watching with a baseline of $534 thousand, followed by non-consumptive diving with about $293 thousand, kayaking/sightseeing with $66 thousand, and sailing with $62 thousand (Table 5-13). In terms of person days of activity, the highest baseline is whale watching with nearly 4 thousand days, followed by non-consumptive diving with nearly 2 thousand days, sailing with 440 days, and kayaking/sightseeing with 357 days (Table 5-13). The cumulative effect of the Federal waters phase would potentially total $1 million dollars or 17.3 percent of the income generated in the study area (Tables 5-14). The highest cumulative baseline income is also whale watching ($578 thousand), followed by non-consumptive diving ($327 thousand), sailing ($70 thousand), and kayaking/sightseeing ($66 thousand) (Table 5-14).

Table 5-13. Economic Impact Associated with Non-consumptive Activities – Proposed Project - State Waters (Baseline 1999)

	Whale Watching		NC Diving		Sailing		Kayaking/Sightseeing	
	Boundary Alternative	% of Study Area[2]	Boundary Alternative	% of Study Area[2]	Boundary Alternative	% of Study Area[2]	Boundary Alternative	% of Study Area[2]
Person-days	3,787	14.57%	1,972	18.30%	440	10.96%	357	28.96%
Market Impact								
Direct Sales	$ 629,435	14.7%	$ 342,533	18.4%	$ 76,877	11.1%	$ 74,647	29.0%
Direct Wages and Salaries	$ 305,042	14.6%	$ 167,288	18.6%	$ 35,679	10.9%	$ 37,477	29.0%
Direct Employment	10	14.0%	6	18.3%	1	10.9%	2	29.0%
Total Income								
Upper Bound	$ 533,824	14.6%	$ 292,754	18.6%	$ 62,438	10.9%	$ 65,585	29.0%
Lower Bound	$ 457,563	14.6%	$ 250,932	18.6%	$ 53,518	10.9%	$ 56,216	29.0%
Total Employment								
Upper Bound	15	14.1%	9	18.2%	2	10.8%	2	28.5%
Lower Bound	13	14.1%	7	18.2%	1	11.0%	2	27.1%
Non-Market Impact								
Consumer's Surplus	$ 43,848	14.6%	$ 22,837	18.3%	$ 5,096	11.0%	$ 4,135	29.0%
Profit[1]	$ 18,509	11.8%	$ 8,278	17.9%	$ 2,418	13.4%	$ 799	28.9%

1. Profit is used as a proxy for producer's surplus.

Table 5-14. Economic Impact Associated with Non-consumptive Activities Proposed Project – Cumulative Total Including Federal Waters Phase (Baseline 1999)

	Whale Watching		NC Diving		Sailing		Kayaking/Sightseeing	
	Boundary Alternative	% of Study Area[2]	Boundary Alternative	% of Study Area[2]	Boundary Alternative	% of Study Area[2]	Boundary Alternative	% of Study Area[2]
Person-days	4,105	15.80%	2,197	20.39%	499	12.42%	357	28.96%
Market Impact								
Direct Sales	$ 682,449	15.9%	$ 382,600	20.6%	$ 86,775	12.5%	$ 74,647	29.0%
Direct Wages and Salaries	$ 330,700	15.9%	$ 186,889	20.8%	$ 40,468	12.4%	$ 37,477	29.0%
Direct Employment	11	15.2%	6	20.4%	1	12.4%	2	29.0%
Total Income								
Upper Bound	$ 578,724	15.9%	$ 327,056	20.8%	$ 70,820	12.4%	$ 65,585	29.0%
Lower Bound	$ 496,050	15.9%	$ 280,333	20.8%	$ 60,702	12.4%	$ 56,216	29.0%
Total Employment								
Upper Bound	16	15.3%	10	20.2%	2	12.2%	2	28.5%
Lower Bound	14	15.3%	8	20.3%	2	12.5%	2	27.1%
Non-Market Impact								
Consumer's Surplus	$ 47,530	15.8%	$ 25,443	20.4%	$ 5,774	12.4%	$ 4,135	29.0%
Profit[1]	$ 19,907	12.7%	$ 9,290	20.1%	$ 2,549	14.1%	$ 799	28.9%

1. Profit is used as a proxy for producer's surplus.

Tables 5-13 and 5-14 show the baseline annual income to potential beneficiaries. It should be noted that because non-consumptive users are potential beneficiaries a step 1 analysis, which estimates potential costs and impacts, does not provide estimates of benefits. Step 2 analysis can estimate potential benefits based on various assumptions. Table 5-15 shows the range of potential cumulative benefits based on certain assumptions about the increase in quality and the value elasticity of quality. Quality refers to a composite attribute that takes into consideration the range of benefits that would have an impact on the non-consumptive recreation experience. This includes such attributes as diversity of wildlife, abundance of fish and invertebrates, the decrease in the density of users, and the increase in water quality. A range of a 10 percent to 100 percent increase in quality was used for this analysis. Value elasticity of quality is defined as the percentage increase in value associated with a one-percent increase in quality. For this analysis, a range of elasticities of 0.04 to 4.5 was used (Leeworthy and Wiley 2002). The valuation measure used was consumers' surplus associated with the proposed project, summed across all non-consumptive uses. Potential cumulative benefits range from a low end of

$332 with the assumption of a 10 percent increase in quality and a 0.04 value elasticity of quality and a high end of $373 thousand with a 100 percent increase in value and a value elasticity of quality of 4.5 (Table 5-15).

Table 5-15. Potential Benefits to Non-consumptive Users from the Proposed Project - Step 2 Analysis

Increase in Quality	Economic Measure	Elasticity of 0.04	Elasticity of 1.0	Elasticity of 4.5
10%				
	Consumer's Surplus	$ 332	$ 8,288	$ 37,297
	Income	$ 4,169	$ 104,219	$ 468,983
	Employment	0.12	3.00	13.50
	Person-days	29	716	3,221
50%				
	Consumer's Surplus	$ 1,658	$ 41,441	$ 186,485
	Income	$ 20,844	$ 521,093	$ 2,344,916
	Employment	0.60	15.00	67.50
	Person-days	143	3,579	16,106
100%				
	Consumer's Surplus	$ 3,315	$ 82,882	$ 372,969
	Income	$ 41,687	$ 1,042,185	$ 4,689,833
	Employment	1.20	30.00	135.00
	Person-days	286	7,158	32,211

1. Benefits are the aggregate amounts across all non-consumptive activities for The Preferred Alternative

Scientific Use and Education

At present, many of the MPAs in the proposed project support scientific and educational activities. Educational activities within the proposed network may be directed at improving the general or technical understanding and appreciation of marine resources and habitats and scientific methodology, and to assist researchers in making observations and measurements. Educational activities are associated with research and contribute to the management and enhancement of marine species would be compatible with the purposes of the proposed MPAs.

For example, educational activities such as tidepool and intertidal surveys, and various sampling tows (bottom grabs, midwater trawls, plankton tows), which are used to assess and study the marine environment, would be allowed. They would only be allowed, however, if they were a part of approved scientific research, carefully planned to avoid disruption to other research critical habitats, and if they may contribute to the management and enhancement of marine resources.

Existing research activities include various monitoring programs that would benefit from the establishment of an MPA network because it would eliminate human consumptive uses within these areas, and thereby remove one variable which may affect the outcome of the study. Research activities also provide a needed baseline of information to gauge the function and effectiveness of the proposed network. In addition, one of the goals of the

proposed MPAs is to promote scientific research that will enhance the knowledge and management of marine resources.

5.4.5 Oil and Gas Resources

There would not be a change in oil and gas resource extraction if the proposed MPAs were adopted. New leases for oil and gas extraction area already prohibited within the Sanctuary. The proposed network would not change this regulation.

5.4.6 Vessel Traffic

The threshold of significance for impacts to vessel traffic can be described as any impact that creates a danger to vessel traffic, increases the level of traffic above current maximums, or requires vessels to transit greater distances in hazardous conditions. The commercial vessel Traffic Separation Scheme (TSS) will not be altered by the proposed project. The proposed project does not alter existing mainland ports and harbors. Because vessel safety in emergencies and foul weather is critical and transiting around an MPA would unnecessarily increase transit distances, transit through and anchoring in MPAs is allowed in the proposed project. While anchoring can disturb bottom habitats, most anchorages are in soft bottom areas that are minimally disturbed by anchoring. An important consideration in developing the proposed project was the location of major anchorages. Because of these factors the specific MPAs were generally placed outside major anchorages. In the one case where an important anchorage, often used for fishing, was within an MPA (at San Miguel Island) the anchorage was excluded from the proposal. Therefore, the creation of the proposed network would not have an effect on vessel traffic.

5.4.7 Noise

The threshold of significance for noise impacts can be described as any noise created by the proposed project that would disturb the nesting, breeding, or feeding of marine species. There would not be a significant increase in noise levels if the proposed MPAs were established because no significant increase in human and vessel traffic is anticipated. A potential decrease in noise is expected as a result of fewer fishing vessels, especially in certain areas thought to be critical for sea bird nesting. An example of this is seen at the Anacapa Island State Marine Reserve and State Marine Conservation Area. Existing squid fishing, which occurs at night during seabird nesting periods, would no longer occur in these locations and thus noise disturbance would be reduced.

In addition, within the Sanctuary, existing regulations prohibit disturbing seabirds or marine mammals by aircraft overflights at less than 1,000 feet (305 meters) above the waters within one nautical mile of the islands, including the area above the proposed MPAs. Any reduction in noise levels may help ensure that marine wildlife such as sea otters,

pinnipeds, cetaceans, and seabirds, are not disturbed. Therefore, no significant adverse environmental impact would result from the project.

5.4.8 Cultural, Historic, and Archaeological Resources

There would not be a change in the availability of salvage or removal from archaeological sites and shipwrecks if the proposed MPAs were adopted. The various sites within the proposed network are already protected by the regulations of the Sanctuary, which prohibit all salvage or extraction of artifacts. The proposed network would not change this regulation.

5.5 Measures Proposed to Mitigate Environmental Effects

The proposed project would not create unavoidable significant adverse environmental effects. The proposed project is self mitigating because it provides for a more conservative set of safeguards than are provided under the existing regulatory framework. The existing regulatory framework and suggested modifications are designed to assure harvests can be maintained at a level that can be sustained over time. The proposed project provides benefits through continued consumptive and non-consumptive use, while lowering direct impacts on a wide array of habitats. These protected habitats will provide benefits to marine populations and help sustain them. Because no significant adverse environmental impacts would result from the proposed project, no measures to mitigate impacts are proposed.

The establishment of the proposed MPAs would result in the unavoidable loss of existing consumptive uses (commercial fishing, sport fishing) that currently exist within the MPA boundaries. However, access for fishing and diving in waters adjacent to the proposed MPAs will continue to exist. Also, local fish populations within the proposed MPAs may contribute to improved fishing outside the MPAs through increased fish production, and emigration of fish from the MPAs to adjacent waters. These economic losses would not lead to a direct impact to natural resources.

5.6 Relationship Between Short-Term Human Uses of the Natural Environment and the Maintenance of Long-Term Productivity

While the establishment of the proposed MPAs would restrict some short-term human uses of the environment, it would help provide assurance that the natural resources and aesthetic values of the areas involved will be available for research and enjoyment of future generations. Resources subject to intense use by commercial and sport fishermen may not be sustainable under current conditions. In general, fishing reduces species abundance, alters size and age composition of fished populations, alters species diversity, changes biological interactions among species, and sometimes alters habitats. Also, degradation of the local environment and its resources can exacerbate conflicts between user groups, such as commercial and sport harvesters or consumptive and non-consumptive users. The degradation of marine ecosystems and communities can also lessen the ability of species and habitats to adapt to changing oceanography, climate and biological conditions.

The establishment of the proposed project is expected to yield long-term ecological benefits. The knowledge gained from development and implementation of the proposed project may provide resource managers, the scientific community, and the general public with comprehensive inventories and biological assessment information. These studies could also help monitor and predict changes in populations and habitats, predict and assess the impacts of regulations on resources and ecosystems, interpret resource values, and identify activities that directly and indirectly affect marine life (Foster and Archer 1988). This information would be invaluable in making responsible coastal and marine resource management decisions.

5.7 Irreversible or Irretrievable Commitments of Resources

The establishment of the proposed MPAs would not result in irreversible or irretrievable losses of resources. The resources and habitats within MPAs would be protected and maintained, instead of being harvested or otherwise removed. The intent of this action would be to set aside several marine ecosystems that would aid the research, management, enhancement, and sustainability of marine resources. Consumptive or extractive activities that currently occur within the proposed MPAs would be discontinued unless they were incorporated into an approved research project.