U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE

Donald K. Hansen, Chairman
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220-1384

Dear Chairman Hansen - Don

In keeping with our commitment to work collaboratively with the Pacific Fishery Management Council (PFMC), please find attached for your review the *Staff Preliminary Working Draft Environmental Document For Consideration Of A Network Of Marine Reserves And Marine Conservation Areas Within The Channel Islands National Marine Sanctuary (CINMS).* This document, which is an initial draft and does not represent the views or policies of NOAA or the Department of Commerce at this time, is an initial building block for the development of a Draft Environmental Impact Statement (DEIS). As we go forward with the development of the DEIS, we are seeking your comments on this early draft. We hope to ensure that 1) the alternatives, analyses, methodologies, and data sources under development are sound; and 2) the range of alternatives under consideration is adequate.

It is important to note that this working draft presents only an initial range of the alternatives being considered by CINMS. As developed thus far, these alternatives may contain gaps and inconsistencies and some ideas may not be fully developed. In addition, several sections of the document identify "place holders" where additional material or source information will be provided as the DEIS is developed. With your input, the CINMS will continue to refine the alternatives as it prepares the DEIS.

As such, we encourage you to read the document thoroughly and to prepare written comments for the CINMS manager. To facilitate these comments, we will provide the PFMC and the Sanctuary Advisory Council (as well as their respective designated committees and working groups) with a range of suggested review questions. In addition, public comment on this preliminary document may be taken during the respective public comment sessions at the September 12-17 meeting of the PFMC and the September 24 meeting of the Sanctuary Advisory Council (SAC).

Thank you for your continued interest and engagement in this important process. We look forward to working with you during the development of the DEIS. For further information, please contact CINMS manager Chris Mobley at (805) 884-1465 or chris.mobley@noaa.gov.

Sincerely,

Daniel J. Basta,
Director
National Marine Sanctuary Program

Enclosure

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Staff Preliminary Working Draft Document for Consideration of a Network of Marine Reserves and Marine Conservation Areas within the Channel Islands National Marine Sanctuary

Disclaimer
This preliminary working draft is a staff prepared document and does not represent the views or policies of NOAA or the Department of Commerce at this time. It was prepared primarily for the purpose of eliciting comments from the Pacific Fishery Management Council, Sanctuary Advisory Council and general public and should not be cited. Major portions of it are incomplete and several sections contain "place holder material." Nevertheless, we encourage those interested in this important issue to read the document thoroughly and provide written commentary to the National Marine Sanctuary Program.

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1. Need and Purpose for Action

1.1. Overview of the Sanctuary

1.1.1. The National Marine Sanctuary Program

Under the National Marine Sanctuaries Act as amended, 16 U.S.C. sec. 1431-1445b, (NMSA), the Secretary of Commerce (Secretary) is authorized to designate and manage areas of the marine environment as national marine sanctuaries. Such designation is based on attributes of special national significance, namely, conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or aesthetic qualities. The primary objective of the NMSA is to protect sanctuary resources.[1]

The National Marine Sanctuary System of 13 national marine sanctuaries and one coral reef ecosystem reserve comprise a federal system of marine protected areas administered by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Sanctuary Program (NMSP). Their designation provides protection for sensitive marine areas, such as coral reefs and kelp forests, habitat used by important marine species, and historically significant shipwrecks and artifacts. In addition, these areas are intended to serve as valuable educational, recreational, and scientific resources.

1.1.2. The Channel Islands National Marine Sanctuary (Sanctuary)

The Sanctuary was designated in 1980 to protect the rich and diverse range of marine life and habitats, unique and productive oceanographic processes and ecosystems, and culturally significant resources. The Sanctuary area is approximately 1,252.5 square nautical miles (NM) adjacent to the following islands and offshore rocks: San Miguel Island, Santa Cruz Island, Santa Rosa Island, Anacapa Island, Santa Barbara Island, Richardson Rock, and Castle Rock (collectively the Islands), extending seaward to a distance of 6 nautical miles. The Sanctuary attracts significant human uses as well, including commercial and recreational fisheries, marine wildlife viewing, boating and other recreational activities, research and monitoring activities, numerous educational activities, maritime shipping, and nearby offshore oil and gas development.

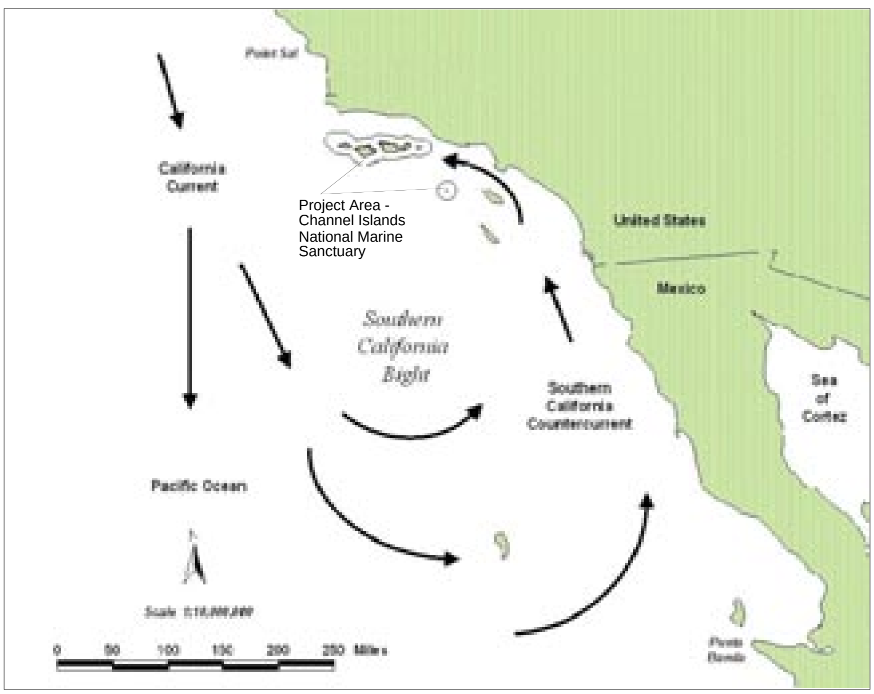
The waters surrounding California's Channel Islands represent a globally unique and diverse assemblage of habitats and species. This region is a subset of the larger ecosystem of the Southern California Bight, an area bounded by Point Conception in the north and Punta Banda, Mexico in the south (Daily et al. 1993); please see Figure 1-1. In the area between Santa Barbara Island in the south and San Miguel Island in the northwest the colder waters of the Oregonian oceanic province in the north converge and mix with the warmer waters of the Californian oceanic province. Each of these two provinces has characteristic oceanic conditions and species

[1] Sanctuary resource means any living or nonliving resource of a national marine sanctuary that contributes to the conservation, recreational, ecological, historical, educational, cultural, archeological, scientific, or aesthetic value of the sanctuary. (16 U.S.C. sec. 1432 (8)).

assemblages, which in turn are parts of distinct biogeographic regions. The mixing of these two provinces in the vicinity of the Channel Islands creates a transition zone within the island chain. Upwelling and ocean currents in the area create a nutrient rich environment that supports high species and habitat diversity.

This rich oceanic and island area is afforded protection at multiple levels of government. In 1980 the waters from mean high water to 6 nautical miles offshore around five of the Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara islands) were designated as a National Marine Sanctuary by the Department of Commerce. Also in 1980, the islands themselves were designated a National Park by the Department of the Interior. (The Park's jurisdiction extends to one nautical mile offshore of the islands, overlapping the Sanctuary's jurisdiction.) In 1986 the United Nations Educational, Scientific and Cultural Organization (UNESCO) Programme on Man and the Biosphere designated the Channel Islands Biosphere Reserve as part of the international network of Biosphere Reserves.

Figure 1-1. Southern California Bight and the Project Area



1.2. Need for Action

In the Southern California Bight marine resources have declined under pressure from a variety of factors, including commercial and recreational fishing, changes in oceanographic conditions associated with El Niño and other large-scale oceanographic cycles, introduction or increased prevalence of disease (e.g. domoic acid), and increased levels of pollutants (e.g., Dugan and Davis 1993, PFMC 2000).

The urbanization of southern California has significantly increased the number of people visiting the coastal zone and using its resources. This has increased human demands on the ocean, including commercial and recreational fishing, and wildlife viewing and other activities. A burgeoning coastal population has also greatly increased the use of our coastal waters as receiving areas for human, industrial, and agricultural wastes (references to follow). In addition, new technologies have increased the efficiency, effectiveness, and yield of sport and commercial fisheries (references to follow). Concurrently there have been wide scale natural phenomena such as El Niño weather patterns, oceanographic regime shifts, and dramatic fluctuations in pinniped populations (references to follow).

The significant changes in ecological conditions resulting from the array of human activities in the Channel Islands region are just beginning to be understood. There have been significant shifts in the historic environmental baseline conditions that are only now being recognized. For example, many kelp beds have become urchin barrens, where urchins and coralline algae have replaced kelp as the dominant feature (references to follow). Deeper canyon and rock areas such as the Footprint region that were formerly rich rockfishing grounds are now almost devoid of larger rockfish such as cowcod and bocaccio (references to follow). The previous management approaches that focused on individual threats, such as pollution, or on individual species, such as lobster or marine mammals, have not been able to adequately account for and prevent significant changes to the area's ecosystem, including non-harvested species and their habitat.

In the Channel Islands area, commercial and recreational fisheries target more than 100 fish species and more than 20 invertebrate species (references to follow). Targeted species have exhibited high variability in landings from year to year (e.g., squid) and in several cases have declined to the point that the fishery has had to be shut down (e.g., abalone) (references to follow). Many targeted species are considered overfished and one previously targeted species (white abalone) is listed as endangered (references to follow). Many former natural refuges for targeted species, such as submarine canyons, submerged pinnacles, deep waters, and waters distant from harbors, can now be accessed due to advancements in fishing technology and increased fishing effort (Agardy et al. 2003). Bycatch has caused declines of some non-targeted species (references to follow). The removal of species that play key ecological roles, such as predatory fish, has altered ecosystem structure (references to follow). Some types of fishing gear have caused temporary or permanent damage to marine habitats (references to follow). The combination of direct take, bycatch, indirect effects, and habitat damage and destruction has contributed to a transformation of the marine environment around the Channel Islands. Additional detail on the status of marine species in the Channel Islands and the extent of human activities is provided in Chapter 4 - Affected Environment and Appendix C, Status of Human Uses.

All of the above factors play a role in contributing to the current decline in ecosystem integrity. In the regional community, there is much interest in better understanding the effects of the individual factors and their interactions, to reverse or stop trends of resource decline, and to restore the integrity and resilience of impaired ecosystems. (provide more discussion with specific examples of ongoing efforts by other sectors in research and management to address these issues).

The NMSA states that “while the need to control the effects of particular activities has led to enactment of resource-specific legislation, these laws cannot in all cases provide a coordinated and comprehensive approach to the conservation and management of special areas of the marine environment” (16 U.S.C. sec. 1431(a)(3)). Therefore, the NMSP system will improve the conservation and management of marine resources and will “maintain for future generations the habitat, and ecological services, of the natural assemblage of living resources that inhabit these areas” (16 U.S.C. sec. 1431(a)(4)(A), (C)). The NMSA charges the NMSP to take a broad and comprehensive management approach to achieve the NMSA’s primary objective of resource protection. The focus of such an approach is on broad-scale, ecosystem-level (i.e., as opposed to single species or single issue) protection and management, which is essentially unique among the various agencies and laws that manage marine resources.

Like all national marine sanctuaries, the Sanctuary is mandated to both “protect…the natural habitats, populations and ecological processes” (16 U.S.C. sec. 1431(b)(3)) of the Sanctuary and “facilitate to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of [the Sanctuary] not prohibited pursuant to other authorities” (16 USC 1431(b)(6)). Sanctuary staff recognize and support the fact that each year thousands of people come to the Sanctuary to work and play, and that the area’s resources are an important part of individual livelihoods and recreation. Managed correctly, use and enjoyment of the Sanctuary can continue to thrive for generations to come.

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1.3. Purpose for Taking Action

Given the needs discussed above, the NMSP is considering action under the NMSA to address the following purposes:

- To ensure the long-term protection of Sanctuary resources by restoring and enhancing the abundance, density, population age structure and diversity of the natural biological communities.
- To protect, restore and maintain functional and intact portions of natural habitats, (including deeper water habitats), populations and ecological processes in the Sanctuary.
- To provide, for research and education, undisturbed reference areas that include the full spectrum of Sanctuary habitats where local populations exhibit a more natural abundance, density, diversity and age structure.
- To set aside, for intrinsic and heritage value, representative habitats and natural biological communities.

- To complement the protection of Sanctuary resources and habitats afforded by the State of California's marine reserves and marine conservation areas.
- To create models of and incentives for ways to conserve and manage the resources of the Sanctuary.

2. Background and History

2.1. Environmental Setting

The Sanctuary supports a rich and diverse range of marine life and habitats, unique and productive oceanographic processes and habitats, and culturally significant resources such as hundreds of shipwrecks and submerged Chumash cultural artifacts. This diversity, along with the busy Santa Barbara Channel, also brings significant human use and value to Sanctuary waters, including commercial fisheries, recreational fishing opportunities, marine wildlife viewing, boating and other recreational activities, maritime shipping, nearby offshore oil and gas development, research and monitoring activities, and numerous educational activities. For more details, see Chapter 4: Affected Environment.

2.2. Management Setting

In the Channel Islands region there are more than 10 local, state, and Federal management bodies that exercise some jurisdiction and authority over the natural and cultural resources, and certain human uses. Key entities include the:

- Channel Islands National Marine Sanctuary
- NOAA Fisheries (National Marine Fisheries Service; NMFS)
- Pacific Fishery Management Council (PFMC)
- Channel Islands National Park (CINP)
- California Department of Fish and Game (CDFG)
- United States Coast Guard (USCG)
- Minerals Management Service (MMS)
- California State Lands Commission
- California Coastal Commission
- Santa Barbara and Ventura Counties

Ocean managers have employed a wide array of management tools in the Channel Islands region for a variety of management purposes (conservation, utilization, etc.).

2.2.1. Federal Fishery Management

Fishery managers use fishing seasons and gear type restrictions, size and bag limits, temporary area closures and other effort control measures to manage commercial and recreational harvests. These management approaches are typically developed and targeted toward achieving maximum sustainable yield or optimal yield of a single species (e.g.. squid) or complex of species (e.g., groundfish). This has resulted in a complex fishery management system (see Appendix C for an overview of existing fisheries management). The range of stocks and species managed for harvest by the CDFG in state waters and the PFMC and NMFS in federal waters extends well beyond Sanctuary boundaries.

Under the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. sec. 1801-1883, (Magnuson-Stevens Act), the PFMC has significant authority over all species of fish from three to 200 nautical miles offshore. Generally, the Council recommends regulations only for species that have a federal fishery management plan (FMP) that has been prepared by the Council and approved by NMFS. For the west coast (Washington, Oregon and California), Federal FMPs have been reviewed for compliance with federal law and approved by NMFS for groundfish, salmon, and coastal pelagic species. The Groundfish Essential Fish Habitat EIS in draft by the National Marine Fisheries Service includes analysis of area fisheries closures as a potential management measure. An FMP for highly migratory species has recently been adopted by the Council but has not yet been approved by NMFS. For species not covered by an FMP, the Council could propose emergency regulations to be effective for up to one year, while it develops an FMP. The Council can also impose certain restrictions on the take of FMP species in non-FMP fisheries. Under the Magnuson-Stevens Act, the Council can and does recommend to NMFS fishing regulations that are also in effect within National Marine Sanctuaries, but only for FMP species. (PFMC website)

The Council's list of objectives, although focused on individual species or stocks, bears some relationship to the Sanctuary's stated purposes. These objectives are:

- Biological Productivity. Enhance long-term biological productivity.
- Insurance. Provide protection for the resource, as a hedge against the realities of management uncertainty and the effects of natural environmental variability.
- Habitat Protection. Conserve and protect essential fish habitat.
- Research and Education. Provide unfished areas for research that will serve as controls for assessment of the effects of long-term environmental variations and the potential habitat alterations due to fishing, and also increase our understanding of the role marine reserves may play in fishery management.

However, the goals and objectives for conventional fisheries management (e.g., increasing yield of stocks for harvest) may not fully encompass all of the purposes outlined in Section 1.3.

2.2.2. Sanctuary Management Plan Revision

Sanctuary regulations were proposed in the Federal Register in 1980, and the original management plan was completed in 1982. No formal review or revision of the plan has occurred since that time. Congress, however, has amended the NMSA numerous times, strengthening and clarifying the conservation principles for the program. The amended NMSA also calls upon each national marine sanctuary to review its management plan in five-year intervals and to revise the management plan and regulations as necessary to fulfill the purposes and policies of the NMSA (16 U.S.C. sec. 1434(e)). Sanctuaries are to engage in management plan review in order to:

- Evaluate substantive progress toward implementing the management plan and goals;
- Evaluate the effectiveness of site-specific management techniques and strategies;
- Determine necessary revisions to the management plan and regulations;

- Prioritize management objectives;
- Inform Sanctuary constituents, including the general public, about the Sanctuary and the management strategies that are planned for the next five years; and
- Guide Sanctuary management toward achievement of Sanctuary goals.

Additionally, significant advances in science and technology, as well as innovations in marine resource management techniques, have rendered the original 1982 Sanctuary management plan and its corresponding EIS very outdated in many respects. Furthermore, the original management plan does not contain performance indicators to evaluate the effectiveness of either the Sanctuary or the NMSP.

The management plan review is being conducted in a separate process. The draft Management Plan and accompanying EIS are scheduled for public release in Summer 2004. Please see http://www.cinms.nos.noaa.gov/marineres/manplan.html for more information.

2.2.3. Marine Zoning

2.2.3.1. Marine Zoning by the National Marine Sanctuary Program

Zoning represents an important management approach used by marine sanctuaries to:

- protect sensitive marine resources;
- separate conflicting uses;
- focus management in specific areas; and
- manage carrying capacity (human use).

Marine zones are discrete areas contained within the larger Sanctuary boundary that have special regulations for activities that differ from the regulations that apply throughout the Sanctuary as a whole. Marine zones in the sanctuary system address numerous uses. For example, marine zones are used to regulate motorized personal watercraft in Monterey Bay National Marine Sanctuary, and the Florida Keys National Marine Sanctuary has an extensive network of marine zoning to protect its ecosystem resources.

2.2.3.2. Marine Zoning By the Sanctuary

Since 1980 the Sanctuary has utilized marine zoning as a resource management tool to assist in the management of specific activities. In order to limit the potential environmental impacts of certain human activities, the Sanctuary currently contains zoned areas that provide a 1 nm buffer area around the islands prohibiting large cargo vessels, a thousand foot high area with a 1 nm buffer from island shores within which aircraft may not disturb marine mammals and seabirds, and a 2 nm buffer around the islands within which construction upon or drilling through the seabed is restricted.

2.2.3.3. Other Marine Zoning in the Channel Islands National Marine Sanctuary

Other agencies have also established marine zones wholly or partially within the Sanctuary:

In 1978, commercial and recreational fishing was prohibited in one small marine protected area of the Channel Islands, the Anacapa Island Natural Area. Within this protected area, lobsters are six times more numerous and individual lobsters are larger than in nearby fished waters (Behrens and Lafferty, unpublished manuscript). Other harvested urchin predators, including California sheephead and kelp bass, are also more numerous and larger in the protected area (Tretault, unpublished data). Predation by large lobsters and other species in the protected area caused the urchin population to decline, so that on average, the density of urchins is 7.4 times greater in fished areas than in the protected area (Behrens and Lafferty, unpublished data). Released from the intense grazing pressure from urchins, kelp in the protected area flourished, supporting a variety of associated species. On average, kelp grew five times more densely and persisted longer in the protected area as compared to fished areas nearby (NPS, unpublished data). Data from the National Park Service show that the Anacapa Island Natural Area supports some of the richest kelp forests in the Channel Islands.

In 2002, the California Fish and Game Commission authorized the establishment of marine reserves and state marine conservation areas that prohibit or limit the take and harvest of living, geological or cultural resources.

The International Maritime Organization has designated a voluntary vessel traffic separation scheme to guide large vessel traffic running through the Santa Barbara Channel.

The CINP also has several zoned areas along the island shores for different public uses, principally to protect seabird colonies and marine mammal haul outs. More recently, the CINP is instituting a new zoning approach to managing park lands, coasts and adjacent waters. (provide more details on this, including specifically why CINP is doing this.)

Due to historic lows in the stocks of certain rockfish (e.g., cow cod and bocaccio), in 2001 the PFMC took emergency action and established large area closures to rebuild these stocks. The Cow Cod Conservation Area and the California Rockfish Conservation Area overlay Sanctuary waters (see Figure 2-1). (Map and more detailed description of the closures to follow.)

Where such zoning occurs or is proposed, the Sanctuary has and will continue to work closely with relevant agencies and stakeholders to collaborate in improving resource protection and appropriate public access.

Figure 2-1: Cowcod Conservation Area/California Rockfish Conservation Area

(Figure To Be Inserted)

2.2.4. Channel Islands Marine Reserves Process, 1999-2003

In 1998, the California Fish and Game Commission (Commission) received a recommendation from a local recreational fishing group to create marine reserves[2], or no-take zones, around the northern Channel Islands as a response to dwindling fish populations. This recommendation suggested closing 20 percent of the shoreline outward to 1 nautical mile to all fishing. The recommendation led to more than one year of public discussion of the issue in the Commission forum. The Sanctuary and the CDFG developed a Federal and State partnership to consider the establishment of marine reserves in the Sanctuary, in order to respond to the proposal, to further the goals of California's Marine Life Management and Marine Life Protection Acts, and to meet the need for an open, constituent-based process. The Commission endorsed this process at their March 4, 1999 meeting.

The Sanctuary Advisory Council, a federal advisory board of local community representatives and federal, state and local government agency representatives, created a multi-stakeholder Marine Reserves Working Group (MRWG) to seek agreement on a recommendation to the Sanctuary Advisory Council regarding the potential establishment of marine reserves within the Sanctuary. The Sanctuary Advisory Council also designated a Science Advisory Panel of recognized experts and a NOAA-led Socio-economic Team to support the MRWG and the Channel Islands marine reserves process. Extensive scientific and socio-economic data were collected in support of the marine reserves assessment process. From July 1999 to May 2001, the MRWG met monthly to receive, weigh, and integrate advice from technical advisors and the public and to develop a recommendation for the Sanctuary Advisory Council on the potential establishment of marine reserves in the Sanctuary.

The MRWG reached consensus on a set of ground rules, a mission statement, a problem statement, a set of goals and objectives, a list of species of interest, and a comprehensive suite of implementation recommendations (see Appendix D for additional details). These include the following statements:

- To protect, maintain, restore, and enhance living marine resources, it is necessary to develop new management strategies that encompass an ecosystem perspective and promote collaboration between competing interests.
- To protect representative and unique marine habitats, ecological processes, and populations of interest.
- To maintain long-term socioeconomic viability while minimizing short-term socioeconomic losses to all users and dependent parties.
- To achieve sustainable fisheries by integrating marine reserves into fisheries management.
- To maintain areas for visitor, spiritual, and recreational opportunities which include cultural and ecological features and their associated values.

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[2] In a California State marine reserve it is unlawful to damage, take, or possess any living, geological, or cultural marine resource, except under a permit or specific authorization from the Fish and Game Commission for research, restoration, or monitoring purposes.

- To foster stewardship of the marine environment by providing educational opportunities to increase awareness and encourage responsible use of resources.

The MRWG developed over 40 different designs for marine zoning and evaluated the ecological value and potential economic impact of each design. To do so, members of the MRWG contributed their own expertise to modify designs or generate alternatives to the designs developed by the Science Advisory Panel and utilized a geospatial tool, known as the Channel Islands Spatial Support and Analysis Tool (CI-SSAT; Killpack et al. 2000). CI-SSAT provided opportunities for visualization, manipulation, and analysis of data for the purpose of designing marine reserves.

After months of deliberation, during which the working group tried to achieve full consensus on a single preferred design, the working group ultimately selected 2 designs to represent the diverse views of the group. The composite map depicts the best effort that each MRWG representative could propose and remain true to his/her constituency (Figure D-1 in Appendix D). This composite map, along with the suite of 40 draft maps that were produced, and background scientific and economic information, were provided through the Sanctuary Advisory Council to the Sanctuary and CDFG for consideration. (Airamé, in prep.)

The MRWG considered a network of marine reserves throughout the entire Sanctuary (0-6 nm) that includes both state and federal waters. The development of ecological criteria and socioeconomic data also included the entire Sanctuary area.

As directed by the ground rules, the MRWG forwarded all areas of consensus, non-agreement and the composite map to the Sanctuary Advisory Council. The Sanctuary Advisory Council evaluated the MRWG's work and progress, deliberated over two meetings, hosted a public forum on the issue, and forwarded a recommendation to the Sanctuary Manager:

> The Channel Islands National Marine Sanctuary Advisory Council commends the Sanctuary staff, Department of Fish and Game (DFG) and all participants of the MRWG, Science and Socio-Economic Panels on their efforts over the past two years. The Sanctuary Advisory Council finds that the MRWG, in seeking consensus on marine reserves, developed scientific and socio-economic data that should be used and built upon in future consideration of such issues. The Sanctuary Advisory Council finds that the MRWG process was open, inclusive and community based.
>
> By a vote of 17 (yes), 1 (no), 1 (abstention), the Sanctuary Advisory Council agreed to:

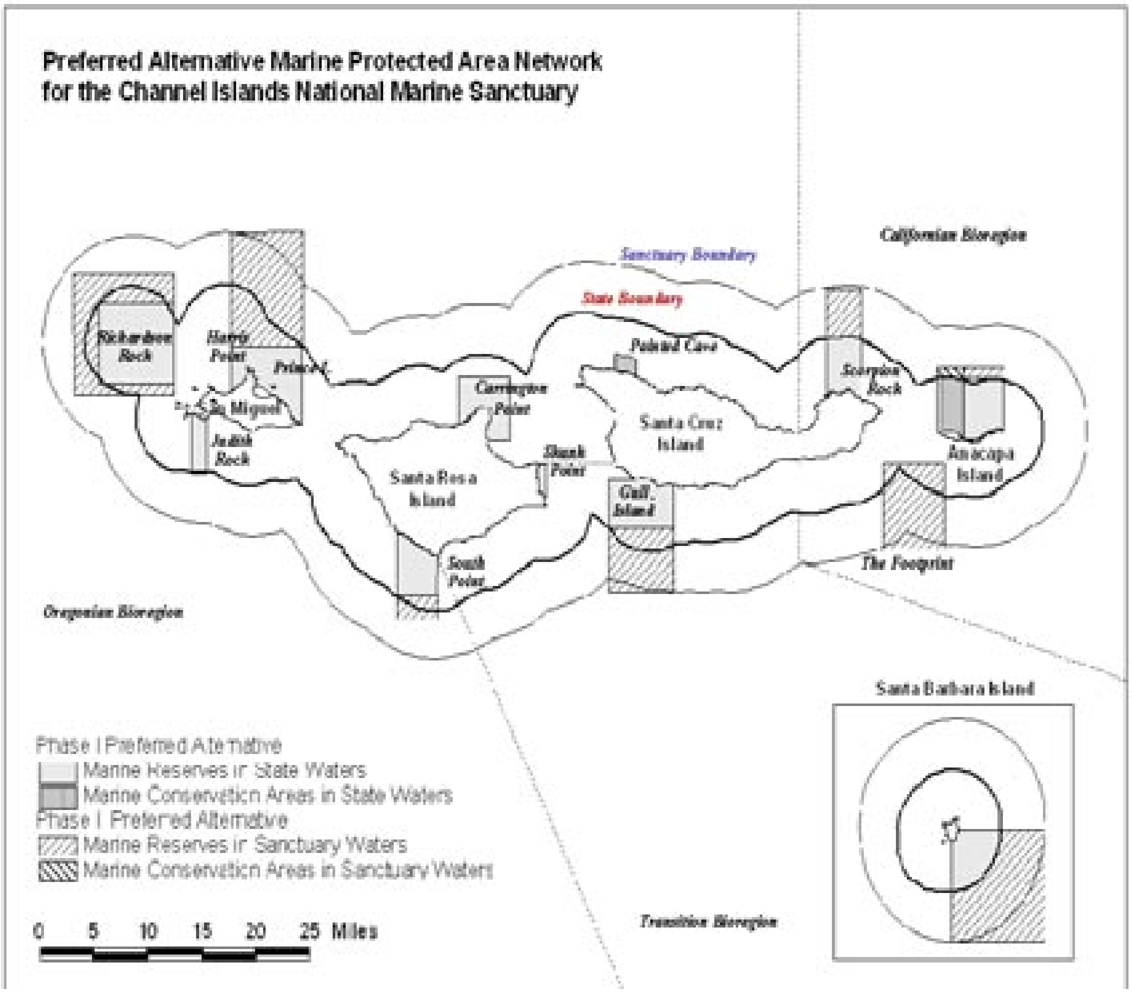
- Formally transmit the full public record of the MRWG and the Sanctuary Advisory Council regarding the development of reserves in the Sanctuary to the Sanctuary Manager;
- Charge the Sanctuary Manager and Department of Fish and Game staff to craft a final recommendation consistent with the Marine Reserve Working Group's consensus agreements for delivery to the Fish and Game Commission in August 2001;

- Request that the Sanctuary Manager and Department of Fish and Game work with the community to the maximum extent feasible in crafting this recommendation.

With this guidance, the Department and Sanctuary crafted a draft reserve network and sent it directly to the Sanctuary Advisory Council, former MRWG, Science Panel, Socio-Economic Panel members seeking further input. The draft reserve network was published in local papers and on the Sanctuary website to solicit input from the general public. Several meetings were held with constituent groups, including the Sanctuary Advisory Council Conservation Working Group, Fishing Group and Ports and Harbors Working Group to discuss the draft network. The Department and Sanctuary also met directly with former MRWG members and several written comments were received and considered.

In preparing a recommendation for the Fish and Game Commission, the Department and Sanctuary used the MRWG consensus statements as well as the MRWG Composite Map of Areas of Overlap and Non-Overlap as a foundation. Because the Composite Map was not a completed reserve network proposal agreed to by consensus of the MRWG, additional work was needed to develop the Department and Sanctuary's spatial recommendation. The recommendation proposed a network of marine reserve and marine conservation areas in the same general locations as the MRWG Composite Map. On August 24, 2001, the Sanctuary and CDFG recommended to the Commission a network of reserves and conservation areas shown in Figure 2-2, below, estimated at approximately 25% of the total area of the Sanctuary. This recommendation became the preferred alternative in the State's California Environmental Quality Act environmental review process.

Figure 2-2: The State of California's preferred network alternative.



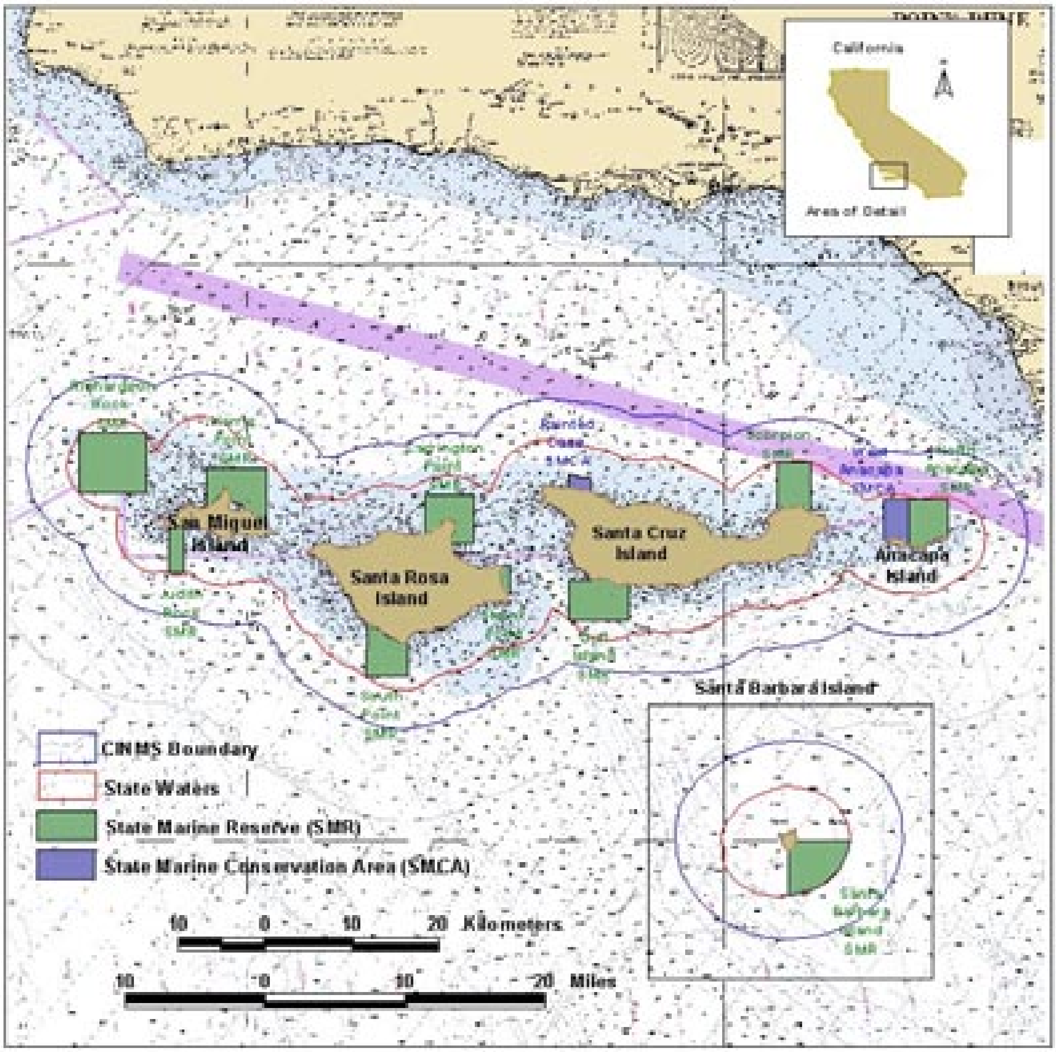
2.2.5. State Marine Reserves and Marine Conservation Areas in the Sanctuary

The CDFG prepared environmental review documents pursuant to the California Environmental Quality Act (CEQA), which included an analysis of 5 alternatives reserves networks and the no-project alternative. The reserve network developed by the CDFG and Sanctuary and shown above in Figure 2-2 was identified as the preferred alternative. On October 23, 2002, with support from NOAA and the National Park Service, the Commission approved the preferred alternative and the establishment of 10 marine reserves and 2 conservation areas[2] within State waters of the Sanctuary that encompass approximately 102 square nautical miles of the Sanctuary. The State's network went into effect on April 9, 2003.

The network alternatives analyzed in the CEQA document were split into an initial State waters phase and subsequent Federal phase. The State rulemaking process and the State environmental documents analyzed the potential cumulative effects of network alternatives in both state and federal waters of the sanctuary. The Commission's action implemented marine reserves and marine conservation areas only within the jurisdiction of the State of California. For enforcement purposes, many of the State marine reserve and marine conservation areas were "squared off," meaning that the outside boundary was drawn on a straight line of latitude, well inside the State's 3 nm jurisdiction. The Harris Point Marine Reserve off San Miguel Island and the Gull Island Marine Reserve off Santa Cruz Island illustrate this point.

The State's designated marine reserve and marine conservation areas are part of the environmental baseline that needs to be taken into account as any additional federal marine reserve and marine conservation areas are considered and proposed in the Draft Environmental Impact Statement. See Figure 2-3 below for a map of the current baseline State marine reserve and marine conservation areas in the Sanctuary. See Appendix D for a more complete discussion of the 1999-2003 state and federal Channel Islands Reserves Process. See Appendix A for a more complete description of the federal environmental process, including a flow chart outlining the steps in the process.

Figure 2-3. Existing State marine reserve and marine conservation areas.



3. Preliminary Draft Range of Alternatives

NOTE TO REVIEWER
These preliminary alternatives serve as a starting point to show the range currently being considered. As a reviewer, your input is important in assisting the sanctuary to ensure that alternatives, analyses, methodologies, and data sources are sound and the current range of alternatives is adequate for consideration in the draft environmental impact statement (DEIS) expected later this year. The alternatives may contain gaps and inconsistencies, and some ideas may not be fully developed. With your input, the planning team will continue to refine the alternatives as it prepares the DEIS.

It must be stressed that these alternatives are not exhaustive and no decision has been made on which alternative the NMSP will select as its preferred alternative in the DEIS. A preferred alternative will be developed once we have analyzed your comments and after additional analysis has been completed. The preferred alternative may be one of the alternatives presented, or it may be a new alternative.

The following four preliminary draft alternatives include the no-action alternative and three marine reserve networks of different sizes and configurations that strive to meet the purposes and need detailed in Chapter 1. Preliminary ecological and economic impact analyses for each alternative are provided in Chapter 5. The proposed marine reserve and marine conservation area network approach allows for ecosystem-based management of Sanctuary waters, including a variety of representative habitats and the species that depend on them. Differences among the spatial alternatives can be detected in deeper waters, where varying amounts of soft and hard substrate on the continental shelf and slope and pelagic habitat are represented.

3.1. Development of Preliminary Draft Alternatives

The following section provides a review of the basis for and criteria applied by Sanctuary staff to design a preliminary range of alternatives. The criteria include consideration of the following:

- The purpose and need statement articulated in Chapter 1.
- Public scoping comments submitted to the Sanctuary in writing and verbally during the public scoping period from May – July 2003. Sanctuary staff hosted several meetings in Santa Barbara and Ventura Counties and received input from the Pacific Fishery Management Council while in San Francisco, CA in June 2003. See Appendix B for a summary of scoping comments.

- Extensive input and advice from the community based Marine Reserves Working Group, Science Panel and Socio-economic Team, agency enforcement personnel and the general public received during the 1999-2003 Channel Islands Marine Reserves Process (see Appendix D).
- The Commission's environmental review process (August 2001-April 2003) and ultimate decision to implement marine reserve and marine conservation areas in State waters of the sanctuary and the suite of alternatives analyzed in the State Environmental Document, October 2002. Existing marine reserve and marine conservation areas established by the State are now considered part of the environmental baseline.
- The administrative capacity of the NMSP, the Sanctuary and partner agencies to properly monitor and enforce any of the alternatives.
- Extensive ecological criteria, developed by the Science Panel and supported by the literature. Similarly, detailed socioeconomic data on a variety of human uses. For details on the data sources and GIS-based analysis used to develop the alternatives, see Appendix D.

3.1.1. Marine Reserves: An Ecosystem Management Tool

A specific type of zoning that holds promise to address the purposes stated in Section 1.3 is a marine reserve (or "no-take" zone). Marine reserves are an ecosystem-based approach to marine resource management that protects marine species and their biophysical environments. Marine reserves are also widely recognized for their potential to: (1) to protect and enhance marine habitats (Rodwell et al. 2003), (2) to conserve biodiversity (Halpern 2003), (3) to protect or enhance ecosystem services (Dailey 1997), (4) to recover depleted stocks of exploited species (Fujita et al. 1998), and (5) to export individuals to fished areas (Kelly et al. 2002). Because of their multiple functions, marine reserves have the potential to be one of the best management tools for restoration and conservation of entire ecosystems (Rodwell et al. 2003 from Conover et al. 2000). They may also serve to expand understanding of marine ecosystems and to enhance non-consumptive opportunities such as education, outreach, and recreation.

The number of documented successful examples of marine reserves is increasing rapidly (references to follow). There is now substantial evidence to show that within areas protected from consumptive activities (e.g., fishing), rapid increases in abundance, size, biomass, and diversity of animals occur virtually regardless of where in the world reserves are sited.

Marine reserves can contribute to biodiversity, ecosystem protection, and even fisheries conservation, but they cannot succeed in the absence of complementary management approaches (references to follow). Other strategies, such as catch limits and gear restrictions in non-reserve areas, are still necessary to maintain sustainable fisheries (Allison et al. 1998). A model developed by Salomon et al. (2002) suggests that a combination of marine reserves and an overall reduction in fishing pressure contributes the greatest increase in biomass for species with both short and long-distance dispersal. Furthermore, marine reserves cannot wholly mitigate chronic and widespread problems such as input of pollutants and climate variability.

The interrelationship between conventional fishery management tools and marine reserves is complex and is stimulating considerable scientific and policy debate. Currently, a National Center for Ecological Analysis and Synthesis working group led by Alan Hastings and Louis Botsford is focused on the development of tools for the practical design of marine reserves. This group will consider a specific situation and constraints (i.e., current fishing rate, current state of the ecosystem, limited area under consideration, uncertainty in larval dispersal, fishermen behavior) in the development of scientifically sound design tools that can be used in ongoing and future implementation efforts for reserve systems; for more information see http://www.nceas.ucsb.edu. Similarly, the PFMC, NOAA National Marine Protected Areas Center and NMFS have a proposal to explore these issues as well.

In summary, the Sanctuary based Alternatives 1-3 on marine reserves and marine conservation area networks because this approach:

- Addresses the purpose and needs stated above;
- is a powerful tool for addressing local ecosystem resources, including all species and habitats, based on data from the Channel Islands and from the scientific literature;
- is within the authority of the Sanctuary under the NMSA and is consistent with the National Marine Sanctuary Program's zoning approach to resource management;
- can complement and augment other existing management approaches such as traditional fisheries management.

Note to Reviewer: During the review of the preliminary draft working document, the Sanctuary anticipates that reviewers may recommend that establishment of networks of marine reserves and marine conservation areas be done under the Magnuson-Stevens Act rather than the National Marine Sanctuaries Act. It is our understanding that the Magnuson-Stevens Act is limited to regulating only those fisheries that are managed under a Fishery Management Plan. Therefore, for example, species not listed in an FMP could still potentially be extracted in a Magnuson-Stevens act "equivalent" to a marine reserve. On the other hand, extensive closures such as the cowcod and rockfish closures may dramatically limit fishing activity in an area, and therefore have the potential to provide at least some of the benefits that would be provided by a complete marine reserve. It is the Sanctuary's expectation that specific proposals for Magnuson-Stevens Act-based marine protected areas may be submitted and considered during this review process.

3.1.2. Scoping Comments Related to Alternative Development

The Sanctuary has also taken into account scoping comments regarding the development of alternatives. The NMSP conducted three public scoping meetings during the scoping period from May 22 – July 23, 2003. See Appendix B for details. The Sanctuary received several general and some specific comments related to the development of marine reserves alternatives, including the following:

- Adjoin federal reserves with existing state reserves

- Include a "trigger" to resume fishing when marine reserve and marine conservation areas have proven their effectiveness
- Expand marine reserve areas to complete a scientifically based network to include the variety of habitats, depth ranges and species with connectivity between reserves
- Federal reserves are important to protect pelagic species and deep water species
- Apply the science panel's original size recommendation to set-aside 30-50% of each habitat type in the sanctuary
- Consider large, contiguous reserve areas
- Maximize connectivity between individual reserves, i.e., the network approach
- Include as an alternative the marine reserve and marine conservation area network developed jointly by the CDFG and the Sanctuary that the State of California implemented in state waters of the Sanctuary.

The Sanctuary also received several comments that suggested alternative management approaches, including:

- Consider broad range of alternatives and management tools and not just reserves (e.g., try marine parks to test impacts of recreational fishing or allow pelagic species to be harvested recreationally from zoned areas).
- Consider traditional management tools or regimes.

3.1.3. Alternative Development Methodology

3.1.3.1. Ecological Evaluation Criteria

Ecological criteria for design of alternatives are described extensively in Appendix D. The Science Advisory Panel assembled a set of ecological criteria for the design of a network of marine reserves to meet the desired outcomes. The ecological criteria include:

- Biogeographic representation
- Habitat representation
- Vulnerable habitats
- Species of interest
- Reserve size
- Connectivity
- Monitoring sites

3.1.3.2. Socioeconomic Considerations

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 Channel Islands Marine Reserves process over two years. See Appendix E for details.

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

A number of diverse data sources and methods were used to estimate both the total amount and spatial distribution of use 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:

- California Department of Fish and Game commercial fishing data showing where fish are caught and the ports where fish are landed
- 14 commercial species/species groups mapped on a 1-minute by 1-minute distributions of catch
- Socioeconomic profiles of the fishermen (e.g., experience, age, education, income, dependency on fishing, people and family members directly employed, investment/ownership of boat and equipment, place of residence and home and landing ports)
- Commercial fishermen costs and earnings
- Kelp harvesting and processing information (obtained from ISP Alginates)
- Surveys of recreational “for hire” operators (by Census)
- National Marine Fisheries Service, Marine Recreational Fishing Statistics Survey for intercept/access points for those fishing from private household boats
- Aerial flyover data for boating activities from the Channel Islands National Marine Sanctuary
- An ethnographic survey of a variety of commercial and recreational sanctuary users

3.1.3.3. Analysis

The GIS database of ecological information about the Channel Islands region (described in Appendix D) was used to determine the amount of each habitat within the proposed marine reserve and marine conservation areas.

Ten options for networks of marine reserves, developed by the Science Advisory Panel, were available to the MRWG for purposes of comparison. The Science Advisory Panel and MRWG utilized a geospatial tool, known as the Channel Islands Spatial Support and Analysis Tool (CI-SSAT; Killpack et al. 2000) to compare and contrast the alternatives. The tool also contained maps showing the distributions of major commercial and recreational activities. (Data describing the economic value of each planning unit to each fishery was not released by the fishing community for general viewing in CI-SSAT in order to protect confidential business information (prime fishing spots). However, the economic information contained within the tool and was used for impact evaluation of alternatives.)

During the Channel Islands Marine Reserve Process, the MRWG developed over 40 different designs for marine zoning and evaluated the ecological value and potential economic impact of each design. To do so, members of the MRWG contributed their own expertise to modify designs or generate alternatives to the maps originally developed by the Science Advisory Panel.

The development of Alternatives 1-3 in this preliminary draft document used the same underlying data sets and approaches that were applied during the Channel Islands Marine Reserves process. However, since the existing state network of marine reserves is in place and part of the existing baseline, all three spatial alternatives were designed to complement the existing state reserves. For example, state reserves are typically extended into federal waters along straight longitudinal or latitudinal lines for ease of location by mariners and enforcement. In addition, in order to reduce confusion and to simplify enforcement, the same management approach is proposed for contiguous areas: state marine reserves are to be adjoined by federal marine reserves, and state marine conservation areas are to be adjoined by federal marine conservation areas. Alternatives 1-3 were also designed to provide a range that includes the preferred federal/state marine reserves network identified in the state of California's final environmental document for marine reserves in the Channel Islands (see Appendix D, Figure D-2, and Figure 2-2).

3.2. Description of Alternatives

NOTE TO REVIEWER
In these alternatives, the Sanctuary is only recommending changes to management within the geographically-defined areas delineated by each alternative. Sanctuary staff welcome input on how, if at all, existing state and federal management outside of the proposed marine reserve and marine conservation areas might also be modified to improve the alternatives' ability to meet the purpose and need for this project.

3.2.1. Spatial Alternatives

3.2.1.1. No Action (Status Quo) Alternative

The no action (status quo) alternative would not add additional protected areas to the existing State marine reserve and marine conservation areas and would require no regulatory action. The existing State marine reserve and marine conservation areas and existing state and federal management of commercial and recreational activities would remain unchanged. Existing sanctuary regulations would continue to apply throughout the Sanctuary. (add map and tables for no-project alternative).

3.2.1.2. General Overview of Habitat Representation in Alternatives 1-3

Add an introductory paragraph or two that describes the kinds of habitats generally captured by extending into deeper, federal waters, and describe what their role and importance may be in the overall ecosystem. For example, what is special about deep, soft sediment areas?

Alternative 1 contains the least area of the action alternatives. The primary differences between Alternative 1 and the other alternatives occur at Richardson Rock and Santa Barbara Island, where Alternative 1 includes very little or no additional protection, whereas the other alternatives include substantial portions of deep water habitats at these locations. Of the alternatives, Alternative 1 contains the least amount of soft sediment at depths of 30-100 m, 100-200 m and >200 m and hard sediment at depths of 30-100 m. Considering the state waters in Alternative 1 that are not included in the current state marine reserves and marine conservation areas (overlap), Alternative 1 has the least amount of soft sediment at depths of 30-100 m and 100-200 m and hard sediment at depths of 30-100 m. However, the differences among alternatives in the amount of hard sediment are very small. Federal marine reserves (FMRs) proposed by Alternative 1 include the least amount of soft sediment at depths of 100-200 m and > 200 m and hard sediment at depths >200 m, compared to other alternatives.

Alternative 2 includes total area and hard sediment at depths of 30-100 m that is intermediate between Alternative 1, which is lower, and Alternative 3, which is higher. Federal marine reserves in Alternatives 1, 2, and 3 each contain 3 nmi^2 of submarine canyons. Federal marine conservation areas proposed at Anacapa Island in Alternatives 1, 2, and 3 contain 2 nmi^2 of soft sediment 30-100 m deep. Ecological data at the 1x1 sq. nm resolution were not available outside the existing Sanctuary to evaluate habitats. The area that falls outside the Sanctuary boundary is likely to include mixed soft and hard sediment at depths greater than 100 m.

Alternative 3 is the largest of the alternatives and, therefore, it includes more deep-water habitat. Of the alternatives, Alternative 3 contains the most soft sediment at depths of 30-100 m, 100-200 m and >200 m. Considering the areas in state waters that are not included in the state marine reserves or marine conservation areas, Alternative 3 includes the greatest amount of soft sediment at depths of 30-100 m and 100-200 m. State marine reserves in Alternative 3 also include substantially more soft sediment at depths of 30-100 m and 100-200 m.

3.2.1.3. Alternative 1

Alternative 1 is a modified version of an alternative submitted by Santa Barbara County commercial fishermen during the State California Environmental Quality Act Review process. Alternative 1 has been modified to fit the east and west boundaries of the existing State adopted marine reserve and marine conservation areas network. Alternative 1 would extend the following State marine reserve and marine conservation areas into deeper waters: Richardson Rock and Harris Pt., San Miguel Island, South Point, Santa Rosa Island, Gull Island and Scorpion, Santa Cruz Island, the Footprint, and Anacapa Island marine reserve and marine conservation areas.

This alternative, including the existing state marine reserve and marine conservation areas, would establish approximately 170.41 square nautical miles (nmi^2) of marine reserves and 8.6 nmi2 of marine conservation areas for a total of 179 nmi^2 of the Sanctuary (Figure 3-1). The northern boundary of the proposed Harris Pt. Marine Reserve off San Miguel Island extends slightly beyond the existing Sanctuary boundary. This alternative is smaller than the other alternatives and was originally developed to minimize the short-term potential economic impacts to commercial fisheries.

Figure 3-1: Alternative 1

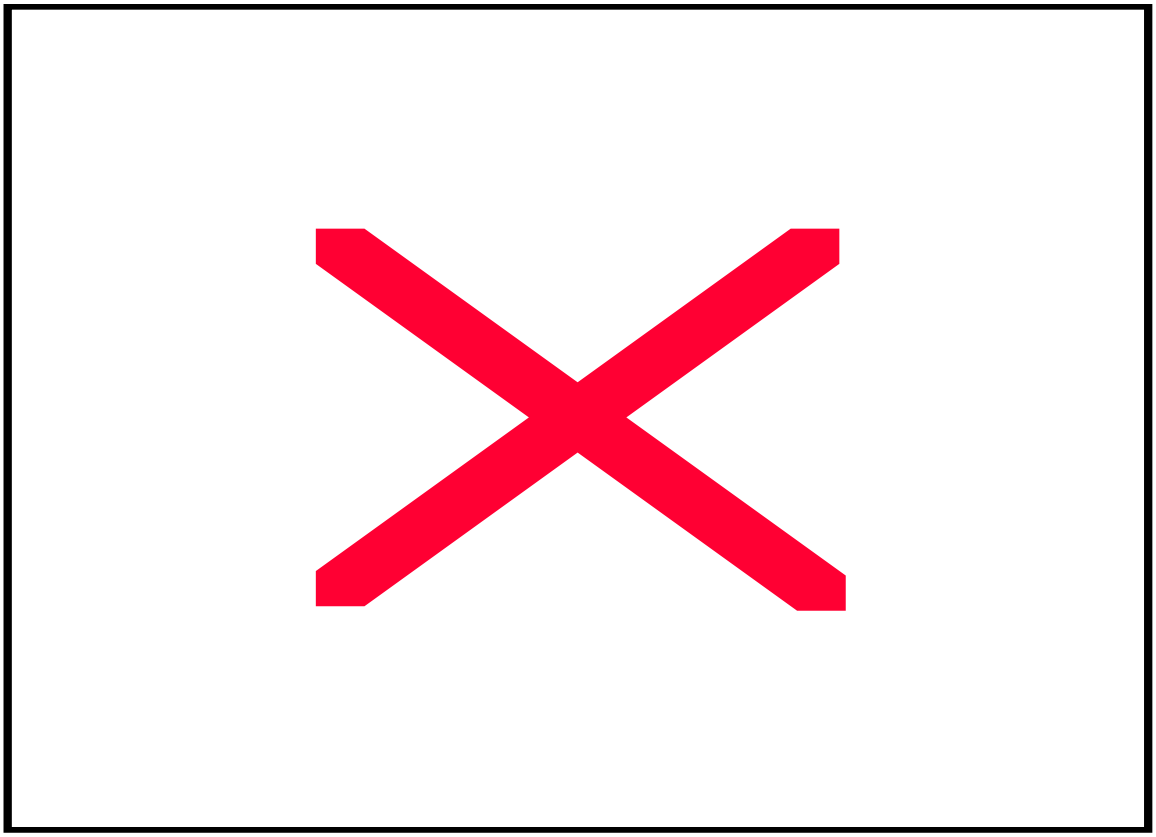


Table 3-1: Total Amount Of Each Habitat In Alternative 1

Alternative	1	1	1	1	1	1	1
Phase	Additional State Water	Federal Water MR	Federal Water MCA	Total New Proposed	Existing SMR	Existing SMCA	Total
Size (nmi2)	?	75.3	1.7	77.1	95.1	6.9	179.0
Sandy Coast	0	0	0	0	12.1	0	12.1
Rocky Coast (Protected)	0	0	0	0	12.5	3.2	15.7
Rocky Coast (Exposed)	0	0	0	0	12.3	0	12.3
SOFT (0-30)	0	0	0	0	19.4	1.8	21.2
HARD (0-30)	0	0	0	0	10.1	0.7	10.8
SOFT (30-100)	8.7	8	2	18.7	58.2	5	82.0
HARD (30-100)	0.3	0	0	0.3	6.4	0	6.7
SOFT (100-200)	8.5	13.5	0	22	31.6	0	53.6
HARD (100-200)	0	0	0	0	2.9	0	2.9
SOFT (>200)	4.4	49.9	0	54.3	13.5	0	67.8
HARD (>200)	1.6	0.6	0	2.2	2	0	4.2
Emergent Rocks (Nearshore)	0	0	0	0	114	0	114
Emergent Rocks (Offshore)	0	0	0	0	10	1	11
Submarine Canyons	2	3	0	5	9	0	14
Kelp Forest	0	0	0	0	4.6	0.03	4.7
Eelgrass	0	0	0	0	0.2	0	0.2
Surfgrass	0	0	0	0	5.6	0	5.6

3.2.1.4. Alternative 2

Alternative 2 is the original proposed action (preferred) alternative as presented in the State CEQA document and was developed by the California Department of Fish and Game and the Sanctuary in 2001. Under direction of the Sanctuary Advisory Council this alternative was based on input and advice received during the Marine Reserves Working Group process. The State waters portion of this alternative is what the Fish and Game Commission adopted in October 2002 and implemented in April 2003.

Alternative 2 would extend the State marine reserve and marine conservation areas into deeper waters in the following areas: Richardson Rock and Harris Pt., San Miguel Island, South Point, Santa Rosa Island, Gull Island and Scorpion, Santa Cruz Island, Anacapa Island marine reserve and marine conservation areas and off Santa Barbara Island. The Footprint area south of Santa Cruz and Anacapa Islands would be added as a new marine reserve zone.

This alternative, including the existing state marine reserve and marine conservation areas, would establish approximately 229.61 nmi^2 of marine reserves and 8.61 nmi^2 of marine conservation areas for a total of 238.2 nmi^2 of the Sanctuary (Figure 3-2). The northern boundary of the proposed Harris Pt. Marine Reserve off San Miguel Island and the southeast boundary of the proposed Santa Barbara Island Marine Reserve extend slightly beyond the existing Sanctuary boundary. The additional area outside the current Sanctuary boundary is approximately 12.4 nmi^2. This alternative strives to satisfy the biological criteria, while also minimizing potential economic impacts to various commercial and recreational fisheries. In order for this alternative to be fully implemented, the Sanctuary designation document would have to be amended to change the Sanctuary boundary to include the additional waters beyond the current boundary.

Figure 3-2: Alternative 2

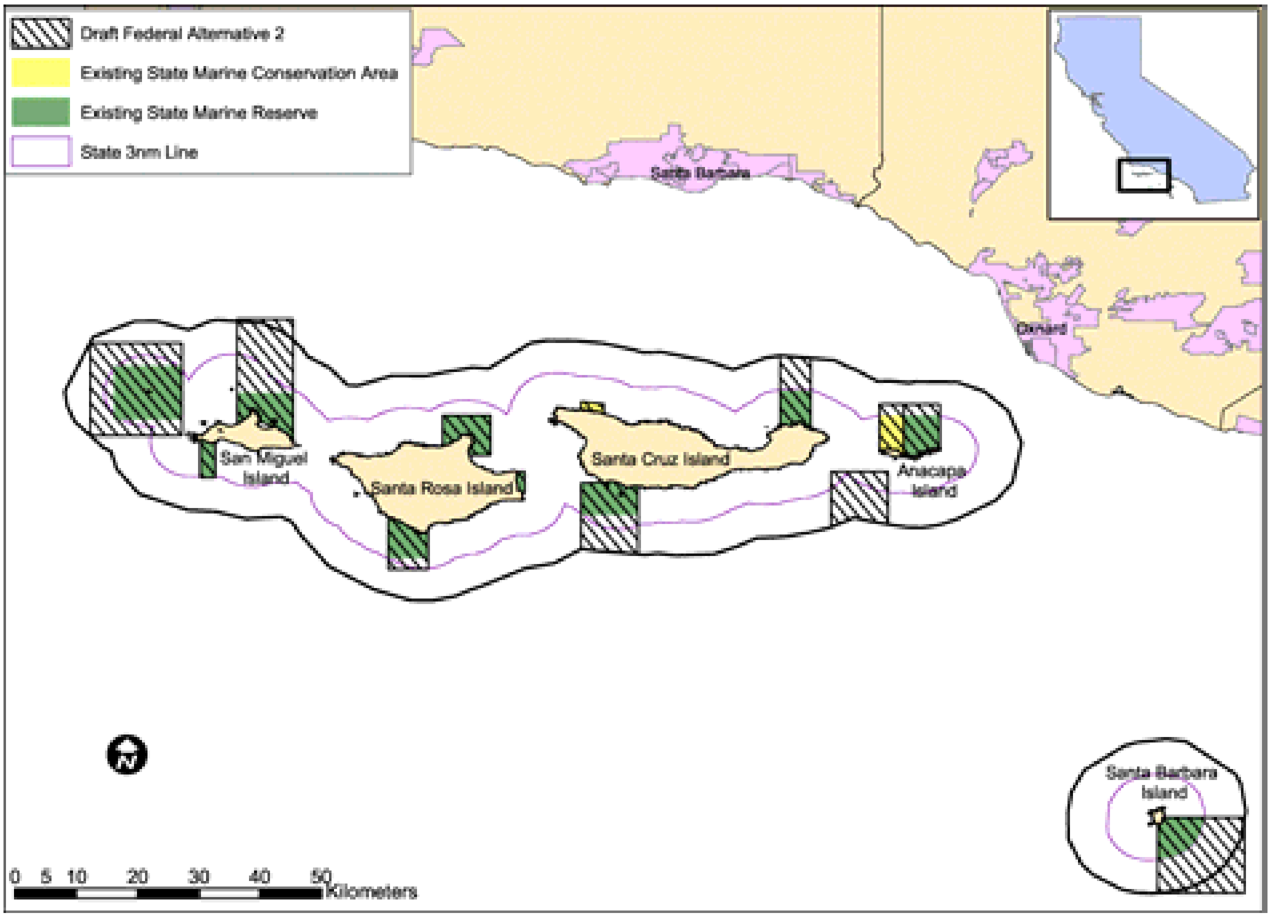


Table 3-2. Total Amount Of Each Habitat In Alternative 2

Alternative	2	2	2	2	2	2	2
Phase	Additional State Water	Federal Water MR	Federal Water MCA	Total New Proposed	Existing SMR	Existing SMCA	Total
Size (nmi2)	?	134.5	1.7	136.3	95.1	6.9	238.2
Sandy Coast	0	0	0	0	12.1	0	12.1
Rocky Coast (Protected)	0	0	0	0	12.5	3.2	15.7
Rocky Coast (Exposed)	0	0	0	0	12.3	0	12.3
SOFT (0-30)	0.6	0	0	0.6	20.0	1.8	22.4
HARD (0-30)	0.2	0	0	0.2	10.3	0.7	11.2
SOFT (30-100)	14.5	10	2	26.5	64.0	5	95.5
HARD (30-100)	0.5	0	0	0.5	6.7	0	7.2
SOFT (100-200)	12.5	31.5	0	44	35.6	0	79.6
HARD (100-200)	0	0	0	0	2.9	0	2.9
SOFT (>200)	4.4	80.2	0	84.6	13.5	0	98.1
HARD (>200)	1.6	4.3	0	5.9	2	0	7.9
Emergent Rocks (Nearshore)	0	0	0	0	114	0	114
Emergent Rocks (Offshore)	0	0	0	0	10	1	11
Submarine Canyons	2	3	0	5	9	0	14
Kelp Forest	0	0	0	0	4.6	0.03	4.7
Eelgrass	0	0	0	0	0.2	0	0.2
Surfgrass	0	0	0	0	5.6	0	5.6

3.2.1.5. Alternative 3

Alternative 3 is based on a network of marine reserves developed during the Channel Islands Marine Reserves process that was slightly modified and fully analyzed in the State CEQA Environmental Document.

For purposes of this NEPA process, alternative 3 has been modified to fit with the inshore boundaries of the existing state adopted marine reserve and marine conservation areas network. Alternative 3 extends all of the State marine reserve and marine conservation areas zones into deeper waters, except for the Painted Cave Marine Conservation Area, Santa Cruz Island and Skunk Point Marine Reserve, Santa Rosa Island, and adds the Footprint area south of Santa Cruz and Anacapa Islands.

This alternative, including the existing state marine reserve and marine conservation areas, would establish approximately 259.6 nmi^2 of marine reserves and 12 nmi^2 of marine conservation area for a total of 271.7 nmi^2 of the Sanctuary (Figure 3-3). The northern boundary of the proposed Harris Pt. Marine Reserve off San Miguel Island and the southeast boundary of the potential Santa Barbara Island Marine Reserve extend slightly beyond the existing Sanctuary boundary. The additional area outside the Sanctuary boundary is approximately 12.4 nmi^2. In order for this alternative to be fully implemented, the Sanctuary designation document would have to be amended to change the Sanctuary boundary to include the additional waters beyond the current boundary.

Figure 3-3: Alternative 3

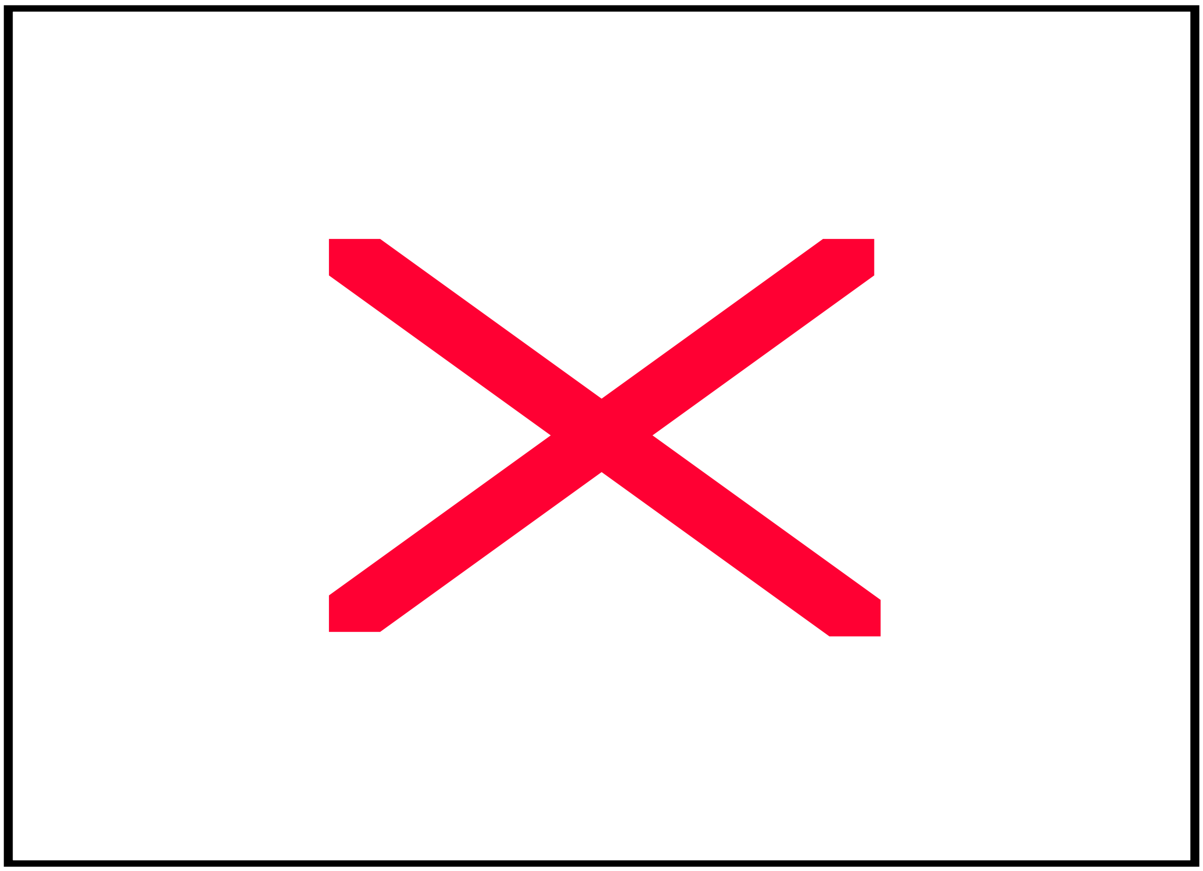


Table 3-3: Total Amount Of Each Habitat In Alternative 3

Alternative	3	3	3	3	3	3	3
Phase	Additional State Water	Federal Water MR	Federal Water MCA	Total New Proposed	Existing SMR	Existing SMCA	Total
Size (nmi2)	?	164.5	5.2	169.7	95.1	6.9	271.7
Sandy Coast	0	0	0	0.0	12.1	0	12.1
Rocky Coast (Protected)	0	0	0	0	12.5	3.2	15.7
Rocky Coast (Exposed)	0	0	0	0	12.3	0	12.3
SOFT (0-30)	0.6	0	0	0.6	20.0	1.8	22.4
HARD (0-30)	0.2	0	0	0.2	10.3	0.7	11.2
SOFT (30-100)	17.5	15	2	34.5	67.0	5	106.5
HARD (30-100)	0.5	0	0	0.5	6.7	0	7.2
SOFT (100-200)	13.5	51.5	0	65	36.6	0	101.6
HARD (100-200)	0	0	0	0	2.9	0	2.9
SOFT (>200)	4.4	105.7	0	110.1	13.5	0	123.6
HARD (>200)	1.6	4.3	0	5.9	2	0	7.9
Emergent Rocks (Nearshore)	0	0	0	0	114	0	114
Emergent Rocks (Offshore)	0	0	0	0	10	1	11
Submarine Canyons	2	3	0	5	9	0	14
Kelp Forest	0	0	0	0	4.6	0.03	4.7
Eelgrass	0	0	0	0	0.2	0	0.2
Surfgrass	0	0	0	0	5.6	0	5.6

3.2.2. Implementing Spatial Alternatives in State Waters

For each spatial alternative the Sanctuary is proposing to add additional area in Federal marine reserve and marine conservation areas, and to overlay the existing State marine reserve and marine conservation areas with Federal marine reserve and marine conservation areas regulations under the NMSA that mirror the state's regulations. Another regulatory option for each spatial alternative would be to abut rather than overlap the existing State marine reserve and marine conservation areas. Changes to certain Sanctuary regulations may subsequently involve changes to the Sanctuary designation document. The Governor of California would have the opportunity to object to such regulations before they could take effect in State waters.

Therefore, for any of the spatial alternatives, there are three potential outcomes for the final configuration of the marine protected area network:

- Federal marine reserve and marine conservation areas would overlay the existing State marine reserve and marine conservation areas with Sanctuary regulations in order to provide continuity between nearshore and offshore habitats and additional administrative capacity (such as enhanced enforcement).

- Federal marine reserve and marine conservation areas would extend into State waters in order to abut the existing State marine reserve and marine conservation areas but would not overlay them.

- If the Governor objects, the regulations would not take effect in State waters. This would create spatial gaps between existing State marine reserve and marine conservation areas and Federal marine reserve and marine conservation areas as shown below in Figure 3-4.

The ecological and socioeconomic impacts of all three possible outcomes are presented for each of the three federal alternatives in Appendix E.

Figure 3-4. Example of spatial gaps between the existing State marine reserve and marine conservation areas network and the three nautical mile State boundary if only Federal water reserves are established.

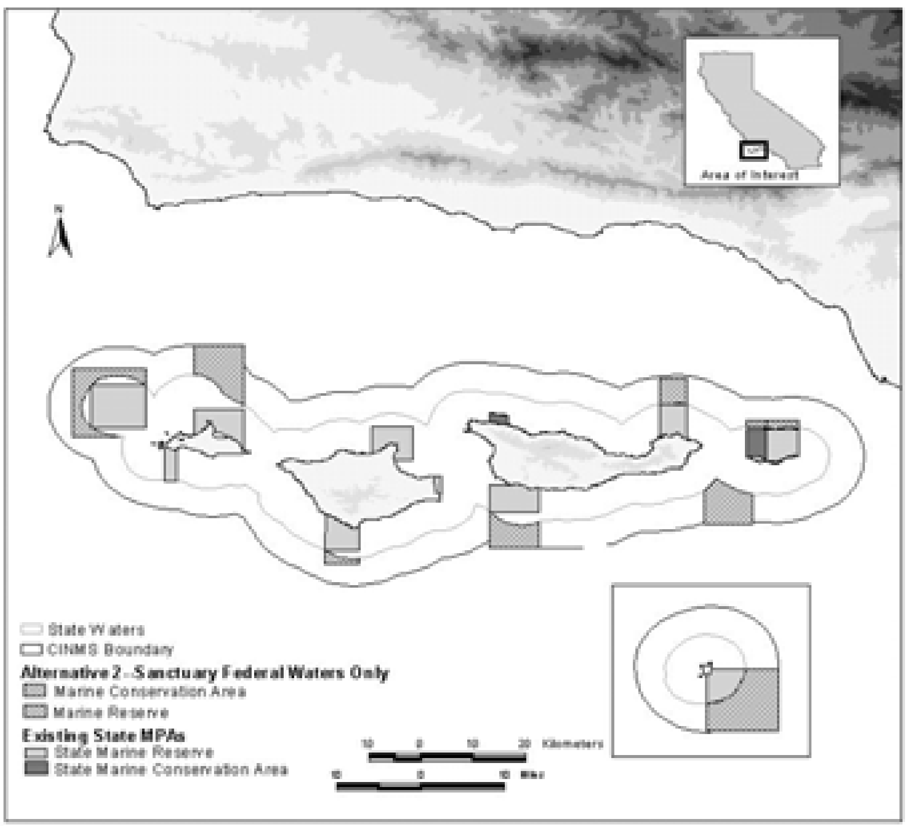


Table 3-4. Amount Of Each Habitat Type In Additional State Waters For Alternatives 1-3

Alternative	1	2	3
Phase	Additional State Water	Additional State Water	Additional State Water
Size (nmi2)			
Sandy Coast	0	0	0
Rocky Coast (Protected)	0	0	0
Rocky Coast (Exposed)	0	0	0
SOFT (0-30)	0	0.6	0.6
HARD (0-30)	0	0.2	0.2
SOFT (30-100)	8.7	14.5	17.5
HARD (30-100)	0.3	0.5	0.5
SOFT (100-200)	8.5	12.5	13.5
HARD (100-200)	0	0	0
SOFT (>200)	4.4	4.4	4.4
HARD (>200)	1.6	1.6	1.6
Emergent Rocks (Nearshore)	0	0	0
Emergent Rocks (Offshore)	0	0	0
Submarine Canyons	2	2	2
Kelp Forest	0	0	0
Eelgrass	0	0	0
Surfgrass	0	0	0

Table 3-5: Amount of each habitat type in Marine Reserves in Sanctuary federal waters (3-6 nm), Alternatives 1-3.

Alternative		1	2	3
Phase	ME	FMRs	FMRs	FMRs
Size (nmi2)		75.3	134.5	164.5
Sandy Coast	-	0	0	0
Rocky Coast (Protected)	-	0	0	0
Rocky Coast (Exposed)	-	0	0	0
SOFT (0-30)	-	0	0	0
HARD (0-30)	-	0	0	0
SOFT (30-100)	3.5	8	10	15
HARD (30-100)	-	0	0	0
SOFT (100-200)	6	13.5	31.5	51.5
HARD (100-200)	-	0	0	0
SOFT (>200)	5	49.9	80.2	105.7
HARD (>200)	-	0.6	4.3	4.3
Emergent Rocks (Nearshore)	-	0	0	0
Emergent Rocks (Offshore)	-	0	0	0
Submarine Canyons	-	3	3	3
Kelp Forest	-	0	0	0
Eelgrass	-	0	0	0
Surfgrass	-	0	0	0

Table 3-6: Amount Of Each Habitat Type In State Marine Reserves In Alternatives 1-3

Alternative		1	2	3
Phase	ME	SMRs	SMRs	SMRs
Size (nmi2)		95.1	95.1	95.1
Sandy Coast	0.9	12.1	12.1	12.1
Rocky Coast (Protected)	4.1	12.5	12.5	12.5
Rocky Coast (Exposed)	1.8	12.3	12.3	12.3
SOFT (0-30)	7.2	19.4	20.0	20.0
HARD (0-30)	2.5	10.1	10.3	10.3
SOFT (30-100)	13	58.2	64.0	64.0
HARD (30-100)	2	6.4	6.7	6.7
SOFT (100-200)	6	31.6	35.6	35.6
HARD (100-200)	-	2.9	2.9	2.9
SOFT (>200)	-	13.5	13.5	13.5
HARD (>200)	-	2	2	2
Emergent Rocks (Nearshore)	24	114	114	114
Emergent Rocks (Offshore)	-	10	10	10
Submarine Canyons	-	9	9	9
Kelp Forest	1	4.6	4.6	4.6
Eelgrass	-	0.2	0.2	0.2
Surfgrass	1.6	5.6	5.6	5.6

Table 3-7. Total amount and % of each habitat type in Alternatives 1-3

Alternative	1	2	3
Phase	Total	Total	Total
Size (nmi2)	179.0	238.2	271.7
Sandy Coast	12.1 (28%)	12.1(28%)	12.1(28%)
Rocky Coast (Protected)	15.7 (30%)	15.7 (30%)	15.7 (30%)
Rocky Coast (Exposed)	12.3 (29%)	12.3 (29%)	12.3 (29%)
Soft (0-30)	21.2 (25%)	22.4 (26%)	22.4 (26%)
Hard (0-30)	10.8 (23%)	11.2 (23%)	11.2 (23%)
Soft (30-100)	82.0 (25%)	95.5 (29%)	106.5(32%)
Hard (30-100)	6.7 (18%)	7.2 (19%)	7.2 (19%)
Soft (100-200)	53.6 (21%)	79.6 (31%)	101.6 (40%)
Hard (100-200)	2.9 (34%)	2.9 (34%)	2.9 (34%)
Soft (>200)	67.8 (12%)	98.1 (18%)	123.6 (22%)
Hard (>200)	4.2 (25%)	7.9 (47%)	7.9 (47%)
Emergent Rocks (Nearshore)	114 (22%)	114 (22%)	114 (22%)
Emergent Rocks (Offshore)	11 (61%)	11 (61%)	11 (61%)
Submarine Canyons	14 (38%)	14 (38%)	14 (38%)
Kelp Forest	4.7 (20%)	4.7 (20%)	4.7 (20%)
Eelgrass	0.2 (30%)	0.2 (30%)	0.2 (30%)
Surfgrass	5.6 (24%)	5.6 (24%)	5.6 (24%)

Modify Table 3-7 to include No-Project Alternative.

Table 3-8: Amount Of Each Habitat Type In Marine Conservation Areas In Sanctuary Federal Waters (3-6 Nm) For Alternatives 1-3

Alternative	1	2	3
Phase	FMCAs	FMCAs	FMCAs
Size (nmi2)	1.7	1.7	5.2
Sandy Coast	0	0	0
Rocky Coast (Protected)	0	0	0
Rocky Coast (Exposed)	0	0	0
SOFT (0-30)	0	0	0
HARD (0-30)	0	0	0
SOFT (30-100)	2	2	2
HARD (30-100)	0	0	0
SOFT (100-200)	0	0	0
HARD (100-200)	0	0	0
SOFT (>200)	0	0	0
HARD (>200)	0	0	0
Emergent Rocks (Nearshore)	0	0	0
Emergent Rocks (Offshore)	0	0	0
Submarine Canyons	0	0	0
Kelp Forest	0	0	0
Eelgrass	0	0	0
Surfgrass	0	0	0

Table 3-9: Amount Of Each Habitat Type In State Marine Conservation Areas In Alternatives 1-3

Alternative		1	2	3
Phase	ME	SMCA	SMCA	SMCA
Size (nmi2)		6.9	6.9	6.9
Sandy Coast	-	0	0	0
Rocky Coast (Protected)	0.6	3.2	3.2	3.2
Rocky Coast (Exposed)	-	0	0	0
SOFT (0-30)	0.8	1.8	1.8	1.8
HARD (0-30)	0.4	0.7	0.7	0.7
SOFT (30-100)	3	5	5	5
HARD (30-100)	-	0	0	0
SOFT (100-200)	-	0	0	0
HARD (100-200)	-	0	0	0
SOFT (>200)	-	0	0	0
HARD (>200)	-	0	0	0
Emergent Rocks (Nearshore)	1	0	0	0
Emergent Rocks (Offshore)	-	1	1	1
Submarine Canyons	-	0	0	0
Kelp Forest	0.01	0.03	0.03	0.03
Eelgrass	-	0	0	0
Surfgrass	-	0	0	0

3.3. Fishermen Proposals

Local Santa Barbara and Ventura commercial fishermen submitted four marine protected area proposals to the Sanctuary in late January 2004. Their proposals were to be included in Appendix F. These proposals were also presented by the fishermen to the Fish and Game Commission in February, 2004 and to the Pacific Fishery Management Council in September, 2003. The Sanctuary, in concert with the National Marine Fisheries Service and State of California, needs to review these proposals further, prior to the release of a formal DEIS. The Sanctuary does not consider these proposals to be feasible alternatives at this time. Based on an initial assessment, the Sanctuary believes that these proposals have the following problems in their current form. First, and most importantly, each proposal calls for altering or eliminating existing State marine reserve and marine conservation areas, which is beyond the jurisdiction of the Sanctuary. Second, each proposal also suggests the establishment of marine protected areas well beyond the current Sanctuary boundary, (versus the minimal boundary changes proposed in Alternatives 2 and 3, which would "square off" the federal marine reserve areas), which is also significantly beyond Sanctuary jurisdiction. Third, detailed ecological and economic data for the extensive areas beyond the Sanctuary boundary with comparable spatial resolution to available data within the current Sanctuary boundary are unavailable, which would make a quantitative comparative analysis more difficult. Finally, the proposal appears to focus on maximizing benefits to groundfish stocks rather than on addressing the purposes and needs described in Chapter 1. This January, 2004 proposal is available upon request to the Sanctuary.

The Sanctuary has discussed these issues with these fishermen as well as other fishing interests in meetings of the Sanctuary Advisory Council's Recreational and Commercial Fishing Working Groups. These groups are now developing a new proposal for Sanctuary and PFMC consideration. It is the our expectation that this proposal will be available for analysis shortly after release of this preliminary working draft document.

4. Affected Environment

This chapter is largely based on the State of California's Final Environmental Document for Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary; specifically Volume 1 Chapter 4 Environmental Settings. This document is available at http://www.dfg.ca.gov/mrd/ci_ceqa/index.html

Interested readers may also request a copy from the California Department of Fish and Game, 1933 Cliff Dr. Suite 9, Santa Barbara, CA 93109. For further details please see the Final Environmental Document.

Any persons or agencies with current data or information to update this chapter are encouraged to contact Sanctuary staff.

4.1. Ecological Setting

The waters that swirl around the five islands within the Channel Islands National Marine Sanctuary combine warm and cool currents to create an exceptional breeding ground for many species of plants and animals. Forests of giant kelp are home to numerous populations of fish and invertebrates. Every year over 27 species of whales and dolphins visit or inhabit the sanctuary including the rare blue, humpback and sei whales. On the islands, seabird colonies and pinniped rookeries flourish while overhead brown pelicans and Western gulls search the water for food.

4.1.1. Bioregions

The confluence of the California Current and Southern California Countercurrent creates three distinct bioregions in and around the Sanctuary: 1) the cold Oregonian Province; 2) the warm California Province and 3) the transition zone between the two. These provinces often overlap within the Sanctuary, which results in a high diversity of marine life as cold water species at the southern end of their range co-exist with warm water species at the north end of their range. Waters north of Point Conception and offshore and south of the Channel Islands are cool and have marine life characteristic of northern and central California.

San Miguel Island lies in the cold waters of the Oregonian Province while Anacapa and Santa Barbara Islands are in the warmer Californian Province. The eastern sides of Santa Rosa and Santa Cruz islands are in the transition zone between the two provinces (Horn and Allen 1978). Point Conception is recognized as the transition zone between the Oregonian and Californian Provinces (Horn and Allen 1978; Murray and Bray 1993; Murray and Littler 1981).

4.1.2. Habitats

There are a wide variety of marine habitats in the Sanctuary. Some of the affected habitats are summarized below. Additional details can be found in the CEQA document.
(get rid of line)

4.1.2.1. Kelp Forest Habitat

Giant kelp, a keystone species, forms extensive underwater beds on rocky substrates (except *M. angustifolia* which occurs on sand) at shallow subtidal depths (9.9 to 99 feet) throughout the Sanctuary region. These impressive, underwater forests are conspicuous features of the Sanctuary and important not only ecologically, but also recreationally and commercially. Individual kelp fronds live only about 6 months (during which they may grow 99 feet or more in length), but new fronds are continually produced during the several year life span of the plant (Rosenthal et al. 1974).

Kelp beds in the Sanctuary are highly productive habitats that provide food, attachment sites, and shelter for a myriad of invertebrates and fishes. The dense thicket of kelp in the water column and at the surface is particularly important as a nursery habitat for juvenile fishes (Carr 1989). Locations supporting kelp generally have been consistent through time, but the extent of these beds has varied considerably based on environmental conditions such as water temperature and natural predation. Greater habitat heterogeneity at the Islands has resulted in increased kelp forest species diversity compared to mainland kelp beds (Murray and Bray 1993).

4.1.2.2. Surfgrass and Eelgrass Habitat

The two types of marine flowering plants found in the Sanctuary, surfgrass and eelgrass, form dense beds on different substrate and in different conditions. Surfgrass beds are highly productive and complex microhabitats that support a wide variety of marine species. Eelgrass beds are also known to be ecologically important for primary production, nutrient cycling, and substrate stabilization (Phillips 1984). Eelgrass provides habitat and food for a unique assemblage of plants, invertebrates, and fishes (den Hartog 1970; McConnaughey and McRoy 1979; Phillips 1984). The diversity of conspicuous plant, invertebrate, and fish species was nearly twice as high within eelgrass beds as on surrounding sand habitats (Engle et al. unpublished data).

The largest beds of eelgrass in the Sanctuary occur at Smugglers Cove, Canada del Agua, and Prisoners Harbor on Santa Cruz Island and at Bechers Bay on Santa Rosa Island. Moderate beds are found at Scorpion and Forney coves on Santa Cruz Island and at Johnsons Lee on Santa Rosa Island. A few small patches of eelgrass exist at Cathedral Cove and Cat Rock on Anacapa Island and at Yellowbanks Anchorage on Santa Cruz Island. The single patch at Cathedral Cove is the only known remnant of once widespread beds scattered along the north side of Anacapa Island.

4.1.2.3. Intertidal Zone Habitats

Intertidal zones are composed of a variety of coastal habitats that are periodically covered and uncovered by waves and tides. This transition zone between sea and land is the strip of shore ranging from the uppermost surfaces wetted during high tides to the lowermost areas exposed to air during low tides. Tidal heights within the Channel Islands can be as high as 9.9 feet during full or new moon periods. On surf-swept rocky cliffs, the wave splash can extend water upward of another 17 feet or more.

Intertidal habitat within the Sanctuary includes approximately 94.5 miles of rocky coastline interspersed with approximately 47 miles of sandy beaches (CDFG 2002). Rocky shores support a rich assortment of plants and animals, including numerous green, brown, and red algae, as well as beds of surfgrass. A wide variety of sedentary invertebrates including barnacles, limpets, and mussels compete for space with the plants in the intertidal zone. Mobile invertebrates, such as snails and crabs, often hide in crevices or under rocks, then emerge to graze on plants or prey on other animals. These intertidal organisms withstand varying degrees of wave shock, dramatic temperature changes, desiccation, and attacks from terrestrial predators.

Fishes in intertidal habitats are limited to tidepools or passing through the intertidal zone at high tide. Seabirds forage in the intertidal at low tide while some roost in aggregations on cliffs just above the shore. Seals and sea lions depend on many of the Sanctuary's intertidal shores for hauling out, especially at San Miguel and Santa Rosa Islands.

4.1.2.4. Nearshore Subtidal Habitat

Subtidal habitats include those marine habitats ranging from the lower limit of the intertidal zone down to 99 feet. Nearshore subtidal habitats include mud, sand, gravel, cobble, and bedrock substrates that are subject to dynamic physical processes, including wave exposure, coastal currents, upwelling, suspended sediments and variability in temperature, salinity and nutrients.

Nearshore subtidal rocky habitats at the Islands are widespread, especially high relief volcanic reefs with walls, ledges, caves, and pinnacles. Typical shallow subtidal areas in the Sanctuary contain assemblages of plants, invertebrates, and fishes, with giant kelp dominating. However, many shallow reefs grazed by sea urchins have less giant kelp and greatly reduced species diversity. Deeper reefs have well developed invertebrate cover, including sponges, sea anemones, sea fans, plume worms, bryozoans, and tunicates. Some low-relief nearshore habitats in high current areas are dominated by large numbers of brittle stars or sea cucumbers. Low-relief sedimentary reefs exist as well, particularly on Santa Rosa Island.

Many sandy nearshore habitats in the Sanctuary have relatively steep slopes composed of coarse, shelly debris. Stable sand habitats with fine grain sediments are generally limited to sheltered coves at canyon mouths, such as those found around Santa Cruz Island. A few of these locations have well-developed eelgrass meadows. Many other sandy habitats consist of patches of shelly sand between rock reefs, forming mosaics of hard and soft substrata.

4.1.2.5. Deep Water Benthic Habitat

Beyond nearshore subtidal depths are deep-water habitats extending from 99 to greater than 660 feet deep. Well over 90 percent of deep-water benthic habitats in the Sanctuary consist of fine sands in shallower portions, grading into silt and clay-dominated sediments in deeper portions (SAIC 1986; Thompson et al. 1993). These soft-bottom particulates are derived from terrestrial runoff and decaying plankton. Coarse sediments occur near Point Conception, and north of San Miguel Island (Blake and Lissner 1993). Fine sediments occur on the sill at the western end of the Santa Barbara Channel, and in the Santa Barbara Basin.

Deep rock bottoms often are located offshore from major headlands and islands, and on the highest parts of undersea ridges, banks, and pinnacles. High relief pinnacles and ridges occur in some areas, such as off the northwest end of San Miguel Island.

Because light disappears rapidly below 165 foot depths, offshore benthic habitats do not support marine plants. Invertebrates can, however, be found in these habitats and include sponges, anemones, cup corals, sea fans, bryozoans, feather stars, brittle stars, sea stars, and lamp shells. Demersal fishes are common, especially various species of rockfishes.

4.1.2.6. Water Column Habitats

Water column, or pelagic, habitats consist of discrete portions of ocean waters categorized by variation among multiple factors, such as light penetration, temperature, oxygen concentration, and density. Based on variation among these factors the water column is divided into numerous vertical and horizontal sub-habitats.

Major vertical zones within the water column begin at the ocean surface with the microlayer, a fine film of organic molecules. Next, the photic zone, from the surface to a depth of approximately 660 feet, is the portion of the water column in which there is sufficient light for photosynthesis. Within the photic zone there is an important temperature and density gradient called the pycnocline that separates warm, mixed surface water from cool, dense water below. The surface water may reach depths between approximately 130 to 330 feet or more. Below the photic zone lie the mesopelagic zone, from approximately 660 to 3,300 feet, and the bathypelagic zone, from approximately 3,300 to 11,500 feet. Water column habitats within the majority of the Sanctuary do not extend deeper than the mesopelagic zone, though the southern reaches of the Sanctuary boundary near the mouth of Santa Cruz Canyon (a submarine canyon between and offshore from southeastern Santa Rosa Island and southwestern Santa Cruz Island) approach bathypelagic depths. In general, horizontal variation in water column habitats occurs from the coast to the open ocean, within currents, at differing latitudes, and among gyres.3 (Thorne-Miller 1991).

Pelagic organisms are highly diverse and many have interesting and unique traits. Pelagic organisms that live in the water column are classified as either plankton (passive drifters that move with the water) or nekton (actively swimming organisms). Some of these organisms are found exclusively in the microlayer, while some occupy it only for a part of their life history (e.g., as eggs and larvae), and others are found in the microlayer and other water column zones. The photic zone represents the range limit of phytoplankton, microscopic marine plants that require light to synthesize their food. Many of the organisms that live in the mesopelagic and bathypelagic zones produce light biochemically for such purposes as attracting prey, or disorienting predators. In general, the mesopelagic zone has the greatest species diversity of pelagic fish. (Thorne-Miller 1991).

[3] Circular motions of water that occur in each of the major ocean basins and are centered on subtropical high-pressure regions. Gyres rotate clockwise in the northern hemisphere and counterclockwise in the southern hemisphere.

4.1.3. Plants and Animals

4.1.3.1. Plankton

Plankton, single celled marine plants (phytoplankton) and animals (zooplankton), form the base of the food web. Many species of plankton inhabit the Sanctuary and marine life is highly dependent on their growth and productivity. Their numbers, biomass, and production vary greatly both spatially and temporally. Plankton are typically classified into three size categories: very small picoplankton, medium size nanoplankton or microplankton (the most common size); and the large mesoplankton (Hardy 1993).

4.1.3.2. Marine Plants

Marine plants of the Sanctuary are made up of algae and seagrasses. Diversity of marine plants is greater in the Southern California Bight and the Channel Islands than along coastal central California. In the Southern California Bight, there are at least 492 species of algae and 4 species of seagrasses known to occur of the 673 species described for California (Abbott and Hollenberg 1976; Murray and Bray 1993).

The Channel Islands are transitional, with each island having its own ratio of southern to northern species of marine plants. Although conditions are dynamic, a general pattern emerges: Santa Barbara Island is inhabited by southern species, Anacapa Island and Santa Cruz Island are intermediate with both southern and northern components, while Santa Rosa Island and San Miguel Island are populated primarily with northern species (Murray and Littler 1981).

4.1.3.3. Invertebrates

Benthic invertebrates include species from nearly all phyla of invertebrates that live in (infauna) or on (epifauna) the sea floor during most of their lives, though most also have pelagic larvae. Benthic invertebrates may also be characterized as “sessile” (attached or sedentary) or “motile” (free-moving). They range in size from little known microscopic forms (micro-invertebrates) to the more common larger organisms (macro-invertebrates). Pelagic invertebrates (e.g., jellyfish and squid) also exist in the Sanctuary water column.

The Channel Islands support a wide variety of invertebrates due to its transitional location between cold and warm biogeographic provinces and its diversity of substrates. The substrates include sheltered and exposed coasts at depths from the intertidal to deep slopes, canyons and basins (Thompson et al. 1993). The total number of species may well be in excess of 5,000, not including microinvertebrates (Smith and Carlton 1975: Straughan and Klink 1980).

Select invertebrates in the Sanctuary include multiple species of corals, prawns, spiny lobster, crabs, sea urchins, sea cucumbers, sea star, abalone, nudibranchs, scallops, mussels, squid, clams, barnacles, snails, salps, tunicates, jellyfish, sea slugs, and anemones. White abalone is protected by the Endangered Species Act (ESA).

4.1.3.4. Fish

About 481 species of fish inhabit the Southern California Bight (Cross and Allen 1993). The great diversity of species in the area occurs for three principal reasons: 1) the ranges of many temperate and tropical species extend into and terminate in the Southern California Bight; 2) the area has complex bottom topography and a complex physical oceanographic regime that includes several water masses and a changeable marine climate (Cross and Allen 1993; Horn and Allen 1978); and 3) the islands and nearshore areas provide a diversity of habitats including soft bottom, rock reefs, extensive kelp beds, and estuaries, bays, and lagoons.

The fish species found around the Channel Islands generally are representative of fish assemblages that occur along the southern California coast, with the addition of some central California species (Hubbs 1974). Abundance of fish assemblages is greater at the northern Channel Islands than at nearby coastal regions of the southern California mainland. Regional upwelling carries nutrient-rich waters from canyons and island shelf areas to surface waters. This results in increased primary productivity and large zooplankton populations, which support exceptionally abundant populations of small schooling species, such as the northern anchovy, Pacific saury, sardine and mackerel. Larger pelagic (open water) fish prey upon these small schooling species, and together they form a significant contribution to the forage base of marine mammals and birds. Island-associated pelagic fish are commonly consumed by pinnipeds and tooth whales.

Fishes commonly found in the Sanctuary include: Albacore, anchovy (northern), barracuda (Pacific), bass (various species), bat ray, blacksmith, bocaccio, bonito (Pacific), brown smoothhound, butterfish (Pacific), California scorpionfish, cabezon, California sheephead, California moray, California flyingfish, California halibut, croaker, (various species), eel, monkeyface, garibaldi, goby (various species), greenling (various species), grunion, gunnel, hake, Pacific half moon, horn shark, jacksmelt, kelpfish (various species), mackerel (various species), northern ronquil, ocean sunfish, opah, opaleye, orangethroat pikeblenny, queenfish, reef perch, rock wrasse, rockfish (various species), ronquil, stripedfin, salmon (king), sanddab, sarcastic fringehead, sardine (Pacific), sargo, saury, Pacific sculpin, seaperch (various species), señorita, shark (various species) silversides, sole (various species), spotted cusk-eel, surfperch (various species), swordfish, thornback, topsmelt, tube snout, turbot (various species), white sea bass, whitespotted greenling, yellowfin fringehead, and zebra perch.

4.1.3.5. Sea Turtles

Four species of sea turtles have been reported in the offshore southern California region: green, loggerhead, olive Ridley, and leatherback (pers. comm. Cordaro 2003). Most information on sea turtle distribution in southern California is based on stranding data. This stranding data indicates that for the Channel Islands area all four species of sea turtle may be found within the Sanctuary at any time of year (pers. comm. Cordaro 2003). All sea turtles are protected by the ESA.

4.1.3.6. Seabirds

Over 195 species of birds use open water, shore, or island habitats in the Southern California Bight (Baird 1990). The Channel Islands region is located along the Pacific Flyway, a major migratory route for birds, and acts as a stopover during both north (April through May) and south (September through December) migrations. The months of June and July are peak months for transient shorebirds (Lehman 1994). The diversity of habitats provided both on- and offshore also contributes to the high species diversity in the region. Sandy beaches provide foraging and resting habitat for a number of shorebirds including Black-Bellied Plover, Willet, Whimbrel, Long-billed Curlew, gulls, and sanderlings. The upland potions of the beach provide kelp deposits that attract invertebrates where Black and Ruddy Turnstones, dowitchers, and other shorebird species forage. Several bird species within the Sanctuary region have special status (of concern, threatened or endangered) under Federal or State law. The Sanctuary provides important habitat for eight seabirds that have special status under federal or state law: Ashy storm-petrel, Black storm-petrel, California brown pelican, California least tern, Double-crested cormorant, Rhinoceros auklet, Western snowy plover, and Xantus' murrelet.

4.1.3.7. Marine Mammals

There are three marine mammals groups in the Sanctuary: 1) whales, dolphins and porpoises (cetaceans); 2) seals and sea lions (pinnipeds); and 3) the southern sea otter.

Cetaceans live their entire lives at sea, while pinnipeds come ashore periodically to rest, breed, bear young, or molt. Pinnepeds depend on several haulout and rookery sites throughout the Channel Islands. In California, sea otters normally spend their entire lives at sea, though some do haul out on land. All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA). Additionally, some marine mammals are protected under the Federal and State ESA. Species with special protected status are listed in Section 1.2.7.3 of the DEIS.

The abundance and distribution of marine mammals is an important indication of the general health and ecological integrity of the Sanctuary. Marine mammals feed on fishes and invertebrates, which feed on other marine life of the Channel Islands region. The distribution and abundance of marine mammals depend on healthy marine habitats, such as kelp forests and associated rocky reef ecosystems.

4.1.3.8. Whales Dolphins And Porpoises

At least 33 species of cetaceans have been reported in the Sanctuary region (Leatherwood et al. 1982; Leatherwood et al. 1987). Most of the reports involve live sightings although a few are known only from strandings. Common species found in the Sanctuary include: long-beaked common dolphin, short-beaked common dolphin, Bottlenose dolphin, Pacific white-sided dolphin, Northern right whale dolphin, Risso's dolphin, California gray whale, Blue whale, and Humpback whale. In winter and spring during the gray whale migrations, groups of up to 70 orcas have been reported in the region.

4.1.3.9. Seals and Sea Lions

The productive waters and relatively undisturbed environment of the Sanctuary provides vital habitat for pinnipeds, offering important feeding areas, breeding sites, and haul outs. Seven species of pinnipeds are found throughout or in part of the Sanctuary: the California sea lion (common), northern fur seal (uncommon), northern elephant seal (common), Pacific harbor seal (common), Guadalupe fur seal (extremely rare), Steller sea lions (rare), and ribbon seal (rare).

4.1.3.10. Sea Otters

Sea otters were common in the Channel Islands until prolonged periods of hunting led to local extinction at the Islands and severe depletion along the mainland California coast. In general, the California population has been slowly but steadily increasing since the discovery of a remnant colony off Bixby Creek in central California in 1937. The recovering California stock of sea otters now generally ranges from Point Conception north to Año Nuevo Island, in Santa Cruz County. From 1987 to 1990, the USFWS, which has primary jurisdiction over sea otters, translocated 139 otters to San Nicolas Island, though as of 2003 only 33 animals were reported. Following the translocation rare sightings of sea otters in the Sanctuary have been reported. Whether sea otters will become re-established within the Sanctuary remains uncertain. The southern sea otter is listed as threatened under the federal ESA.

4.2. The Human Setting

Humans have regarded the Channel Islands and its surrounding marine waters as a special place for thousands of years. Chumash Native American societies thrived for thousands of years in the Channel Islands region. Early maritime activities resulted in many ships running aground or sinking within the dangerous waters surrounding the Channel Islands, leaving us today with hundreds of historic shipwrecks, some discovered and many still lost. This rich maritime heritage of the Channel Islands region stands as a testament to the cultural importance and historic value of the Sanctuary.

In modern times, the unique nature of the Sanctuary region has attracted many commercial and recreational uses. The proximity of the northern Channel Islands and Santa Barbara Island to the mainland coast makes them uniquely accessible from Santa Barbara, Ventura, Port Hueneme, and Channel Islands Harbors as well as ports in Los Angeles County (primarily San Pedro and Terminal Island). Human use of the Sanctuary is not limited to regional residents; almost 20 percent of those who use California's coastal areas for recreation are interstate or international visitors (Resources Agency of California 1997).

Within the Sanctuary region, population growth has risen sharply over the last twenty years. The two counties adjacent to the Sanctuary, Santa Barbara and Ventura, have a combined population of over 1.1 million and the number of regional users in the Sanctuary is growing exponentially. Currently, there are more than 10 million people living in the greater Southern California Bight region. As the numbers of people increase, so do the number of Sanctuary users involved in a wide variety of activities (any references, such as Park visitation trend data, increase in shipping, increase in fishing?).

4.2.1. Recreational Activities

Recreational and tourist-related activities occur throughout the waters of the Sanctuary. Many activities are more heavily concentrated close to the islands and on the eastern half of the Sanctuary. Sportfishing, diving, whale watching, pleasure boating, kayaking, surfing, and sightseeing are all popular pastimes within the Sanctuary. In 1999, recreation and tourism businesses represented almost 480 thousand person-days of activity within the Sanctuary. (A person-day of activity is defined as one person participating in an activity for one day or any part thereof.)

4.2.1.1. Sportfishing and Consumptive Diving

Due to its relatively mild weather, the Channel Islands region is a leading year-round sportfishing (or recreational fishing) area along the West Coast. In 1999, sportfishing and consumptive diving activity in the Sanctuary generated approximately $24 million in income and supported 654 full and part-time jobs in Santa Barbara, Ventura and Los Angeles counties (Leeworthy and Wiley, 2003). Recreational (or sport) fishing is typically done with hook-and-line, nets and spearguns and may be conducted from shore, from vessels, or using SCUBA equipment (consumptive diving). Both sportfishing and consumptive diving (including SCUBA and free-diving) in the Sanctuary take place primarily from private and chartered commercial passenger fishing vessels (CPFVs).

Sportfisheries in the region access both nearshore and offshore areas, targeting bottom and mid-water fish species, primarily in the eastern half of the Sanctuary. Types of fish landed on CPFVs include kelp bass, mackerel, California sheephead, halfmoon, and whitefish. Species commonly targeted by consumptive divers, who travel from all over the world to dive in the Sanctuary, include many rockfish species and kelp bass, halibut, yellowtail and white seabass, as well as lobster and scallops. Offshore fishing focuses on mobile species like yellowtail, tuna, white seabass, barracuda, broadbill swordfish, marlin, and mako shark.

4.2.2. Commercial Activities

4.2.2.1. Fishing

The Sanctuary has extremely productive commercial fishing grounds. Commercial fishing gear used in the Sanctuary includes nets, traps, lines, and dive equipment (provide more specifics on current gear types used within boundaries). The majority of fish are caught in nearshore waters that contain giant kelp beds, an important habitat for numerous species. Key targeted species include: squid, sea urchin, spiny lobster, prawn[4], nearshore and offshore finfishes (e.g., rockfishes and California sheephead), coastal pelagic species (e.g., anchovy, sardine, and mackerel), flatfishes (e.g., California halibut, starry flounder, and sanddabs), rock crab, sea

[4] Prawn fisheries in the Sanctuary area include trawl and trap fishing for spot prawns and trawl fishing for ridgeback prawn. In 2002 the California Fish and Game Commission voted to close the spot prawn trawl fishery.

cucumber, tuna, and kelp. Live fish trapping for rockfish, California sheephead, California scorpionfish and other shallow water species occurs primarily near the coastlines of the Channel Islands. In addition, trap gear is used to take shrimp and prawns, California spiny lobster, and three types of rock crab (red, brown and yellow). Other fisheries include shark and swordfish drift netting (is this still happening today?), squid seining, urchin diving, and diving or trawling for sea cucumbers. Most of California's commercial dive sea cucumber catch is from the four northern Channel Islands (Leet et al. 2001). Abalone, once one of the most valuable fisheries in the Sanctuary (over $2.5 million harvested between 1988 and 1997 according to Leeworthy and Wiley 2003) and state, was closed to commercial harvest by the state legislature in 1997. There is a small but increasing fishery for turban snails and whelks, which is not currently regulated.

Of the Sanctuary's commercially caught species market squid, sea urchin, spiny lobster, and halibut are some of the most economically valuable, with urchin and squid exceeding the market value of all other species. Figure 2.2 shows the ex vessel value (revenue to the fishermen), adjusted for inflation and stated in year 2000 dollars, of all marine species caught in the Sanctuary between 1988 - 1999. The 1996 - 1999 average revenue from fish and invertebrates caught in the Sanctuary was ~~$20.3~~ $22.4 million (Leeworthy and Wiley 2003). In 2000, the ex vessel value of catch from the Sanctuary accounted for 15.55 percent of the ex vessel value of landings in all of California (down from 24.48% in 1999) (Leeworthy and Wiley 2003). Table 4-1 shows the ex vessel value of marine species, by group, caught in the Sanctuary and landed commercially during 1999.

4.2.2.2. Kelp Harvesting

Giant kelp harvesting occurs near Point Conception, San Miguel Island, Santa Rosa Island and near Point Mugu. Kelp is one of the Sanctuary's most valuable harvested species. In 1999, kelp harvested from the Sanctuary had a processed value of about $6 million (Leeworthy and Wiley, 2003). Presently ISP Alginates is the only company harvesting giant kelp in the Sanctuary (CDFG 2002), while several small-scale harvesters operate along the mainland coast (Ugoretz pers. comm.). With proper management the surface canopy of kelp forests can be harvested several times annually without damage to the kelp bed (Kimura and Foster 1977). However, because the kelp canopy serves as important habitat for juvenile fishes (Carr 1989) and many species of invertebrates (Watanabe 1984), harvesting kelp may have adverse effects on other inhabitants of the kelp forest community. For example, significant reductions in turban snail species were observed in harvested areas compared with unharvested areas in Carmel Bay (Hunt 1977).

Table 4-1. 1999 Ex-vessel value of commercial landings in the Sanctuary

Species Groups	1999 Value	Species Groups	1999 Value
Squid	$26,558,813	CA Sheephead	$153,147
Urchins	$5,963,876	Sculpin & Bass	$88,547
Prawn	$743,159	Roundfish	$37,318
Tuna	$53,694	Shrimp	$1,057
Spiny Lobster	$952,991	Yellowtail	$14,832
Flatfish	$324,685	Mussels, snails	$7,745
Rockfishes	$549,446	Rays & Skates	$2,283
Crab	$313,289	Salmon	$1,407
Wetfish	$608,865	Octopus	$169
Swordfish	$21,472	Surf Perch	$447
Sea Cucumbers	$267,842	Abalone	$47
Sharks	$41,638	Other	$23,728
		All species (excluding kelp)	$36,730,497

4.2.3. Research Activities

The Channel Islands are the subject of extensive scientific interest and thousands of academic and professional researchers have a myriad of Sanctuary-focused articles, academic papers, and other products. Most research falls under the following categories: physical and biological science research; socioeconomic, cultural, and historic research; and political science research. Within each of these categories research projects are typically:

- Intramural (projects are funded by the NMSP and conducted by Sanctuary staff);
- Extramural (projects are funded and conducted by outside agencies and institutions); or
- Directed (projects are conducted by outside agencies and institutions with guidance and/or support from the Sanctuary and the NMSP).

4.2.3.1. Physical and Biological Science Research

Research activities that pertain to the Sanctuary's physical and biological setting are the most extensive. In their report Summary of Research Programs in the Channel Islands National Marine Sanctuary, Abeles et al. (2003) provide a comprehensive assessment of major physical and biological science research activities in the Sanctuary to date, with a focus on studies that include a long-term monitoring component. As shown in Table 2 below, the report categorizes 42 research projects in the Sanctuary according to ecological levels of classification: population studies (marine plants, marine invertebrates, marine fish, marine birds, marine mammals), community studies, environment studies, and ecosystem studies.

4.2.3.2. Socioeconomic, Cultural, and Historic Research

Research activities that pertain to the Sanctuary's human setting include socioeconomic studies of industries and individuals linked to the Sanctuary, as well as studies of maritime heritage resources. Socioeconomic studies in the Sanctuary have not been as extensive as other research projects in the Sanctuary. However, since the California Department of Fish and Game and the Sanctuary began the Sanctuary marine reserves process, several socioeconomic studies have been undertaken and a major socioeconomic monitoring program is being developed and implemented. Maritime heritage resource research is focused on either studies of Native American artifacts, paleontological remains, or historic studies of shipwrecks, aircraft wrecks, and material associated with wharves, piers and landings. The Sanctuary, the NMSP, and major partners, such as the CINP, the Santa Barbara Maritime Museum, the State of California, Coastal Maritime Archaeology Resources (CMAR), and the Chumash Maritime Association, conduct the majority of research on Sanctuary maritime heritage resources.

4.2.3.3. Political Science Research

Political science research focuses on the Sanctuary's operational setting. Several political scientists studying topics such as collaborative stakeholder-based processes, or consensus-based processes, have cited the Sanctuary as a case study. Political science interest in the Sanctuary primarily stems from the Sanctuary's use of its Sanctuary Advisory Council and that Council's working groups. Political science research projects tend to be extramural.

4.2.4. Educational Activities

Educational activities have been a central focus of the Sanctuary since its 1980 designation. Today the Sanctuary plays an important role in public and formal marine science education activities for all ages from K-12, to adults. Sanctuary educational activities have reached a wide variety of audiences on a local, regional, national, and international scale. Sanctuary educational activities are focused in two strategic areas: 1) community involvement, partnerships and community program development, and 2) product development.

4.2.4.1. Community Involvement, Partnerships and Community Programs

Community involvement is an essential component of the Sanctuary's Education and Outreach program. Community involvement in Sanctuary educational activities is achieved in large part through the Channel Islands Naturalist Corps, a volunteer corps of naturalists trained to provide interpretation about the Sanctuary and Park on a variety of passenger vessels, such as whale watch and dive boats, as well as at outreach and special events. Community involvement in educational activities is also achieved through the Sanctuary Advisory Council and in particular its Sanctuary Education Team. This team is made up of community members who work to address Sanctuary education needs, and to keep local educational institutions informed about Sanctuary educational opportunities. Advisory Council members at large are charged with keeping their constituents educated about the Sanctuary. Community involvement in educational activities is also achieved through participation in Sanctuary events and programs.

Together the Sanctuary and its education partners develop and implement numerous interactive educational programs including training programs, workshops, special events, and school programs, many of which are already targeted to inform and educate the public about the existing state marine reserve network.

5. Environmental Consequences Of Alternatives

Note to Reviewer
Please note that this is not a complete impact analysis and is a work in progress. Your input on the methodology and analysis is critical to taking this analysis from a preliminary review to the draft environmental impact statement.

5.1. Ecological and Socioeconomic Effects

This chapter summarizes the ecological consequences and potential socioeconomic effects of the preliminary range of alternatives. Table 5-1 below summarizes the environmental effects associated with the preliminary alternatives. For additional detail, see Appendix E.

Based on the analyses conducted to date, the extension of the state marine reserves and marine conservation areas are not expected to result in any significant adverse ecological impacts. Conversely, alternatives 1-3 are expected to have beneficial effects on the local ecosystem, resulting from the establishment of protected areas in federal waters of the Sanctuary. It is possible that displacement of effort to areas outside the proposed marine reserves and marine conservation area could potentially impact the environment through congestion of fishing into smaller areas. This could cause increases in the relative fishing pressure on certain species, which may cause a short term negative environmental impact outside marine reserve and marine conservation areas. The alternatives attempt to limit this potential impact by avoiding key fishing areas identified in the Channel Islands Reserve Process to the extent possible. Potential displacement of effort also may be offset by the potential for long term beneficial effects caused by increased production and spillover from the proposed marine reserve and marine conservation areas. In addition, existing harvest controls (e.g., size limits, bag limits, seasons) will continue to control take outside marine reserve and marine conservation areas, and other regulatory processes limiting total effort of fisheries in the area are underway.

Potential socioeconomic impacts of the alternatives would primarily involve the removal of areas of Sanctuary waters from extractive (consumptive) uses involving commercial and recreational fishing and consumptive diving (e.g., spearfishing). The estimated maximum potential impact on consumptive activities resulting from additional protection in state and federal waters ranges from $2,349,148 (2.2% of baseline level) for Alternative 1 to $3,252,903 for Alternative 3 (Table E-4). This impact is much less than the $12,565,222 estimated potential impact from the existing state marine reserves and marine conservation area (Table E-4). These maximum potential losses may be mitigated over time, since improvement in environmental health and local populations may ultimately enhance consumptive uses in the Channel Islands area over the long-term.

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 marine reserve and marine conservation areas. 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.

As described in Chapter 3, alternatives 1-3 differ in size, connectivity, biogeographic representation, habitat representation, vulnerable habitats, species of interest, and ease of monitoring and enforcement. These differences are summarized in Table 5-1, below, and a few of these factors are discussed further in the following text.

5.1.1. Network 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 ecologically interconnected marine reserves, 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 marine reserves in Alternatives 2 and 3. The probability that larvae and adults would disperse to adjacent marine reserves is relatively high because the total area covered by marine reserves is relatively large, and marine reserves are located in the predominant current across the north sides of Santa Rosa, Santa Cruz, and Anacapa Islands. Larvae and adults may disperse between marine reserves because distances between marine reserves are relatively small and individual marine reserves are relatively large.

5.1.2. Protection From Human Threats and Natural Catastrophes

It is unlikely that all of the marine reserve and marine conservation areas proposed in any of the NEPA alternatives would be impacted simultaneously by catastrophic events, such as oil spills or large storms, because marine reserve and marine conservation areas are widely distributed across the Sanctuary. The alternatives include proposals for multiple marine reserves on the north and south sides of each island in the Sanctuary, building on the State network. 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 areas. The design of the alternatives did not explicitly incorporate an “insurance factor”, a multiplier required to account for the effects of catastrophic events, recommended by Allison et al. (2003). Complementary management strategies strive to prevent and respond to other threats from spills or other human catastrophes. However, the distribution of multiple protected areas in a network around the islands is designed to limit the likelihood of a single impact affecting all areas at once.

Table 5-1: Summary of Direct Ecological and Socioeconomic Effects of Each Alternative

	ALTERNATIVES			
ECOLOGICAL CRITERIA	No Action	1	2	3
Biogeographic Representation[1]		Oregon Transition Calif.	Oregon Transition Calif.	Oregon Transition Calif.
Habitat representation (Area: nmi2) Note: need to Add Pelagic and Mid water habitat	0	Soft Sediment (174.5) Hard Sediment (0.6) Pelagic (77) Submarine Canyon (3) Pinnacles	Soft Sediment (123.7) Hard Sediment (4.3) Pelagic (136.2) Submarine Canyon(3) Pinnacles	Soft Sediment (174.5) Hard Sediment (4.3) Pelagic (169.7) Submarine Canyon (3) Pinnacles
Vulnerable habitats / EFH ?	Nearshore only	Nearshore only	Nearshore only	Nearshore only
Species of Interest[2]	-	Marine Mammals Seabirds Endangered Species Rockfish overfished Sharks	Marine Mammals Seabirds Endangered Species Rockfish overfished Sharks	Marine Mammals Seabirds Endangered Species Rockfish overfished Sharks
3. Network Size (nmi2) [3]	0	77.0	136.2	169.7
Connectivity- need to add data in this row	Calculate Avg. Min Distance	Calculate Avg. Min Distance	Calculate Avg. Min Distance	Calculate Avg. Min Distance
Scientific Use	Ø to negative	+	+	+
Education Value	Ø to negative	+	+	+
Maximum potential economic impacts on aggregate consumptive uses from new protected area in state and federal waters (Table E-4)	$0 or 0% of baseline	$2,349,148 or 2.2% of baseline	$2,423,747 or 2.3% of baseline	$3,252,903 or 3.0% of baseline

<u>Key</u>

+ (Positive Effect)
Ø (No Effect)
[1] Chapter 4 delineates and describes the biogeographic regions within Sanctuary waters
[2] Species of interest include: (a) species of special concern (b) species with critical life-history stages (c) targeted species and (d) bycatch species
[3] Marine reserve and conservation area in additional state and federal waters of the Sanctuary

6. Appendix A: Federal Environmental Process

6.1. Implementing The Proposed Action

Under the NMSA, regulation of fishing is allowed only if that Sanctuary's designation document allows regulation of fishing. Since the Channel Islands' 1980 original designation document does not authorize the regulation of fishing, a change to the Sanctuary's designation document would be required for the Sanctuary to establish marine reserve zones under the NMSA. Any change to the designation document would be done in compliance with the National Environmental Policy Act and procedural requirements of the NMSA.

While the Council could recommend the creation of marine protected areas under its Magnuson-Stevens Act authority, it has limited ability to protect fish and habitat in the designated area from anything other than fishing impacts. For example, the Council does not control dredging, dumping, or other potentially damaging activities. Further, the Council does not have jurisdiction over other resources such as cultural and historical resources. Also, the Council is essentially limited to addressing fisheries for which there is an established Fish Management Plan (FMP). Therefore, for example, species not listed in an FMP could still be potentially extracted in a Magnuson-Stevens Act "equivalent" to a no-take marine reserve. On the other hand, extensive closures such as the rockfish and cowcod closures may dramatically limit fishing activity in an area, and therefore have the potential to provide at least some of the benefits that would be provided by a complete marine reserve.

Any recommendations made by the Council to be implemented under the NMSA must fulfill the purposes and policies of the NMSA and the goals and objectives of the particular Sanctuary.

Section 304(a)(5) of the NMSA states:

6.1.1. Fishing Regulations

> The Secretary shall provide the appropriate Regional Fishery Management Council with the opportunity to prepare draft regulations for fishing within the Exclusive Economic Zone as the Council may deem necessary to implement the proposed designation. Draft regulations prepared by the Council, or a Council determination that regulations are not necessary pursuant to this paragraph, shall be accepted and issued as proposed regulations by the Secretary unless the Secretary finds that the Council's action fails to fulfill the purposes and policies of this chapter and the goals and objectives of the proposed designation. In preparing the draft regulations, a Regional Fishery Management Council shall use as guidance the national standards of section 301(a) of the Magnuson-Stevens Act (16 U.S.C. 1851) to the extent that the standards are consistent and compatible with the goals and objectives of the proposed designation. The Secretary shall prepare the fishing regulations, if the Council declines to make a determination with respect to the need for regulations, makes a determination which is rejected by the Secretary, or fails to prepare the draft regulations in a timely manner. Any amendments to the fishing regulations shall be drafted, approved, and issued in the same manner as the original regulations. The Secretary shall also cooperate with other appropriate fishery

management authorities with rights or responsibilities within a proposed sanctuary at the earliest practicable stage in drafting any sanctuary fishing regulations.

Concurrent with the environmental review process the Sanctuary will consult with other agencies on potential changes to the terms of designation. For changes in the terms of designation to take effect in State waters the Governor of California will be afforded the opportunity to indicate if that is unacceptable.

6.1.2. Cooperating Agencies

CEQ defines the rights and responsibilities of cooperating agencies in section 1501.6 of the CEQ regulations. Upon the request of the lead agency, any other federal agency that has jurisdiction by law or that has special expertise with respect to any environmental issue shall be a cooperating agency. No federal agencies were formally requested to be cooperating agencies, nor have any federal or state agencies requested this status. Nonetheless, the NMSP has been and will continue to work closely with its resource management partners.

For this environmental review process, the Sanctuary is responsible for producing the environmental impact statement, proposed regulations, and any proposed modifications to the Sanctuary's designation document, complying fully with the National Environmental Policy Act (NEPA), the National Marine Sanctuaries Act (NMSA), the Administrative Procedure Act, and all other applicable legal requirements.

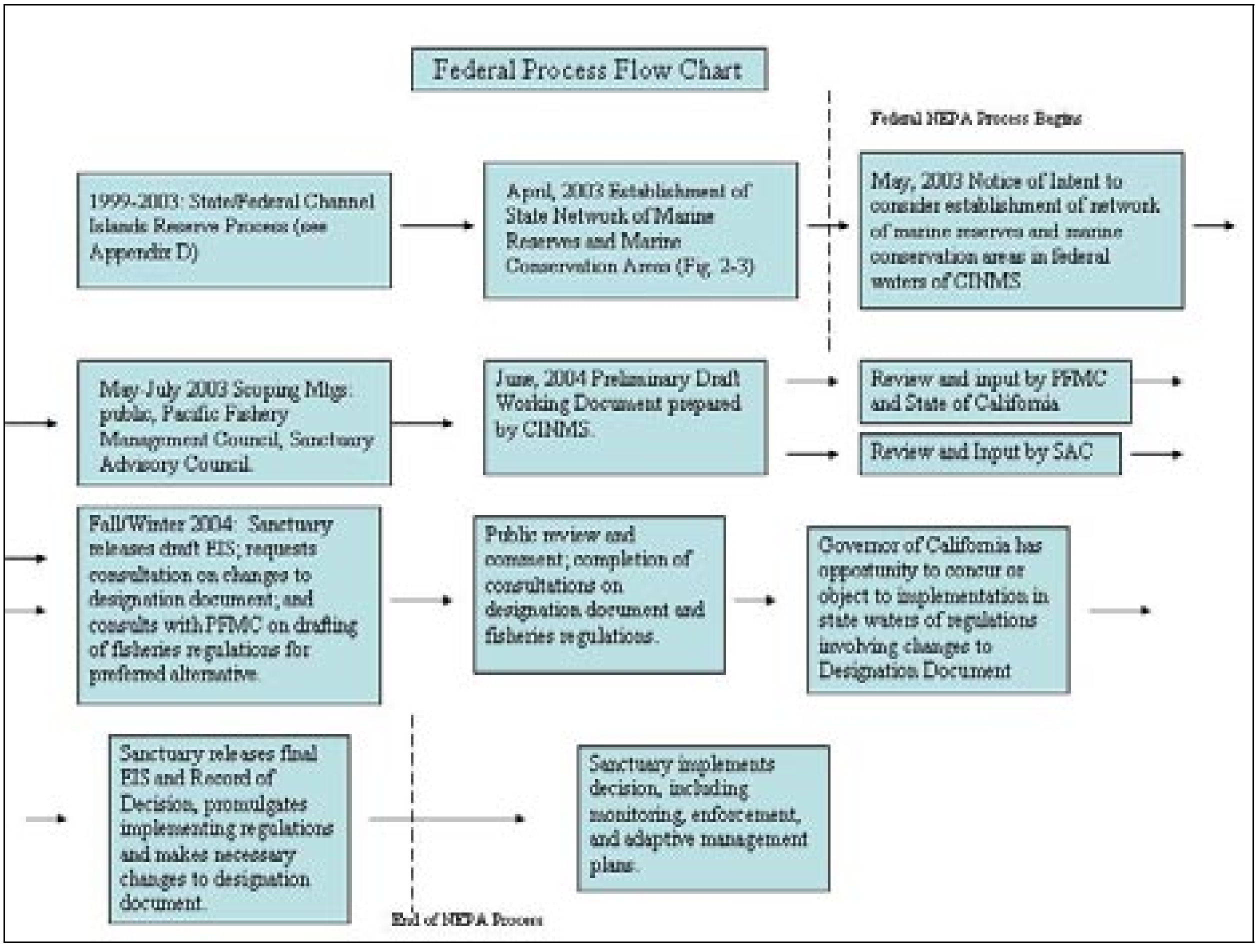
There are a number of State and Federal agencies and councils or commissions that have jurisdiction and regulatory responsibility over California coastal marine and ocean resources in the Sanctuary. The environmental review process requires close coordination and cooperation with all entities that have overlapping management jurisdiction in the Sanctuary. The NMSP has sought the input of several state and federal officials and agencies in preparing this preliminary environmental document and will continue to seek input throughout the process. Key entities include the California Department of Fish and Game, the California Fish and Game Commission, the National Marine Fisheries Service, the Pacific Fishery Management Council, and the Channel Islands National Park.

The partnership established between the State of California and Sanctuary during the Channel Islands Marine Reserves Process bodes well for the continued coordination in this federal environmental review process. As stated in the purposes for action and in the Notice of Intent (NOI) the Sanctuary intends to complement the State of California's April 2003 establishment of State marine reserve and marine conservation areas in the Sanctuary. Additionally, the Sanctuary and California Department of Fish and Game continue to work cooperatively on the implementation, education and outreach, monitoring and enforcement of the State marine reserve and marine conservation areas.

The National Marine Fisheries Service (NMFS) policy and science branches participated during the Channel Islands Marine Reserves Process. NMFS expertise and assistance in coordinating with the PFMC will be essential to moving forward with this environmental review.

The Sanctuary and Pacific Fishery Management Council (PFMC) have agreed to work closely in a spirit of partnership during this environmental review process, including consulting and cooperating fully with each other in matters regarding the conservation and management of natural resources of mutual concern and geographic authority. Further, as reviewed above, the PFMC will be provided the opportunity to prepare draft Sanctuary fishing regulations for the Exclusive Economic Zone portion of the Sanctuary for any proposal that requires NMSA fishing regulations in order to be implemented. Finally, any change to a term of designation would not apply to State waters if the Governor objects during the requisite review period.

Figure A-1: Federal Process Flow Chart



Do Not Cite or Quote: this preliminary working draft is for review purposes only and does not represent the views or policies of NOAA or the Department of Commerce.

7. Appendix B: Scoping Process

7.1. Public Scoping Summary

The Council on Environmental Quality (CEQ) requires Federal agencies to conduct scoping prior to preparing an Environmental Impact Statement (EIS) for a proposed action. According to CEQ regulations (40 Code of Federal Regulations Section 1501.7), "there shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. This process shall be termed scoping."

On May 22, 2003 the National Marine Sanctuary Program published a Notice of Intent (NOI) in the Federal Register announcing its intent to consider the establishment of a network of marine reserves within the Channel Islands National Marine Sanctuary and to prepare an environmental impact statement to examine a range of management and regulatory alternatives associated with consideration of marine reserves within the Sanctuary. The NOI described the joint Federal and State partnership between the Sanctuary and California Department of Fish and Game established in 1999 to consider marine reserves within the Sanctuary and the extensive community based Channel Islands Marine Reserves Process from 1999-2001. The NOI noted that the NEPA process will build upon the Channel Islands Marine Reserves Process, including the information and analyses contained in the State's CEQA environmental documents that ultimately led to the California Fish and Game Commission's October 2002 decision to establishment marine protected areas in state waters of the Sanctuary.

The NMSP conducted three public scoping meetings during the scoping period from May 22 – July 23, 2003 to gather information and other comments from individuals, organizations, and government agencies on the scope, types and significance of issues related to consideration of marine reserves in the Sanctuary. In addition to the formally announced public scoping period, the Sanctuary Advisory Council, which is a community-based federal advisory body to the Sanctuary, allows for public participation and public comment on proposed Sanctuary actions during Sanctuary Advisory Council and Sanctuary Advisory Council working group meetings. The dates and locations of the formal and informal public scoping meetings are listed below.

Table B-1: Public Scoping Meetings

Date	Location	In attendance	Estimated Attendance
June 5, 2003	Pt. Hueneme, CA	General public	30
June 12, 2003	Santa Barbara, CA	General public	60
June 16-20, 2003	Foster City, CA	Pacific Fishery Management Council, PFMC Habitat Advisory Panel, PFMC California Delegation, PFMC Science and Statistical Committee, PFMC Enforcement Advisory Group, PFMC Groundfish Advisory Panel	100 +
June 26, 2003	Santa Barbara, CA	Sanctuary Advisory Council - Conservation Working Group	15
July 15, 2003	Carpinteria, CA	Sanctuary Advisory Council - Business Working Group	12
July 18, 2003	Ventura, CA	Sanctuary Advisory Council	50

To date the Sanctuary has received over 50 written comments and input from over 200 people. In addition, though not part of this formal federal scoping process, the California Department of Fish and Game, California Fish and Game Commission, Pacific Fishery Management Council and advisory bodies, Sanctuary and the Sanctuary Advisory Council and its working groups have hosted over 125 public meetings as part of the Channel Islands Marine Reserves Process from 1998 through 2003. Over the six years of deliberation the Sanctuary and State have received tens of thousands of comments. A complete history of the Channel Islands Marine Reserves Process including the public meetings is summarized in Chapter 2 and detailed in Appendix D.

Major constituencies represented at the federal scoping included:

- Sanctuary Advisory Council members, alternates and working group members
- Pacific Fishery Management Council members and advisory body members
- Recreational fishing organizations and individuals
- Commercial Fishing organizations and individuals
- Environmental organizations and individuals
- Congresswoman Capps' office
- State and Federal agencies
- General public

7.1.1. Range of Public Scoping Comments

The Sanctuary received a broad range of scoping comments. The comments are summarized below. The Sanctuary has attempted to address all of these comments in the relevant sections of this environmental document. We welcome comments on whether the scoping comments have been adequately addressed by this preliminary working draft.

7.1.2. Comments Regarding the Relationship of this Federal EIS Process to Other Processes

- What is the Pacific Fishery Management Council's role in this process?
- If the sanctuary designation document is revised to regulate fishing, Article 5, section 1 of the current designation document will need to be amended.
- Utilize the Marine Reserves Working Group work and address areas of consensus and non-consensus. Build on the existing State environmental process documents and information.
- Keep the marine reserves and Sanctuary management plan revision NEPA processes separate. Time is of the essence. Given four years of community process it is critical to move forward.
- The Sanctuary needs to clarify the processes required to revise the Sanctuary Management Plan, amend the Designation Document and consider marine reserves under the National Marine Sanctuaries Act

7.1.3. Comments Regarding Project Purpose and Need, or Design of Project Alternatives

- Consider values to general public and existence values
- Follow mandate of the National Marine Sanctuaries Act
- Consider findings in the Pew Ocean Report
- State goals for recreational fishing in the Sanctuary, now and in the future
- Support an ecosystem perspective
- Support species by species management
- Concern that the process pits biodiversity against game management
- Support for conservation and habitat protection
- Consider birds and marine mammals
- Reserves provide heritage and intrinsic values
- Support experimental and adaptive approach
- Support IUCN Category 4 criteria for sustainable use
- Public education and outreach is essential on marine reserve and marine conservation areas in general and the existing Channel Islands marine reserve and marine conservation areas
- Support a science-based approach
- Apply the precautionary principle
- Note overwhelming public support for marine reserves
- Adjoin federal reserves with existing state reserves
- Include a "trigger" to resume fishing when marine reserve and marine conservation areas have proven their effectiveness

- Expand marine reserve areas to complete a scientifically-based network to include the variety of habitats, depth ranges and species with connectivity between reserves
- Federal reserves are important to protect pelagic species and deep water species
- Apply the science advisory panel's original size recommendation to set-aside 30-50% of each habitat type in the sanctuary
- Consider large, contiguous reserve areas
- Maximize connectivity between individual reserves, i.e., the network approach
- Include as an alternative the marine reserve network developed jointly by the California DFG and the Sanctuary that the State implemented in state waters of the Sanctuary.

7.1.4. Comments Regarding Other Management Approaches

- Consider broad range of alternatives and management tools, not just reserves i.e. try marine parks to test impacts of recreational fishing
- Consider existing management options
- Do not address Sanctuary boundary expansion
- Allow pelagic species to be harvested recreationally from zoned areas

7.1.5. Comments Regarding Affected Environment

- Consider 1/3 of assessed stocks are overfished
- Concern with trash and debris at islands
- Concern with human use impacts on islands
- Factor in El Niño and other natural perturbations
- Consider impacts of pollution, oil slicks, sewage, nuclear and toxic wastes

7.1.6. Comments Regarding Impact Analysis

- Consider both short and long term benefits and impacts
- Analyze positive and negative impacts to consumptive and non-consumptive users
- Consider impacts on areas outside of reserves
- Consider impact to local economy
- There has been inadequate social planning for negative effects
- Job losses need to be considered
- Economic benefits of reserves should be calculated (e.g., non-consumptive uses)
- Show socioeconomic impacts to fishermen and fishing-related businesses
- Fund socioeconomic monitoring to understand fishery impacts
- Consider impacts of current regulations
- Consider long-term benefits to fisheries
- Consider federal funding of commercial buy-back programs
- Reserve size will determine the scale and timing of effects, i.e., small reserves will have a smaller effect and take longer to yield benefits versus larger reserves
- Assess Costs and benefits of phasing reserve establishment to the resources and economy over time.

- Discuss effects of the groundfish closures
- Consider existing recreational fishing impacts on resources
- Consider impacts to public access of state and federal waters
- Analyze bycatch in conservation areas or bycatch from non-rod/reel gear
- Establish socioeconomic impact thresholds of significance
- Provide analysis of yield from fisheries

7.1.7. Comments Regarding Monitoring, Evaluation and Enforcement of Marine Protected Areas

Use data from existing marine reserves.

- Evaluate if existing management is adequate and demonstrate administrative and monitoring capabilities before considering expansion of reserves.
- Funding is needed for socioeconomic monitoring to understand fishery impacts.
- Ensure management actions are enforceable and provide for adequate enforcement
- Detail explicit management plan with methods and transparent data analyses
- Mark marine reserve and marine conservation areas boundaries for those without Global Positioning Systems (GPS)

8. Appendix C: Status of Human Uses

Note to Reviewer: Much of this information is drawn from the State of California's Environmental Document for establishment of the state MPAs at the Channel Islands. We are interested in any data or information that would help us in updating this appendix.

8.1. Commercial Fishing

8.1.1. Aquaculture

Aquaculture is the practice of culturing, growing, and harvesting an aquatic species in a controlled setting. California has approximately 400 registered aquaculturists who raise products within intensive systems (enclosed, or on land; Resources Agency of California 1997). Currently Ecomar is using several of the OCS oil and gas structures near the Sanctuary to raise aquacultural products, such as mussels and other invertebrates. The bulk of the statewide mussel production (85 percent) comes from offshore oil production platforms. No other approved aquaculture activities currently occur near the Sanctuary. However, there is a proposal to develop a multi-species aquaculture operation on Platform Grace, approximately 3 miles from the Sanctuary boundary near the east end of Santa Cruz Island.

8.1.2. Commercial Harvest

Commercial fishing (by nets, traps, and lines, diving, and other methods) occurs at various locations off the coast of Southern California, including portions of the Channel Islands, an extremely productive commercial fishing area. The nearshore waters along the coast from Ventura to Santa Barbara and the waters just off the Channel Islands contain giant kelp beds that provide habitats for numerous species. The majority of fish are caught within these areas. Fishery seasons in state waters are established and regulated by the Commission and regulated by the Department of Fish and Game.

The commercial harvest of kelp and other marine vegetation near the coastline is an established industry in Southern California. Live fish trapping (e.g., rockfish, sheephead, and other nearshore species) occurs primarily in the shallower waters near the coastlines of the Channel Islands. Hook and line fisheries catch a variety of species on hand lines, longlines, rod-and-reel, and trolled gear. The main species caught in the hook and line fishery are rockfish species (Sebastes spp.). Lobsters are fished in coastal waters since they are typically most abundant in rocky areas with kelp in depths of 100 feet (30 meters) or less. The waters off the majority of the Channel Islands are conducive to this habitat since they generally have an offshore shelf that extends gradually into deeper waters. Gillnets are not allowed within 3 nautical miles of the mainland coast, or within 1 nautical mile of the offshore islands in the project area. Commercial drift gillnetting for pelagic shark and swordfish and white seabass occurs in the open waters throughout portions of the Channel Islands. This fishery, however, is only a small portion of the total industry in Southern California. The following section describes commercial fishing use of the project area.

8.1.2.1. Giant Kelp

Giant kelp was first harvested along the California coast during the early 1900s (Leet et al. 2001). Many harvesting companies operated from San Diego to Santa Barbara beginning in 1911. Those companies primarily extracted potash and acetone from kelp for use in manufacturing explosives during World War I. In the early 1920s, having lost the war demand, kelp harvesting virtually stopped. In the late 1920s, giant kelp was again harvested off California.

Giant kelp is now primarily harvested in California for extraction of alginates and other compounds and to supply food to several aquaculture companies for rearing abalones. It is also used for the herring-roe-on-kelp fishery in San Francisco Bay (Leet et al. 2001). Giant kelp is now one of California's most valuable living marine resources and in the mid-1980s supported an industry valued at more than $40 million a year. The annual harvest has varied from a high of 395,000 tons in 1918 to a low of less than 1,000 tons in the late 1920s. Such fluctuations are primarily due to climate and natural growth cycles, as well as market supply and demand. During the 10-year period 1970 to 1979, the harvest averaged nearly 157,000 tons, while from 1980 to 1989 the average harvest was only 80,400 tons. The harvest was low in the 1980s because the kelp forests were devastated by the 1982-1984 El Niño and accompanying storms, and by the 200-year storm that occurred in January 1988. In most areas the beds of giant kelp recovered quickly with the return of cooler, nutrient rich waters. Harvests in California increased to more than 130,000 tons in 1989 and to more than 150,000 tons in 1990.

In the project area, ISP Alginates is the only company harvesting giant kelp. During the 1990s, increasing international competition from Japan for the "low end," or less purified end of the sodium alginate market caused ISP Alginates to reduce harvests by about 50 percent (Leet et al. 2001). ISP Alginates anticipates California's harvest in this decade will be approximately 80,000 tons annually. The ISP Alginates Company uses specially designed vessels that have a cutting mechanism on the stern and a system to convey the kelp into the harvester bin. A propeller on the bow slowly pushes the harvester stern-first through the kelp bed, and the reciprocating blades mounted at the base of the conveyor are lowered to a depth of three feet into the kelp as harvesting begins. The cut kelp is gathered on the conveyor and deposited in the bin. These vessels can each collect up to 600 tons of kelp per day. Although the surface canopy can be harvested several times each year without damage to the kelp bed, State regulations require that kelp may be cut no deeper than four feet beneath the surface. To facilitate its harvesting operations, the company conducts regular aerial surveys. The survey information is used to direct harvesting vessels to mature areas of kelp canopy with sufficient density for harvesting.

8.1.2.2. Sea Urchin

One of the most important fisheries in California is the red sea urchin (*Strongylocentrus franciscanus*). The majority of sea urchin landings in southern California have come from the northern Channel Islands off of Santa Barbara, where large and accessible stocks once occurred (Leet et al. 2001). Red sea urchins are harvested by divers who generally use surface-supplied air delivered through a hose (hooka gear) instead of self contained underwater breathing

apparatus (SCUBA). Hooka gear consists of a low–pressure air compressor that feeds air through a hose to the diver's regulator. The hose is fed out from a reel so the diver has more maneuverability underwater. The urchins are gathered with a rake or hook and placed into large mesh bags which when full are lifted to the surface. Occasionally the bags, hoseline, and even the diver have to be freed from entangling kelp by cutting or breaking away kelp stipes.
The gonads of both male and female urchin are the object of the fishery and are referred to as "roe" or "uni" in Japanese. Gonad quality depends on size, color, texture, and firmness. Algal food supply and the stage of gonadal development affect quality and price. The highest prices are garnered during the Japanese holidays around the New Year. Sea urchins are collected by divers operating in nearshore waters. Divers check gonad quality and are size-selective while fishing to ensure marketability. In the last few years the red urchin fishery has become fully exploited throughout its range in northern and southern California. The purple sea urchin (*S. purpuratus*), which occurs over the same geographical range, is harvested in California, but only on a limited basis.

The Southern California red sea urchin fishery is relatively new, having developed over the last 30 years, and caters mainly to the Japanese export market (Leet et al. 2001). It began in 1971 as part of a National Marine Fisheries Service program to develop fisheries for underutilized marine species (Leet et al. 2001). The fishery was also seen as a way to curb sea urchins' destructive grazing on giant kelp. Southern California urchin typically garner higher prices than Northern California urchin due to the longer market presence and consistently higher gonad quality.

There have been two periods of rapid urchin fishery expansion in California. The first culminated in 1981 when landings peaked at 25 million pounds in southern California. Contributing to this rapid escalation of the fishery was a pool of fishermen and boats involved in the declining commercial abalone dive fishery. Sea urchin landings then decreased following the El Niño of 1982-1983, when warm water weakened or killed kelp, the primary food source for sea urchins. Catches did not recover until 1985-1986, helped in part by the strengthening of the Japanese yen relative to the U.S. dollar. Urchin landings gradually increased to levels exceeding the 1981 peak and subsequently declined again during the El Niño events of 1992-1993 and 1997-1998. The latest decline was about twice the magnitude of that seen in 1982-1984, and to date the subsequent recovery in landings (and catch per unit effort or CPUE) has been far less dramatic (P. Kalvass, unpublished CDFG data).

Data on red sea urchin abundance collected by the National Park Service suggest that fishing has contributed to a general decline in the abundance of large individuals. Since 1985, abundances of harvestable size red urchins have declined by 1% per year at fished sites on Santa Rosa and San Miguel islands, (the sites contributing most to the catch), relative to non-fished reserve sites on Anacapa Island (S. Schroeter & D. Reed, unpublished analysis of NPS kelp forest monitoring data). Similar declines were not observed in the abundance of young-of-year recruits (urchins < 1" or 2.5 cm).

On the other hand, with the decline of large predators on sea urchin (including large California spiny lobster, California sheephead, and Southern sea otter), the urchin population has persisted at levels much higher than historical population sizes. High population density can contribute to the spread of disease. One study documented the spread of disease through dense urchin populations in the Channel Islands. During the study (1992-1998), urchin abundance increased over time as invertebrate predators (spiny lobsters) decreased under fishing pressure (Lafferty and Kushner 2000). Bacterial disease spread through populations with high densities of urchins. Sites with lower predator abundance had higher urchin abundance and higher incidences of the disease. An exception was the marine protected area at Anacapa Island, where urchin density was lower, due to higher predation by more abundant and larger lobsters, and the disease was nearly absent (Lafferty and Kushner 2000).

8.1.2.3. Abalone

In the 1950s and 1960s, abalone (*Haliotis spp.*) supported thriving commercial and recreational fisheries in the Channel Islands. Commercial fisheries for pink abalone and green abalone (*H. corrugata and H. fulgens*) peaked between 1950-1960, and 1971, respectively. In the early 1950s, pink abalone comprised the largest segment (about 75 percent) of the abalone fishery and was a significant component of the total abalone landings (CA DFG 2002). Pink abalone declined over 80 percent by 1999. Green abalone was common along the far southern mainland coast and at the southern Channel Islands, and occurred at the northern Channel Islands, but is now rarely encountered. Populations of green abalone appear to be extremely low (CA DFG 2002). The commercial fishery for black abalone (*H. cracherodii*) peaked in the 1970s and reached a second, lower peak in the mid 1980s. Prior to 1992, the commercial fishery for black abalone was second in pounds landed to red abalone. However, black abalone suffered significant stock declines, coincident with the spread of withering foot syndrome and continued fishing. The fishery for black abalone was closed in 1992 (Karpov et al. 2000). The commercial fishery for white abalone (*H. sorenseni*) collapsed by 1980, after heavy fishing (Tegner et al. 1996). There is no association of white abalone declines with withering foot syndrome (P. Haaker, personal communication). The white abalone fishery has been closed since 1993 but white abalone densities have continued to fall (Carlton et al. 1999; Davis et al. 1998). In 1997, white abalone was listed under the federal Endangered Species Act and a similar listing is being considered for black abalone. Red abalone (*H. rufescens*) was previously an important fishery in California, with landings peaking in 1967 and steadily declining thereafter (Leet et al. 1992). In central and southern California, red abalone had declined the least of all five species by the time the fishery was closed in 1997 (Leet et al. 2001). Red abalone is the only abalone species that remains locally common in some areas on San Miguel Island. In 1997, the area from San Francisco Bay to the California-Mexican border was closed to commercial and recreational harvest of abalone. The Department of Fish and Game determined that these species had suffered stock collapse due to overfishing. Currently, no commercial harvest of abalone is allowed in California.

8.1.2.4. Spiny Lobster

The commercial fishery for California spiny lobster (*Panulirus interruptus*), which started in the late 1800s, is one of the highest value fisheries in the Channel Islands region. Commercial fishermen use box-like traps constructed of heavy wire mesh to capture spiny lobsters. Traps of other materials, such as plastic, are allowed, but wire traps remain the most popular. About 100 to 300 traps per fisherman is common, but some may fish as many as 500 traps at the peak of the season. The traps are baited with whole or cut fish and weighted with bricks, cement, or steel to keep them on the seafloor. High-speed boats in the 20 to 40-foot size range are popular in this fishery, but everything from 15-foot skiffs to 50-foot fishing boats are used. Most trap boats are equipped with a davit and hydraulics to assist in pulling the traps (Leet et al. 2001)

The range of California spiny lobster is from Monterey Bay south to Manzanillo, Mexico. Spiny lobsters are found primarily from the intertidal zone to 43 fathoms (258 feet), in mussel beds and rocky areas with crevices, often in kelp beds. They generally hide in crevices and holes during the day and may be found on sandy bottoms at night. Commercial lobster fishing occurs in shallow, rocky areas from Point Conception to the Mexican border and off the islands and banks of the Channel Islands project area.

Sophisticated electronic equipment enables trappers to find suitable lobster habitat, and deploy and relocate traps. Traps are typically deployed along depth contours in waters less than 100 feet, or clustered around rocky outcrops on the bottom. At the beginning of the season the traps are usually very close to shore. By the end of the season they are typically deployed in 100 to 300 feet of water.

Seasonal landings in the 200,000 to 400,000 pound range rose following World War II and peaked in the 1949-1950 season, with a record 1.05 million pounds landed. A general decline followed for the next 25 years, reaching a low of 152,000 pounds in the 1974-1975 season. Landings started back up the next season, but remained between 400,000 and 500,000 pounds for nine consecutive seasons from 1979-1980 to 1987-1988. For the next nine years landings ranged from 600,000 to 800,000 pounds with a peak of 950,000 in the 1997-1998 season. Landings dropped back down after that. The peaks and valleys that have characterized this fishery are not unexpected in a fishery that is strongly influenced by the weather, El Niño and La Niña events, and the export market. About 90 percent of the legal lobsters taken in the commercial fishery weigh between 1.25 and 2.0 pounds, which produces the size of tail desired for the restaurant trade. Most of the harvest in recent years has been exported to Asian countries and France. However, depressed economies overseas have resulted in an effort to re-establish domestic markets.

The California spiny lobster fishery in southern California has persisted, in part due to persistence of suspected source populations in Mexico, but abundance and size distributions are clearly different from historical patterns (Dayton et al. 1998). The commercial fishery began in 1872, and in 1887 the average lobster taken was approximately 150 mm in carapace length (CL). By 1955, the average lobster from the commercial fishery was 119 mm CL. Average harvest in San Diego from 1976-1980 varied from 86-90 mm CL. In 1888, 260 traps yielded 231,060 lbs. By 1975, 19,000 traps were required to harvest almost the same mass (233,179 lbs; Tegner and Levin 1983). Lobster landings, although well below the peaks of the 1950s, have continued through the mid-1990s at relatively high levels.

Dramatic indirect effects of lobster fishing have been observed in the Channel Islands region. Historically, lobsters and other predators kept sea urchin populations at low levels, and kelp forests flourished. However, over time, commercial and recreational fisheries for lobster reduced the population size and average length of individual lobsters (Tegner and Levin 1983). Reduced populations of smaller lobsters were not effective predators on urchins and urchin populations increased as a result. Intense grazing by purple urchins (which were not fished) caused dramatic declines in kelp growth, leading to the formation of bare rocky reefs covered with urchins (known as urchin barrens). Crustose coralline algae, resistant to urchin grazing, became the dominant algae on rocky substrate in urchin barrens (Harrold and Reed 1985).

In 1978, commercial and recreational fishing was prohibited in one small marine protected area of the Channel Islands, the Anacapa Island Natural Area. Within this protected area, lobsters are six times more numerous and individual lobsters are larger than in nearby fished waters (Behrens and Lafferty, unpublished manuscript). Other harvested urchin predators, including California sheephead and kelp bass, are also more numerous and larger in the protected area (Tretault, unpublished data). Predation by large lobsters and other species in the protected area caused the urchin population to decline, so that on average, the density of urchins is 7.4 times greater in fished areas than in the protected area (Behrens and Lafferty, unpublished data). Released from the intense grazing pressure from urchins, kelp in the protected area flourished, supporting a variety of associated species. On average, kelp grew five times more densely and persisted longer in the protected area as compared to fished areas nearby (NPS, unpublished data). Data from the National Park Service show that the Anacapa Island Natural Area supports some of the richest kelp forests in the Channel Islands.

8.1.2.5. Prawn

The prawn fishery in the Channel Islands area includes trawl and (is there trawling today?) trap fishing for spot prawns (Pandalus platyceros) and trawl fishing for ridgeback prawn (Sicyonia ingentis). Traditionally, a number of trawl boats fished year round for ridgeback and spot prawns, targeting ridgeback prawns during the closed season for spot prawns, and fishing for spot prawn during the ridgeback closure. The California spot prawn fishery reached a peak of 800,000 pounds landed in 1998 and the (California?) ridgeback prawn fishery reached a peak of almost 1 million pounds landed in 1984 with a second peak of 1.4 million pounds landed in 1999. Live spot prawns are now taken by trap and trawl vessels and account for 95 percent of these landings. Live ridgeback prawns account for 28 to 68 percent of these landings (Leet et al. 2001).

The prawn trawling industry began in the 1965 and expanded over time. The trawler fleet operates from Fort Bragg south to the United States-Mexico border. Most vessels operate out of Monterey, Morro Bay, Santa Barbara, and Ventura, although a number of Washington-based vessels participate in this fishery during the fall and winter. The vessel length of the trawl fleet ranges from 28 to 85 feet with an average vessel length of 47 feet. Standard gear is a single-rig shrimp trawl of a semi-balloon, or Gulf Shrimp Act, design. Occasionally, double-rig or paired shrimp trawls are used. The body of the trawl net is typically composed of a single layer of 2.5- to three-inch meshes with a 36-square inch bycatch reduction device, and a minimum cod-end mesh size of 1.5 inches. Many fishermen prefer to use a double cod-end composed of two-to three-inch mesh. The introduction of roller (or rockhopper) gear in the 1990s led to the exploration of more area and the discovery of additional habitat suitable for spot prawns. The primary locations for prawn trawling occurred (or occurs?) along the upper edge of the continental shelf, which corresponds in many places with deep sandy areas near the Sanctuary boundary.

In the Channel Islands, 30 operators in the Channel Islands region were licensed to deploy trawl gear to catch spot and ridgeback prawns in 1999 (Leeworthy and Wiley 2002, and updated 2003 in Appendix C). On February 18, 2003, the California Fish and Game Commission adopted regulations prohibiting the use of trawl nets to take spot prawn. The regulations went into effect on April 1, 2003. Ridgeback trawl fishermen may land up to 50 pounds without restriction or 15 percent, by weight, of spot prawn during the open season for ridgeback prawn.

The trap fishery for spot prawns started nearly 70 years ago, when prawns were caught incidentally in octopus traps. In 1985, a trap fishery for spot prawn expanded in the Southern California Bight, with a concentration around the Channel Islands. The trap fleet operates with boats ranging in size from 20 to 75 feet. Trap designs are limited either to plastic oval-shaped traps or to the more popular rectangular wire traps. Normally, a fisherman will set 25 to 50 traps attached to a single groundline (string) with anchors and buoys at both ends. Traps are set at depths of 600 to 1000 feet along submarine canyons or shelf breaks (Leet et al. 2001).

8.1.3. Nearshore Finfishes (Including Rockfishes and California Sheephead)

The Nearshore Fisheries Management portion of the California Marine Life Management Act of 1998 defined nearshore finfish species as rockfish (*Sebastes spp.*), California sheephead (*Semicossyphus pulcher*), greenlings (*Hexagrammos spp*.), cabezon (*Scorpaenichthys marmoratus*), and other species found primarily in rocky reef or kelp habitat in nearshore waters. In the subsequent analyses in this document, the category rockfish includes all species of rockfish and cabezon. (Since the early 1990's greater emphasis has been placed on identifying individual fish species harvested from this group rather than utilizing market categories that combine multiple species.)

The development of the live or premium fishery in the late 1980’s resulted in increasing commercial catches of many species of rockfish occupying the nearshore environment in and around kelp beds. The principal goal of this nontraditional fishery is to deliver fish live to the consumer in as timely a manner as possible. Trucks or vans equipped with aerated tanks are used to transport fish directly to buyers. This fishery has increased substantially since 1988, and it continues to supply communities with live and premium quality fishes. The impetus of this fishery is the unprecedented and increasing high price paid for live fish.

Many groundfish species, including rockfish, have declined throughout their ranges and nine species are considered overfished by the Pacific Fishery Management Council. The nine overfished species are canary rockfish (*Sebastes pinniger*), cowcod (*S. levis*), yelloweye rockfish(*S. ruberrimus*), bocaccio (*S. paucispinis*), darkblotched rockfish (*S. crameri*), widow rockfish (*S. entomelas*), Pacific Ocean perch (*S. alutus*), lingcod (*Ophiodon elongatus*), and Pacific whiting (*Merluccius productus*;); (Love et al. 1998, Yoklavich 1998, Moser et al. 2000).

Recent lingcod stock assessments have concluded that lingcod is seriously depleted and that California populations appear to be less than 25 percent of their pre-1970s level (Leet et al. 2001). Rockfishes are particularly vulnerable to commercial and recreational fishing because they are long-lived (approximately 13-100 years) and have relatively slow growth, late maturity

(4-12 years), and unpredictable recruitment from year to year (Horn and Allen 1978, Cross and Allen 1993).

In the Channel Islands, 128 operators were issued commercial permits in 1999 to use handline, longline, rod & reel, and troll gear to target rockfish. In California, rockfish populations have exhibited systematic declines as a consequence of fishing pressure. There is evidence of a decline in blue rockfish stocks off southern California since the 1970s (Reilly 2001). There is clear evidence that olive rockfish have declined in abundance south of Point Conception (Love 2001). The commercial fishery for brown rockfish expanded since 1981 to a peak in 1991, and has subsequently declined. Commercial and recreational catches of brown rockfish have steadily increased during the last 40 years, while the average length and weight of brown rockfish in landings have declined by 31% and 49%, respectively (Ashcraft and Heisdorf 2001). There is compelling evidence that copper rockfish populations have severely declined in many areas and large individuals are noticeably less common than in past decades (Lea 2001). Fishery dependent surveys in 1981-1986 indicated a 23 percent decline in average weight of black rockfish compared to fish taken from 1958-1961 (Reilly 2001). The spawning population of canary rockfish has declined dramatically, with estimates of 1999 spawning population sizes of 6-23 percent of historically unfished levels (Williams and Adams 2001). Attempts to decrease fishing pressure on canary rockfish are resulting in severe restrictions for many other west coast fisheries (Williams and Adams 2001).

As a consequence of severe declines of rockfish, take of canary rockfish, cowcod, and yelloweye rockfish has been prohibited entirely. In 2001, two closures encompassing 100 and 4,200 square nautical miles were established in southern California to protect prime habitat for cowcod rockfish and other bottom-dwelling groundfish species. The larger area includes waters around Santa Barbara and San Nicolas islands. Recreational and commercial fishing for lingcod and most rockfish species is prohibited in the closures. At no time may California sheephead, lingcod, cabezon, kelp or rock greenlings, California scorpionfish, rockfish, or ocean whitefish be taken or possessed while fishing in water 20 fathoms or greater in depth in the Cowcod Conservation Areas (California Fish and Game Code Section 27.82, Title 14). Commercial bottom trawling for shrimp and prawn is also prohibited. According to a state/federal biological survey, the cowcod rebuilding period is expected to take up to 100 years. Consistent protection over a long period of time is necessary to help depleted populations of rockfishes and other vulnerable species recover from the cumulative impacts of commercial and recreational fishing.

California sheephead range from the Gulf of California to Monterey, but are rarely found north of Point Conception. This species frequents rocky areas and kelp beds from the surface to 150 feet and deeper; females are usually found in shallower depths than the males. Typical food items are sea urchins, crabs, sand dollars, mussels, abalone and bryozoans (Feder et al., 1974). While sheephead are most often observed in kelp beds and are known to venture farther from the bottom in the presence of kelp, the exact role that sheephead play, if any, in the kelp forest community is unclear (Feder et al. 1974).

The live sheephead fishery uses baited wire traps to capture small females. These traps are similar in design to those used by crab harvesters. The basic design is a 3'x2'x1.5', double compartment trap with two entrance funnels. Traps are usually constructed of 2"x2" wire mesh.

Since sheephead inhabit giant kelp beds, harvesters will set out traps adjacent to and within the kelp beds, along the southern California coast and around the Channel Islands.

There have been major changes in abundance and size distribution of California sheephead (*Semicossyphus pulcher*) in southern California. Between 1950 and 1989, the California sheephead fishery was dominated by recreational fishing. Recreational landings of California sheephead reached a peak at 230 metric tons in 1980, and subsequently decreased to 50-100 metric tons per year since 1994. Since 1989, the commercial fishery has dominated the sheephead industry. Commercial landings of California sheephead exhibited two peaks in 1987 (100 metric tons) and 1992 (150 metric tons), with a subsequent decline to approximately 60 metric tons in 2000.

ADD Rockfish Conservation Area discussion

8.1.3.1. Giant Sea Bass

Giant (black) sea bass (*Stereolepis gigas*) were once plentiful in local kelp forests in southern California (Dayton et al. 1998). There is no quantitative information on the density of giant sea bass but diver sightings of giant sea bass are fairly rare today, while historically divers reported seeing several of these fish on a single dive. Giant sea bass are known to aggregate off the north coast of Anacapa Island (De Wet-Oleson, unpublished data). Giant sea bass and other species that form aggregations for feeding or spawning are particularly vulnerable to fishers who target these area to catch large numbers of fish. Because of their large size (hundreds of kilograms) and their tendency to remain in a specific home range (possibly 2-3 ha), giant sea bass are vulnerable to spearfishers, net fishers and other anglers (De Wet Oleson, personal communication; Dayton et al. 1998).

Because of their long-term decline, in 1981, California regulations prohibited the take of giant sea bass for any purpose, with the exception that commercial fishermen could retain and sell two fish per trip if caught incidentally in a gillnet or trammel net. The law was amended in 1988, reducing the incidental take to one fish in California waters. Although this law may have prevented commercial fishermen from selling giant sea bass in California, it did not prohibit fishing over habitats occupied by this species and probably did little to reduce the incidental mortality of giant sea bass, as giant sea bass that were entangled in the nets were discarded at sea. The banning of inshore gillnets in 1994 displaced the California gillnet fishery from the majority of areas inhabited by giant sea bass, and it is reasonable to assume that this closure significantly reduced the incidental mortality of giant sea bass in California. Even so, given the slow growth and reproduction of the species, the California population of giant sea bass remains below historical highs (CA DFG 2002).

8.1.4. Coastal Pelagic Species (Anchovy, Sardine, Mackerel, and Squid)

The Coastal Pelagic Species (CPS or wetfish) category includes fisheries that generally employ purse seiners, and includes the Pacific sardine (*Sardinops sagax caeruleus*), northern anchovy (*Engraulis mordax*), and Pacific mackerel (*Scomber japonicus*). This state category closely mirrors the Pacific Fishery Management Council's management classification of the Federal Coastal Pelagic Species Fisheries Management Plan.

ADD DETAIL

8.1.4.1. Market Squid

Market squid (*Loligo opalescens*) range from British Columbia to Central Baja California (Recksiek and Frey 1978). Squid reproduction involves spawning within the water column, followed by the deposition of eggs upon the seafloor. The peak of the fishery targets the squid mating and egg laying aggregations and occurs during fall and winter in Southern California. The majority of market squid harvest is centered in the northern Channel Islands region, mainly in the project area. In general, squid harvest involves luring the animals to the surface with high wattage lamps, encircling them with purse seine nets, and pumping and/or using brail nets to remove the squid from the water, finally storing them in a fish hold. On a good net set, tons of squid may be harvested. Squid are minimally processed, mainly in San Pedro, California, and then frozen and shipped around the world, predominately to markets in the Mediterranean and China (Hastings and MacWilliams 1999). Annual squid catches can be greatly influenced by El Niño events, as shown in the following section.

Squid play a vital role in the California Current ecosystem and serve as a major link in the food chain as both predator and prey. For example, squid prey items include planktonic crustacea, mainly euphausiids and copepods, but also fish, cephalopods, gastropods and polychaetes (Karpov and Cailliet 1978). In turn, many species of marine mammals from Risso's dolphins (*Grampus griseus*) to California Sea Lions (*Zalophus californianus*), numerous fish species, including many economically important species like tuna and halibut, and numerous seabirds all depend upon squid as a key food source (Hastings and MacWilliams 1999).

Market squid have been harvested for over 100 years off the California coast from Monterey to San Pedro. The squid fishery has evolved into one of the largest fisheries in volume and economic value in California. Expanding global markets, especially in China and the Mediterranean, coupled with a decline in squid product from other parts of the world, has fueled a rapid expansion of the California squid fishery (Hastings and MacWilliams 1999).

Today, market squid is the dominant commercial fisheries in the Channel Islands, far exceeding the market value of all other species (Leeworthy and Wiley, 2002, and updated 2003 in Appendix C). In 1999, 169 operators were licensed to deploy purse seine gear to catch market squid in the Channel Islands region (Leeworthy and Wiley, 2002, and updated 2003 in Appendix C). The fishery for squid targets spawning aggregations on the nearshore shelves of the Channel Islands (Vojkovich 1998).

Squid appear to be negatively affected by El Niño events. After a peak in 1981, the squid fishery collapsed during the 1983-1984 El Niño event, and eventually rebounded to record levels in 1995-1997. The fishery declined slightly during another El Niño in 1998. The squid management plan (DFG 2001) requires reductions in the capacity of the squid fleet to limit the potential for future overfishing.

8.1.4.2. Tuna

The tuna category includes several highly migratory species that occur in the Channel Islands, including albacore, bluefin tuna, yellowfin tuna, and bonito. Tuna are caught commercially with hook and line gear. Trolling or jig vessels take the majority of albacore, with a small portion using live bait. Additionally, the wetfish fleet may target some tuna species during the summer. In some year, they may catch significant amounts of albacore (Leet et al. 2001). Commercial effort for albacore has fluctuated over the past 100 years, based primarily on market and oceanic conditions.

8.1.4.3. Pelagic Sharks

Forty operators in the Channel Islands region were issued licenses to set gill nets targeting pelagic sharks in 1999 (Leeworthy and Wiley 2002, and updated 2003 in Appendix C). In California, the fishery for shortfin mako shark began in 1978, peaked in 1986 and has declined since 1989 (Leet et al. 2001). The California fishery for thresher shark began in 1977, with a dramatic rise to a peak in 1981 and a sharp decline during subsequent years. The California fishery for blue shark begin in 1980 at a peak and dropped to almost nothing in subsequent years, with two small increases in the fishery in 1990 and 1995. The California fishery for other mackerel sharks began about 100 years ago with very low levels (Leet et al. 2001). A dramatic increase in the fishery for other mackerel sharks occurred in 1930, followed by a steep decline to extremely low levels during subsequent years. The take of white sharks is prohibited entirely. The trends in shark fisheries indicate rapid expansion and collapse of all targeted species. The significant reduction of this important predator may be affecting trophic (food chain) dynamics in the Channel Islands region.

8.1.4.4. Flatfishes

The flatfish fisheries of interest include California halibut (*Paralichthys californicus*), starry flounder (*Platichthys stellatus*), sanddabs (*Citharichthys spp*.), and other flatfish. California halibut is caught by trawl and hook-and-line, and is an important fishery in the State. Both recreational and commercial anglers prize flatfish and they are targeted from boats, piers, and the shoreline. Major fluctuations in landings of some species seem to indicate inconsistent recruitment and availability.

In the Channel Islands, 85 local operators were licensed in 1999 to deploy trawl gear targeting flatfishes (including halibut, starry flounder, and sanddabs) and California sea cucumber (Leeworthy and Wiley 2002, and updated 2003 in Appendix C). The halibut industry has declined over a period of 100 years, with peak landings of almost 5 million pounds in California in 1916 and an uneven decline to a low of several hundred thousand pounds in 1969 (Leet et al. 2001). Commercial landings of halibut have remained at about 1 million pounds during the last 20 years. The recreational (hook & line) halibut fishery in California peaked in 1947 and 1965 and the subsequent landings have remained low since 1970. Halibut landings from the recreational fishery in California are about 1.5% of the landings by the commercial fishery. Year-per-recruit analysis indicated that overall fishing effort was about twice the optimal level.

8.1.4.5. Rock Crab

The rock crab fishery is made up of three species: the yellow rock crab (*Cancer anthonyi*), the brown rock crab (*C. antennarius*), and the red rock crab (*C. productus*). Approximately 95 percent of the landings in this fishery come from southern California, although rock crabs inhabit the nearshore waters of the entire State (Leet et al. 2001). The three species are commonly found on sand near rocky reefs and within kelp beds around the holdfasts of kelp plants, where they prey on a variety of invertebrates. Rock crabs, along with several species of fish, are considered large predators associated with kelp, but the exact role that crabs play in kelp forest community dynamics is unknown (Foster and Scheil 1985).

Rock crabs are harvested using baited traps. The traps are set and buoyed either singly or as part of a string (two or more traps tied together). Trap designs and materials vary but most employ single chamber, rectangular traps of 2X4– or 2X2–inch wire mesh. Once set, the traps are left in place for 48 to 96 hours before being checked. A single harvester may use 200 or more traps at one time. Fishermen tend to replace their traps in the same location until fishing in that area diminishes. This creates pathways in the kelp canopy because of the passage of the boats along the same course. The kelp that is cut loose will either fall to the bottom to be eaten by sea urchins and other herbivores, drift out to sea, or become part of the beach litter, or a combination of these events may occur.

8.1.4.6. Sea Cucumber

Most of the State's sea cucumber catch is taken in southern California waters, with divers almost exclusively harvesting the warty sea cucumber (*Parastichopus parvimensis*) while trawlers primarily take the California sea cucumber (*P. californicus*). Divers take sea cucumbers as far south as San Diego, but most of the catch is taken off the four northern Channel Islands in depths of 6-20 fm (Leet et al. 2001).

Most of the California and warty sea cucumber harvest is shipped overseas to Hong Kong, Taiwan, China, and Korea. Domestic Chinese markets also purchase a portion of California 's sea cucumber catch. The majority are boiled, dried, and salted before export, while lesser quantities are marketed as a frozen, pickled, or live product. The processed sea cucumbers can sell wholesale for up to $20 per pound. In Asia, sea cucumbers are claimed to have a variety of beneficial medicinal or health-enhancing properties, including lowering high blood pressure, aiding proper digestive function, and curing impotency. Western medical researchers are investigating the pharmaceutical potential of various sea cucumber chemical extracts such as saponins and chondroitin sulfates (Leet et al. 2001).

At present there are few regulations on the harvest of these growing sea cucumber fisheries. In 1997, legislation was enacted to regulate the sea cucumber fishery. The major regulatory changes included requiring permits for each gear type, limiting the number of permittees based on the number of permits issued in previous years, and requiring a minimum landing of 50 pounds during 4 years (Leet et al. 2001). These regulations are unrelated to the population size of sea cucumbers and therefore may not ensure sustainability of the fishery. In the dive fishery for warty sea cucumbers there have been significant declines (i.e., 33% -83%) in population size of fished areas at the Channel Islands relative to unfished reserves (Schroeter et al. 2001).

8.2. Regulations

A variety of regulations are currently used to manage fisheries in the project area. These include total prohibitions on the take of certain species, seasonal closures, and other regulations. Tables C-1 and C-2 below summarize some of the major closures currently in place. This information is an update to the tables provided in the 2002 State of California's Final Environmental Document for Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary; specifically Volume 1 Chapter 4 Environmental Settings.

Because these tables are not a complete reproduction of all fishing regulations, (e.g., bag limits, size limits, in-season adjustments in allowable take and gear restrictions), they should not be used as guidance for legal compliance.

Table C-1: General Summary Of Existing Commercial Fishing Prohibitions In The Southern California Area As Of January 1, 2004

Insert Table C-1

Table C-2: General Summary Of Existing Recreational Fishing Prohibitions In The Southern California Area As Of January 1, 2004

Insert Table C-2

(Salmon fishing seasons are set on an annual basis. The closed season shown here was for the 2003 ocean salmon fishery and may change in 2004.)

INSERT IMAGE OF RCA AND CCA

8.2.1. Bycatch

Some fisheries have been restricted due to excessive bycatch, not because harvest exceeded the total allowable catch of the target species. Bycatch, or incidental take, can have a significant impact on non-targeted species. The highest bycatch mortality occurs in gill net, drift net, longline and trawl fisheries. In 1999, 176 commercial permits were issued to operators in the Channel Islands region to deploy trawl gear, 40 commercial permits were issued for drift gill net gear, 190 commercial permits were issued to deploy handline, longline, rod & reel, and troll gear, and 206 commercial permits were issued for purse seine gear (including 169 permits that also covered use of round haul nets). Table C-3 summarizes the number of permits issued in 1999, the type of gear used, and the target species.

Table C-3. The Number Of Commercial Permits Issued To Operators In The Channel Islands Region In 1999 (Leeworthy and Wiley, 2002/2003).

Permits	Gear	Target
85	Trawl and H&L	Flatfish
30	Trawl and trap	Prawn
61	Trawl	California sea cucumber
40	Drift gill net	Pelagic shark
37	Purse seine	Coastal pelagic species
169	Purse seine and round haul nets	Market squid
128	*H&L	Rockfish
19	*H&L	Tuna
43	*H&L and trap	Sculpin and bass

H&L includes handline, longline, rod & reel, and troll gear.

Eleven fish species are identified as bycatch in commercial and recreational fisheries in California, including sablefish, cabezon, four species of flatfish, shortspine and longspine thornyhead, yellowtail rockfish, chilipepper rockfish, and black rockfish. Commercial bottom trawl and longline fisheries take shortspine and longspine thornyheads as bycatch. Shortspine thornyhead has declined as a result of excessive bycatch by these fisheries. Commercial trawl, gill net, long line, and trap fisheries take sablefish, dover sole, and rockfish as bycatch. Calico rockfish appeared as bycatch in prawn trawls and other nearshore fisheries in southern California and are caught by sport fishers when they are fishing for other, larger benthic species (Leet et al. 2001). Cabezon, rockfish, and English sole are taken as incidental bycatch in fisheries that use handline, longline, rod & reel, troll gear, and gill nets. Horwood et al. (1998) suggest that closed areas may provide the only practical means of protecting vulnerable species caught as bycatch in the main fisheries.

Seabird bycatch in gill net and longline fisheries is one of the greatest threats to seabirds worldwide (Tasker et al. 2000). Seabirds are an important component of the Sanctuary food web. Gill nets entrap large numbers of shearwaters, auks and Xantus's Murrelet, a threatened species. Longline fisheries primarily catch shearwaters, petrels, and albatrosses (Tasker et al. 2000).

Most stocks of marine mammals in the Pacific and Atlantic experience significant mortality in gill net and drift net fisheries (Read and Wade 1999). Mortality of dolphins, porpoises and small whales often exceeds maximum allowable annual removal limits set by the Marine Mammal Protection Act because populations are often aggregated (Read and Wade 1999).

The following table summarizes west coast bycatch species incidentally taken by federally-managed fisheries of the U.S. Pacific Ocean(Table C-4).

Table C-4: Bycatch Populations Taken In U.S. Pacific Federally Managed Fisheries

Bycatch Species	Fishery	Gear Type
Sea Turtles	Tuna Swordfish Thresher shark	Surface hook and line Drift gill net Harpoon Pelagic longline Purse seine Recreational fisheries
Albatross	Highly Migratory Species	Surface hook and line Drift gill net Harpoon Pelagic longline Purse seine Recreational fisheries
Dolphins, Whales and Other Marine Mammals	Swordfish Thresher shark Tuna	Purse seine Drift gill net
Groundfish Bocaccio Canary rockfish Cowcod Darkblotched rockfish Lingcod Pacific ocean perch Pacific whiting Yelloweye rockfish	Coastal pelagic species Northern anchovy Jack mackerel Market squid Pacific sardine Pacific mackerel Swordfish Thresher shark	Purse seine Lampara nets Drift gill nets
Seabirds	Swordfish Thresher shark Tuna	Drift gillnets Purse seines
Molas	Swordfish Thresher shark Tuna	Drift gill nets
Blue and shortfin mako sharks	Swordfish Thresher shark	Drift gill nets
Invertebrates ? what inverts?	Swordfish Thresher shark	Drift gill nets

Source: Southwest Region Current Bycatch Priorities and Implementation Plan; NMFS 2003.

(Need more detail on which bycatch is significant concern for Channel Is., and why, with refs.)

8.2.2. Impacts Of Fishing Gear On Habitats

The abrasive contact of mobile fishing gear (define mobile fishing gear) with the seafloor, particularly trawling and dredging gear, can damage or destroy benthic habitats and faunas (JNCC 2004). In 1999, 176 commercial permits were issued to operators in the Channel Islands region to deploy trawl gear (Table 1.1). Check on the number of trawl permits issued (or maintained) in 2003. The intensity of the impact varies with the particular gear used and the nature of the habitat. Fishing efforts that use high energy and exert close contact with the habitat generally have high impacts on marine habitats.

Trawl doors scraped on the seafloor may penetrate sediments by up to 15 cm (JNCC 2004). Beam trawls penetrate up to 8 cm across the width of the beam (JNCC 2004). Such sediment disturbance flattens contours on the sediment surface and creates grooves by the heaviest parts of the gear. Typical trawl fisheries in California trawl the same section of sea bottom more than once per year on average (Friedlander et al. 1999).

Animals directly in the path of mobile fishing gear may be caught and subsequently die (mortality rates vary by species). Species burrowing into the seabed may be crushed. Fragile and surface-dwelling species suffer a much higher mortality than deep-burrowing or robust species. In rocky habitats, roller gear detaches and crushes organisms growing in the path of the trawl. Roller gear was introduced to the Channel Islands in the early 1990s, allowing fishers to explore and target new habitats. Long-term trawling in an area changes the marine community, both by altering benthic habitat complexity and by removing or damaging infauna and sessile organisms (Friedlander et al. 1999). Bottom-dwelling invertebrates can take up to 5 years or more to recover from one pass of the dredge (Peterson and Estes 2001).

(add more detail on which specific gear types are likely to have caused damage in Channel Islands, whether they are still being used today, and what evidence there may be for actual damage from gear use in the Channel Islands. Also clarify which gear types are not likely to cause damage to habitat.)

Although active fishing gear (define active fishing gear) can damage habitats, generally the use of the gear is controlled and the gear is removed from the ocean when the fisherman returns to port. However, lost fishing gear can continue to "ghost" fish in the environment. Ghost fishing occurs when fishing gear is lost and continues to entrap marine life and damage marine habitats. Gill and trammel nets, which are used to catch marine fishes and crustaceans, may be lost as a result of bad weather, operator error, or when they are damaged. When nets are lost, they may entrap a wide variety of marine organisms, including crustaceans, fishes, seabirds and marine mammals. After uncontrolled nets entrap a few organisms, predators and scavengers are attracted to the dead and decomposing bodies. Many of these animals also become trapped in the netting and subsequently attract other predators and scavengers. Catch rate of uncontrolled nets may decline over time as nets deplete surrounding waters or become snagged on reefs or rocks on the seafloor. One study of ghost fishing indicates that gill and trammel nets continued to catch commercial crustacean species continuously for 9 months of the study (Kaiser et al. 1996).

Static fishing gear types (define static fishing gear) have a lower impact on smaller areas of the seabed than active gear types. In the Channel Islands, traps are set for lobster, prawn, and the live fish industries. The lobster industry included 46 fishers in 1999 (Leeworthy and Wiley, 2002/2003). Include the number of traps set and lost during each season (M. Stadler, personal communication). Studies have shown that lost lobster pots may continue catching (and killing) animals for months (JNCC 2004).

Consider adding anecdotal incidents – gill net with sea lions entangled, DELTA sub reports for Footprint area, whale entanglements, etc…

8.3. Economic Overview of Commercial Activities

Table C-5 below shows the annual ex-vessel value of the commercial fisheries in the project area for years 1999 and for the average of years 1996-1999. In 1999, the top 14 species/species groups accounted for 99.7 percent of the commercial landings from the project area and for the years 1996-1999, the top 14 accounted for 98.69 percent of the commercial landings from the project area. Abalone fishing was halted in 1997, so for the years 1996-1999, the top 14 fisheries excluding abalone accounted for 99.21 percent of the value of commercial landings.

The top 14 harvested species/species groups are included in the classification and subsequent analyses in Chapter 5 and Appendix E of commercial fisheries, along with kelp. Kelp was treated differently because only one company harvests it, ISP Alginates, located in San Diego, California. Harvested value equivalent to ex-vessel value was not available. Instead, ISP Alginates supplied the processed value of kelp (1996-1999 average of $5,991,367). A separate economic impact model was created for kelp with the help of Dale Glantz of ISP Alginates. All the economic impact from kelp takes place in San Diego County where it is landed and processed.

Due to the trends in project area catch and value from 1988-1999, Leeworthy and Wiley (2002) used the average of years 1996-1999 as the most representative estimate for extrapolating future impacts. The trends in catch, value of catch and prices for the project area and for the State of California are included in Leeworthy and Wiley (2002). One can see in Table C-5 below that squid is the dominant fishery in the project area as well as the State of California. Squid catch, however, is sensitive to El Niño events. In 1998, squid catch plummeted then rebounded to a record catch in 1999. Spatial distributions of the fisheries value data for kelp, squid, wetfish and tuna are shown in Figures C-1, C-2, C-3, and C-4 below, respectively. Landing data for each fishery, separated according to port, can be found in Leeworthy and Wiley (2002).

Table C-5: 1999 Ex-Vessel Value Of Commercial Landings In the Sanctuary

Species Groups	1999 Value	Species Groups	1999 Value
Squid	$26,558,813	CA Sheephead	$153,147
Urchins	$5,963,876	Sculpin & Bass	$88,547
Prawn	$743,159	Roundfish	$37,318
Tuna	$53,694	Shrimp	$1,057
Spiny Lobster	$952,991	Yellowtail	$14,832
Flatfish	$324,685	Mussels, snails	$7,745
Rockfishes	$549,446	Rays & Skates	$2,283
Crab	$313,289	Salmon	$1,407
Wetfish	$608,865	Octopus	$169
Swordfish	$21,472	Surf Perch	$447
Sea Cucumbers	$267,842	Abalone	$47
Sharks	$41,638	Other	$23,728
		All species (excluding kelp)	$36,730,497

Insert Figures C-1, C-2, C-3, C-4: spatial distributions of the fisheries value data for kelp, squid, wetfish, and tuna.

8.3.1. Socioeconomic Profiles of Fishermen

(Clean up all sections below until Recreation and Tourism)

Leeworthy and Wiley (2002) surveyed two separate samples of fishermen. The first sample is sometimes referred to as the Pomeroy Sample and includes fishermen in the squid/wetfish fishery. The second sample is sometimes referred to as the Barilotti Sample and includes fishermen in all other fisheries, except squid and wetfish. It is important to note that both samples can be characterized as being involved in multi-species fisheries. Often the multiple species dependency is seasonal and important in supplying income flows over the course of a year. Small percentages of dependency on a particular species/species group may involve a week or a month of income at a time when the opportunity to catch the main species/species groups fished are not available and participation in other fisheries are the only source of income. This kind of dependency is taken into account in subsequent analyses. Leeworthy and Wiley (2002) provide a baseline profile of fishermen of the project area is provided, and compare them with some profiles of fishermen obtained from a study of Tri-County fishermen (i.e., Santa Barbara, Ventura and San Luis Obispo counties).

The commercial fishermen other than squid/wetfish or the Barilotti Sample included 59 fishermen. The squid/wetfish or Pomeroy Sample included 29 purse seine boats and 8 light boats. Profiles of purse seine boats and light boats are presented separately. Not every fisherman supplied complete information so sample size (N) or the number responding to each item is reported. Measurements included: 1) Experience (Years of Commercial Fishing and Years Commercial Fishing in the project area and Age of the fisherman interviewed), 2) Education (Years of Schooling of the fisherman interviewed), 3) Dependency on Fishing (Percent of Income from Fishing, Percent of Fishing Revenue from project area and Number of Crew and Family Members Supported by directly by the fishing operation), 4) Ownership/Investment (Boat Ownership and Replacement Value of Boats and Equipment), 5) Residence (State and City) and 6) Ports Used (Home Port, Main tie-up Port, and Main Landing Port). More detail was available from the squid/wetfish fishermen (Pomeroy Sample) than the other commercial fishermen (Barilotti Sample).

Although the samples of commercial fishermen accounted for 79 percent of the annual total ex-vessel value of catch from the project area, they represent only 13 percent of the total number of fishermen reporting catch in the project area. In 1999, there were 737 fishing operations reporting some catch from the project area. Nineteen (19) percent accounted for 82 percent of the annual total ex-vessel value, with each of these operations receiving at least $50,000 per year in ex-vessel value (141 operations). Almost 64 percent of fishing operations (469) received less than $20,000 per year and accounted for only about 6 percent of annual total ex-vessel value from the project area, and 23 percent (170 operations) earned less than $1,000 per year, which was 0.20 percent of the annual total ex-vessel value from the project area (Leeworthy and Wiley 2002).

8.3.2. Tri-County Fishermen

Leeworthy and Wiley (2002) provide additional baseline data are for Tri-Counties fishermen (Table 4-25). No difference was found between the two study samples (Pomeroy and Barilotti) for Experience, Age, or Number of Crew. The Tri-County sample had higher levels of education, a higher percentage of boat ownership, a lower proportion living in Santa Barbara and also reporting Santa Barbara as their Home Port, and our sample was less dependent on fishing for their income.

8.3.3. Baseline Relationships with Consumers

Leeworthy and Wiley (2002) also analyzed Consumer’s Surplus, using 1999 data provided by the National Marine Fisheries Service, and baseline data are presented here. It appears that squid and urchins are the only species/species groups for which significant proportions of U.S. landings come from the project area. The United Nations Food and Agricultural Organization (FAO) reports a 1999 world commercial catch of squid of 3,373,463 metric tons or 7,438,486 million pounds. Project area landings were therefore about 2.15 percent of world supply, although 1999 was a record year for squid in the project area. FAO also reports the 1999 world commercial catch of urchins of 118,750 metric tons or 261,844 million pounds. Project area urchin landings were therefore about 2.24 percent of world supply.

8.3.4. Fisheries Access

For economic analysis, it is critical to understand the structure of who can enter the fishery, if there are constraints on the amount and timing of total take allowed and what is the current capacity to catch the fish stock. While most fisheries in the project area require permits, they fit into the most permissible types of permit structure. These permit types are listed below:

A permit system where there are no restrictions on the number of permits, only requirements to possess one. The fishery may have some total allowable take, but not specified by fishermen (first come first serve). In this type the economic analysis of open access fisheries applies.

A permit system where the number of permits is limited, and criteria for obtaining a permit are set. The capacity of the fleet, however, is such that they could catch an amount above the total allowable catch. One might describe this as limited entry, but the limits have no real effect economically or biologically because of the capacity of the fleet. This would still be analyzed as an open access fishery.

A permit system where the number of permits is limited, criteria for obtaining a permit are set, and the capacity of the fleet is controlled to where it cannot exceed total allowable catch. In this case there are no Individual Transferable Quotas, but there is the possibility of the participants in the fishery earning economic rents. This is likely to be a derby fishery, where participants compete for a larger share of the catch. Because of the limits on capacity, this is not analyzed as an open access fishery.

A permit system where fishermen possess Individual transferable Quotas (ITQs). A limited number of fishermen are given ITQs, which specify a certain share of the total allowable catch. This avoids the derby fishery problem and since one can buy and sell the ITQs, it solves the capacity problem and fosters economic efficiency. This is not an open access fishery.

Using the above criteria, all of the commercial fisheries in the project area can currently be characterized as open access fisheries. The squid/wetfish fishery is currently considering implementing a limited entry program in the current draft management plan. The nearshore finfish fishery has reduced its capacity, and is considering limited entry. There are no present analyses of whether these limits would lead to economic rents (define) in the fishery. Therefore, no analyses of the effects of marine reserve and marine conservation areas on economic rents are possible.

8.3.5. Recreation and Tourism

Recreational activities occur primarily in nearshore areas, particularly along the mainland and around the Channel Islands. Examples of common offshore recreational activities include sportfishing, sailing, boating, and swimming. In addition, the coastal and offshore marine environments are ideal locations for tourist activities. Tourist-related activities include sightseeing, whale watching, sportfishing, pleasure boating, and diving.

8.3.6. Consumptive Activities

8.3.6.1. Recreational / Sport Fishing And Consumptive Diving

Recreational (sport) fishing involves hook-and-line fishing from piers and docks, jetties and breakwaters, beaches and banks, private or rental boats, and commercial passenger fishing vessels. Recreational fishing also includes activities such as spear and net fishing. Recreational fisheries in the project area access both nearshore and offshore areas, targeting both bottom fish and mid-water fish species. Consumptive recreational divers use both private and rental boats and commercial passenger fishing vessels. They also SCUBA dive and free-dive from the shore in a variety of locations.

The Channel Islands project area is a leading recreational fishing area along the West Coast. Weather and sea conditions allow for year-round fishing. The coastlines around the Channel Islands are popular sportfishing areas; although the majority of kelp beds are within one nm of shore, some fishing areas extend far from shore and include lingcod and rockfish grounds west of San Miguel Island, broadbill swordfish, marlin, and mako shark waters south of Santa Cruz Island, and kelp beds offshore and surrounding portions of all the islands.

The sportfishing industry in California is composed of commercial passenger fishing vessels (CPFV), private boats, and shore anglers. The CPFV's take groups of anglers out on 1/2–day, 3/4–day, full day, and multiday trips. The majority of 1/2– and 3/4–day trips fish within or near the kelp beds, except in the summer when California barracuda (Sphyraena argentea) and Pacific bonito (Sarda chiliensis) are present (Crooke pers. comm.). CPFV dive trips are often multi-day trips going to one or more of the offshore islands. These trips focus on harvesting certain species such as lobster during their respective recreational harvest seasons. A large number of sport divers (both free divers and SCUBA divers) spearfish for many of the species caught by hook and line. Species commonly targeted by consumptive divers include many rockfish species and kelp bass, halibut, yellowtail and white seabass, as well as lobster and scallops. Divers are generally limited to the shallowest intertidal waters to depths around 130 feet.

Commercial passenger fishing vessels (CPFVs) frequently offer one-day sportfishing excursions from either Ventura or Santa Barbara harbors. Types of fish landed on commercial passenger fishing vessels include kelp bass, mackerel, California sheephead, halfmoon, and whitefish. Offshore fishing focuses on more mobile species like yellowtail, tuna, white seabass, and barracuda.

The largest numbers of fish caught for recreational purposes are caught within 3 miles of shore. Barred surfperch, California halibut, jacksmelt, pacific mackerel, kelp bass, rockfish, white croaker are a few of the species that represent the largest catch numbers.

Recreational fishing also exerts significant pressure on targeted species, including rockfish. The recreational fishery for black rockfish rapidly expanded since 1979, peaked in 1985, and declined precipitously since 1993 (Reilly 2001). The recreational fishery for blue rockfish rapidly expanded in 1979, peaked in 1982 and 1993 and exhibited a subsequent rapid decline (Reilly 2001). The recreational fishery for olive rockfish expanded rapidly in 1979, peaked in 1981, and subsequently declined (Love 2001). The recreational fishery for brown rockfish expanded since 1979, peaked in 1987, and rapidly declined in recent years (Ashcraft and Heisdorf 2001). The recreational fishery for copper rockfish exploded in 1979 to a peak in 1980, and declined steadily in subsequent years (Lea 2001). Recreational fisheries for kelp rockfish, china rockfish, black and yellow rockfish, grass rockfish, and gopher rockfish expanded rapidly in 1979 to peaks between 1981 and 1985, all exhibiting subsequent declines (Larson and Wilson-Vandenberg 2001). Although there is no comprehensive stock assessment for these populations, each species probably is subject to local depression in abundance and average size wherever recreational or commercial fishing is concentrated (Leet et al. 2001).

Schroeder and Love (2002) compared rockfish density within a de-facto marine reserve (an oil platform where recreational fishing does not occur), an area allowing only recreational fishing, and an unprotected area (where both recreational and commercial fishing are allowed) in the Channel Islands region. Rockfish density was an order of magnitude less within the recreational fishing area than in the unprotected area. Community composition also was significantly different. Cowcod densities were 8 and 32 times greater in the de facto reserve than in the recreational area or unprotected area, respectively. Similarly, bocaccio densities within the de facto reserve were 18 and 408 times greater than in the recreational area or unprotected area, respectively. The authors conclude that recreational fishing can have measurable effects on the densities of targeted species.

8.3.7. Non-consumptive Activities

8.3.7.1. Whale Watching

Whale watching in the Channel Islands is popular, due to the high frequency of sightings and diversity of marine mammals. Day trips are offered from several areas landings, including Santa Barbara, Ventura and Channel Islands harbors.

8.3.7.2. Non-consumptive Diving

The Channel Islands area is considered to have some of the most highly renowned nonconsumptive diving opportunities in California. Interest in diving in the project area is keen, due to the beautiful marine habitat, shipwrecks, and other underwater historical sites. Morris and Lima (1996) describe the history of submerged cultural resources (e.g., shipwrecks) of the Channel Islands, and systematically review the archeological sites from field work in this marine area. Over 100 vessels have wrecked in the Channel Islands National Park and National Marine Sanctuary; about 21 of these have been located. A literature survey of knowledge of the marine areas shipwrecks is also found in Howorth and Hudson (1985). Nonconsumptive divers enjoy interacting with the marine environment, exploring new habitats, and underwater photography.

8.3.7.3. Sailing

Sailing is a popular pastime in the project area. The Channel Islands are within reach of several ports for single or multiple day trips. Users who sail in the project area likely also participate in other consumptive and/or nonconsumptive recreational activities during their trips.

8.3.7.4. Kayaking/Island Sight-Seeing

Several operations offer sea kayaking excursions in the project area. Users can also take kayaks out to the islands on commercial or private vessels, and spend single or multiple days kayaking along the shoreline of the Channel Islands. Due to abundant marine life and the presence of large sea caves and rock formations, the Channel Islands are considered a primary destination for sea kayakers in California.

8.3.8. Economic Overview of Recreational Activities

This section provides the baseline economic measures for the recreation industry. Consumptive recreation 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. No information was found on non-consumptive activities from private household/rental boats, so non-consumptive uses are undercounted. 1999 is the baseline year used for extrapolating future impacts.

A previous assessment of recreational fishing (Leeworthy and Wiley 2000) summarized information available for years 1993 to 1998 from the National Marine Fisheries Service's Marine Fishing Statistics Survey (MRFSS). MRFSS data showed 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 between 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 (-0.76 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 differences in trends could not be reconciled because the MRFSS Northern California data also showed a downward trend.

Species like California halibut, white seabass, Pacific barracuda and yellowtail, which were not among the top 20 species between 1993 and 1998, were in the top 20 or close in 1999 and 2000 (yellowtail actually ranked 21st). In 2000, the number of trips ended the downward trend in total trips and across all boat modes, and total catch increased as well. The number of trips increased dramatically between 1999 and 2000 (55.19 percent). The number of trips rebounded to almost their 1996 level. Overall, the trend in trips is still down from the 1993 level (-6.3 percent).

Many of the top 20 species had downward trends in the number of fish caught. The top 20 species also changed fairly dramatically. In 1999 and 2000, all the rockfish species that were previously among the top 20 between 1993 and 1998 dropped out of the top 20, except vermillion rockfish and bocaccio. Vermillion rockfish were ranked 13th in 1999 and 17th in 2000 and bocaccio was ranked number 19th in 1999 and 21st in 2000. Species ranked 11th through 20th in 1993 were all out of the top 20 in 2000, even though only three of these species showed downward trends in catch between 1993 and 1998.

8.3.8.1. Person Days Of Activity

In 1999, there were an estimated 437,908 total person-days (one person undertaking an activity for any part of a day or a whole day) of consumptive recreation in the project area (Table 4-30). Fishing from a private household boat was the top activity with over 214,000 person-days (49 percent of the consumptive recreation activity) followed by about 159,000 person-days of fishing from charter/party boats (36 percent of the consumptive recreation activity). Consumptive diving accounted for the remaining 15 percent of consumptive recreation activity. In 1999, 21 percent of the private household boat fishing and about 26 percent of the charter/party boat fishing in Southern California was done in the project area. Spatial distributions of charter/party boat fishing, charter/party boat consumptive diving, private boat fishing, and private boat consumptive diving are shown in Figures C-5, C-6, C-7, and C-8 respectively.

Insert Table 4-30, Figures 4-14,15,16,17 from CEQA Document, name them Table C-5, and Figures C-5 to C-8

In 1999, there were an estimated 42,008 person-days of non-consumptive recreation from "for hire" operations in the project area. As mentioned above, an estimate of the amount of non-consumptive recreation activity from private household boats was not possible. Whale watching was the top non-consumptive recreational activity with about 26 thousand person-days (62 percent of all non-consumptive recreation activity) followed by non-consumptive diving with almost 11 thousand person-days (26 percent of all non-consumptive recreation activity). Sailing and kayaking/island sightseeing accounted for the remaining 13 percent of non-consumptive recreation activity. Spatial distributions of whale watching, non-consumptive diving, sailing, and kayaking/island sightseeing are shown below in Figures C-9, C-10, C-11, and C-12, respectively.

Insert Figures 4-18, 4-19, 4-20, and 4-21from CEQA document and name them Figures C-9 to C-12

In 1999, the recreation industry included a total of 479,916 person-days of consumptive and non-consumptive recreation. Consumptive recreation was 91.25 percent of all recreation activity in the project area. The "for hire" industry (51 charter/party boat/guide operations) accounted for almost 46 percent of all the person-days of recreation activity. This is important because the estimates of use from this industry were based on a census, not a sample, of all operators who operate in the project area (Leeworthy and Wiley 2002

8.3.8.2. Expenditure Profiles

Table C-6 below shows the expenditure profiles developed for each activity/boat mode. Low food, beverage and lodging costs would indicate a low percentage of users being overnight visitors or dominated by local users. In 1999, coastal residents accounted for 86.7 percent of charter/party boat trips and 96.86 percent of private household boat trips for fishing in southern California (NMFS, MRFSS). Not all the profiles found had consistent categories; sometimes food and beverage was reported separately and sometimes they were aggregated together. When reported separately, the separated categories were used in the impact analysis. The profiles for charter/party boat fishing and private household/rental boat fishing are from a 2000 study of Southern California marine recreational fishing (Gentner, Price and Steinback 2001). See Leeworthy and Wiley (2002) for a discussion and critique of the approach used in an American Sportfishing Association report.

Insert Table 4-32 from CEQA document, call it Table C-6

8.3.8.3. Baseline Economic Impacts of Recreation in the Sanctuary

The baseline impacts of consumptive and non-consumptive recreational activities are summarized in Tables C-7 and C-8 below.

Insert Tables 4-33 and 34 from CEQA, call them C-7 and C-8.

8.3.9. Oil and Gas

Under Federal regulations, no new offshore oil or gas activity is allowed within the project area. Oil and gas development does occur in the Santa Barbara Channel. Current onshore facilities prepare crude oil for shipment to refining centers, and produce natural gas. A characterization of onshore facilities for offshore oil and gas activities is found in California Offshore Oil and Gas Energy Resources Baseline Conditions & Future Development Scenarios (MMS 1999). Oil and gas activities would not be affected by any of the action alternatives in a manner different from the no-project alternative.

8.3.10. Vessel Traffic and Harbors

8.3.10.1. Commercial Vessel Traffic

The Los Angeles-Long Beach Harbor is the busiest on the west coast (McGinnis, 1990). Commercial vessels use the shipping lanes of the Santa Barbara Channel. To help direct offshore vessel traffic in the Santa Barbara Channel, a Traffic Separation Scheme (TSS) was designated in the project area to separate opposing flows of vessel traffic into lanes, including a zone between lanes where traffic is to be avoided. Vessels are not required to use any designated TSS, but failure to use one would be a major factor for determining liability in the event of a collision.

The most recent survey of the number of commercial vessels that use the shipping lanes of the channel is found in the County of Santa Barbara Energy Division (1989) and the National Maritime Research Center (1981). The County of Santa Barbara (1989) study reported 8,458 vessels, or 23.3 trips per day, during 1987 and projected an estimated 15,864 per year, or 43.2 trips per day, during 2000. Commercial vessel traffic is not expected to be affected by any of the action alternatives in a manner different from the no-project alternative.

8.3.10.2. Ports and Harbors

Santa Barbara Harbor, built in 1926, is a 1,068-slip harbor and is used primarily by fishing, commercial, and recreational vessels. It is a popular destination for recreational boaters, fishermen, and tourists. The harbor offers a number of boating services including maintenance, hull cleaning, repairs, and towing.

Ventura Harbor, built in 1963, is located approximately 65 miles northwest of Los Angeles. The harbor has increased in size so that it now encompasses 152 acres of land, 122 acres of water, and has 1,375 slips. This small harbor is used primarily by recreational and commercial vessels, and provides several services and outdoor activities. Its proximity to the Channel Islands makes it an excellent point of origin for day or extended trips. Although it is used primarily by recreational and commercial fishing vessels, Ventura Harbor does offer berths for some supply and work vessels that service offshore platforms (MMS 1999).

Channel Islands Harbor is located in Oxnard, halfway between Ventura Harbor and Port Hueneme. With nine marinas and four yacht clubs, the harbor is home to more than 2,800 recreational and commercial vessels. Channel Islands Harbor is the closest harbor to the Channel Islands, making it a convenient location for day or extended trips. Public facilities and services include laundry rooms, restrooms and showers, picnic areas, marine supplies, and maintenance and repair shops. Vessels associated with the offshore oil and gas industry typically do not use Channel Islands Harbor (MMS 1999).

Port Hueneme is the only deep water port between Los Angeles and San Francisco, and is used by commercial ships to load and unload goods. Port Hueneme is also used by supply and crew vessels that service offshore platforms (MMS 1999).

9. Appendix D: The Marine Reserves Working Group Process

9.1. The Channel Islands Marine Reserves Process

9.1.1. A Federal, State and Local Community Partnership

In 1998, the California Fish and Game Commission (Commission) received a recommendation from a local recreational fishing group to create marine reserves5, or no-take zones, around the northern Channel Islands as a response to dwindling fish populations. This recommendation suggested closing 20 percent of the shoreline outward to 1 nautical mile to all fishing. The recommendation led to more than one year of public discussion of the issue in the Commission forum. In response to the proposal and the need for an open, constituent-based process consistent with Sanctuary and California Department of Fish and Game (CDFG) missions and mandates, the Sanctuary and the CDFG developed a Federal and State partnership, the Channel Islands Marine Reserves Process, to consider the establishment of marine reserves in the Sanctuary. The Commission endorsed this process at their March 4, 1999 meeting.

The Channel Islands National Marine Sanctuary Advisory Council, a federal advisory board of local community representatives and federal, state and local government agency representatives, created a multi-stakeholder Marine Reserves Working Group (MRWG) to seek agreement on a recommendation to the Sanctuary Advisory Council regarding the potential establishment of marine reserves within the Sanctuary. The Sanctuary Advisory Council also designated a Science Advisory Panel of recognized experts and NOAA led a Socio-economic Team to support the MRWG and Channel Islands Marine Reserves Process. Extensive scientific and socio-economic data were collected in support of the baseline assessment and marine reserves design process. From July 1999 to May 2001, the MRWG met monthly to receive, weigh, and integrate advice from technical advisors and the public and to develop a recommendation for the Sanctuary Advisory Council on the potential establishment of marine reserves in the Sanctuary.

The MRWG reached consensus on a set of ground rules, mission statement, problem statement and goals and objectives, a list of species of interest and a comprehensive suite of implementation recommendations. The goal statements included the following:

> To protect, maintain, restore, and enhance living marine resources, it is necessary to develop new management strategies that encompass an ecosystem perspective and promote collaboration between competing interests. One strategy is to develop reserves where all harvest is prohibited. Reserves provide a precautionary measure against the possible impacts of an expanding human population and management uncertainties, offer education and research opportunities, and provide reference areas to measure non-harvesting impacts.

[5] In a California State marine reserve it is unlawful to damage, take, or possess any living, geological, or cultural marine resource, except under a permit or specific authorization from the Fish and Game Commission for research, restoration, or monitoring purposes.

- *Ecosystem Biodiversity: To protect representative and unique marine habitats, ecological processes, and populations of interest.*

- *Socioeconomic: To maintain long-term socioeconomic viability while minimizing short-term socioeconomic losses to all users and dependent parties.*

- *Sustainable Fisheries: To achieve sustainable fisheries by integrating marine reserves into fisheries management.*

- *Natural and Cultural Heritage: To maintain areas for visitor, spiritual, and recreational opportunities which include cultural and ecological features and their associated values.*

- *Education: To foster stewardship of the marine environment by providing educational opportunities to increase awareness and encourage responsible use of resources.*

9.1.2. Community Development of Alternatives

The MRWG developed over 40 different designs for marine zoning and evaluated the ecological value and potential economic impact of each design. To do so, members of the MRWG contributed their own expertise to modify designs or generate alternatives to the designs developed by the Science Advisory Panel and utilized a geospatial tool, known as the Channel Islands Spatial Support and Analysis Tool (CI-SSAT; Killpack et al. 2000). CI-SSAT provided opportunities for visualization, manipulation, and analysis of data for the purpose of designing marine reserves.

CI-SSAT provides a computer-based environment for viewing and evaluating information (Killpack et al. 2000). The interface resembles a Geographic Information System (GIS) with optional viewing of spatially explicit data. Data can be selected or hidden, by checking a box beside the data label. Once the data have been selected, the user can zoom in or out to obtain broader or more detailed views.

In the Channel Islands case, CI-SSAT contained both ecological and economic data. The map of conservation "hotspots," generated using irreplaceability analysis in Sites V.1, was included in the CI-SSAT. The ecological data, including distributions of sediments, giant kelp, seagrasses, seabirds, and marine mammals, also were included. Ten options for networks of marine reserves, developed by the Science Advisory Panel, were available for purposes of comparison. The tool also contained maps showing the distributions of major commercial and recreational activities. Data describing the economic value of each planning unit to each fishery was not released by the fishing community for general viewing by the public in CI-SSAT. However, the economic information was contained within the tool and was used for impact evaluation of alternatives.

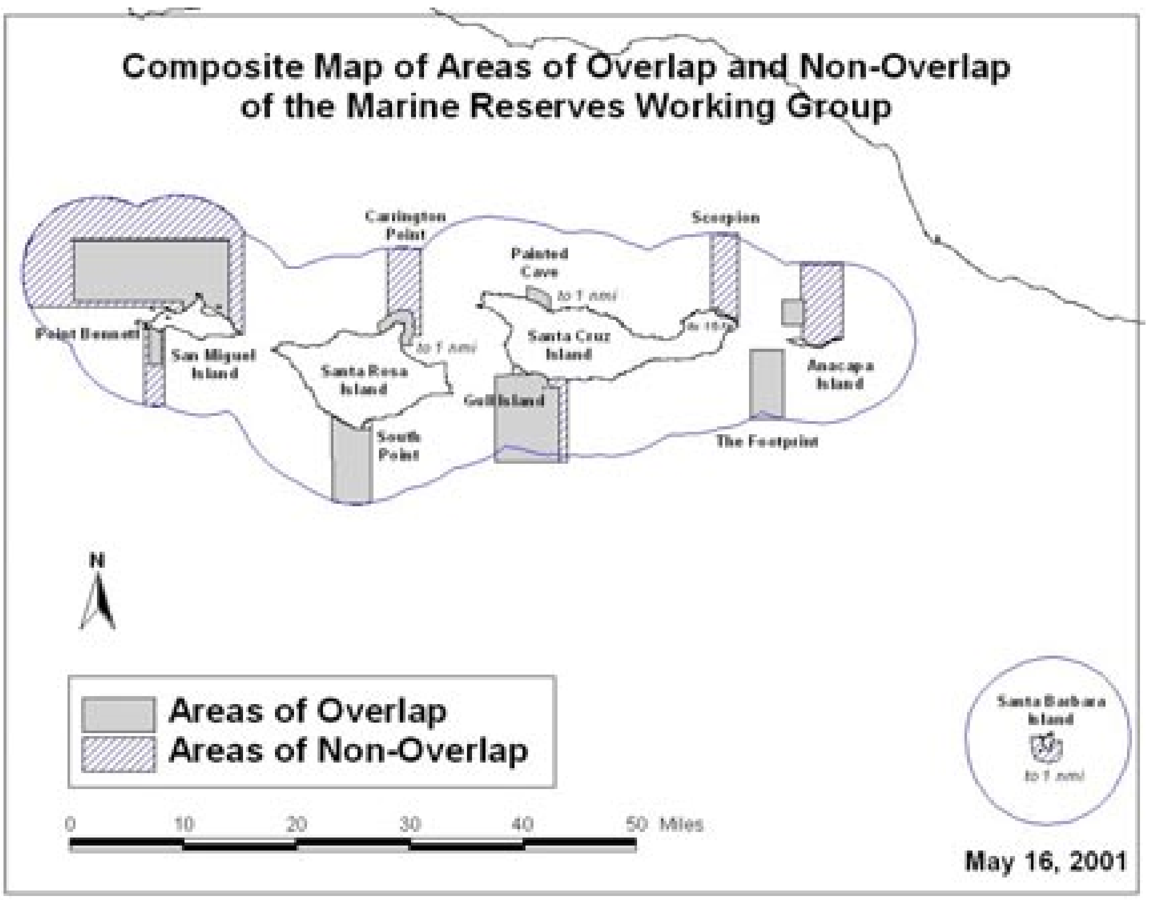
CI-SSAT is capable of performing an analysis similar to the irreplaceability analysis of Sites V.1. For any particular analysis, CI-SSAT generates a map, based on an initial weighting of ecological and economic criteria that shows how much each planning unit contributes to a design. If the user desires to produce a zoning plan based entirely on ecological criteria, the analysis will reflect only ecological data, and the biodiversity "hotspots" will be identified based on habitat heterogeneity, species diversity, and rare habitats or species. If the user desires to minimize economic impact of a zoning plan, then the CI-SSAT analysis selects the areas that have low overlap with existing commercial and recreational consumptive activities. If the user desires to balance ecological with economic criteria, the areas of conservation value will be selected in the sites that minimize economic impacts. The outcome is a compromise similar to a Sites V.1 annealing process with consideration of the economic cost of each planning unit. Once the analysis is completed, the user can work with the base map from the analysis to develop a marine zoning plan. In the Channel Islands case, the MRWG decided not to use CI-SSAT function to weight criteria. (Members of the working group agreed that the ecological and economic criteria should be weighted equally, but they were unwilling to work from a compromised map that contained incomplete socioeconomic information (due to the fishermen's desire for confidentiality of their business information).) Thus, CI-SSAT was more useful for visualization, exploration, and comparison of zoning plans developed by working group members.

CI-SSAT permits users to view or hide any ecological or economic data layer in the analysis. Simple drawing features allow users to create rectangles, circles, or odd shapes to represent potential reserves. Once the user has completed a zoning plan, a quick evaluation provides the user with (1) information about the amount of each habitat or portion of species' range captured within the reserve boundaries and (2) the potential impact of the reserve on major commercial industries and recreational activities. By adjusting the boundaries to include more of a particular habitat or species, or to reduce the impact to a particular industry or activity, CI-SSAT facilitates development of a marine zoning plan to meet the user's criteria. The tool supports rapid modification and real-time evaluation of alternatives.

After months of deliberation, the working group selected 2 designs to represent the diverse views of the group. The composite map depicts the best effort that each MRWG representative could propose and remain true to his/her constituency (Figure D-1). This composite map, along with the suite of 40 draft maps that were produced, and background scientific and economic information, were provided through the Sanctuary Advisory Council to the Sanctuary and CDFG for consideration. (Airamé, in prep.)

It is important to note that the MRWG considered a network of marine reserves throughout the entire Sanctuary (0-6 nm) that includes both state and federal waters. The development of ecological criteria and socioeconomic data also included the entire Sanctuary area.

Figure D-1. Composite Map of Areas of Overlap and Non-Overlap Marine Reserve Network Proposals



As directed by the ground rules, the MRWG forwarded all areas of consensus, non-agreement and the composite map to the Sanctuary Advisory Council. The Sanctuary Advisory Council evaluated the MRWG's work and progress, deliberated over two meetings, hosted a public forum on the issue, and forwarded a recommendation to the Sanctuary Manager:

> The Channel Islands National Marine Sanctuary Advisory Council commends the Sanctuary staff, Department of Fish and Game (DFG) and all participants of the MRWG, Science and Socio-Economic Panels on their efforts over the past two years. The Sanctuary Advisory Council finds that the MRWG, in seeking consensus on marine reserves, developed scientific and socio-economic data that should be used and built upon in future consideration of such issues. The Sanctuary Advisory Council finds that the MRWG process was open, inclusive and community based.

By a vote of 17 (yes), 1 (no), 1 (abstention), the Sanctuary Advisory Council agreed to:

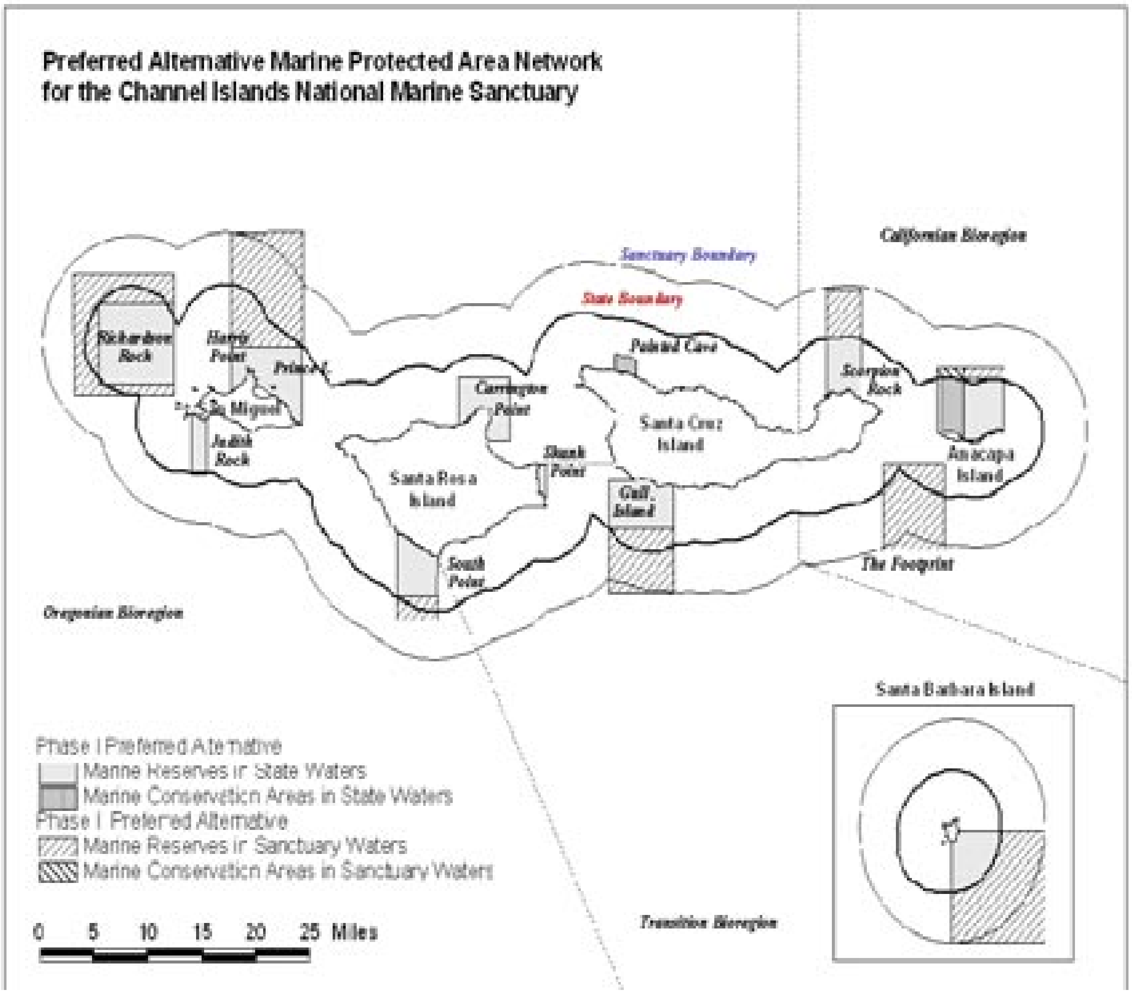
- Formally transmit the full public record of the MRWG and the Sanctuary Advisory Council regarding the development of reserves in the Sanctuary to the Sanctuary Manager;

- Charge the Sanctuary Manager and Department of Fish and Game staff to craft a final recommendation consistent with the Marine Reserve Working Group's consensus agreements for delivery to the Fish and Game Commission in August 2001;
- Request that the Sanctuary Manager and Department of Fish and Game work with the community to the maximum extent feasible in crafting this recommendation.

With this guidance, the Department and Sanctuary crafted a draft reserve network and sent it directly to the Sanctuary Advisory Council, former MRWG, Science Panel, Socio-Economic Panel members seeking further input. The draft reserve network was published in local papers and on the Sanctuary website to solicit input from the general public. Several meetings were held with constituent groups, including the Sanctuary Advisory Council Conservation Working Group, Fishing Group and Ports and Harbors Working Group to discuss the draft network. The Department and Sanctuary also met directly with former MRWG members and several written comments were received and considered.

In preparing a recommendation for the Fish and Game Commission, the Department and Sanctuary used the MRWG consensus statements as well as the MRWG Composite Map of Areas of Overlap and Non-Overlap as a foundation. The recommendation proposed a network of marine reserve and marine conservation areas in the same general locations as the MRWG Composite Map. On August 24, 2001, the Sanctuary and CDFG recommended to the Commission a network of reserves and conservation areas shown in Figure D-2, below, estimated at approximately 25% of the total area of the Sanctuary. This recommendation became the preferred alternative in the State's California Environmental Quality Act environmental review process.

Figure D-2: The State Of California's Preferred Network Alternative.



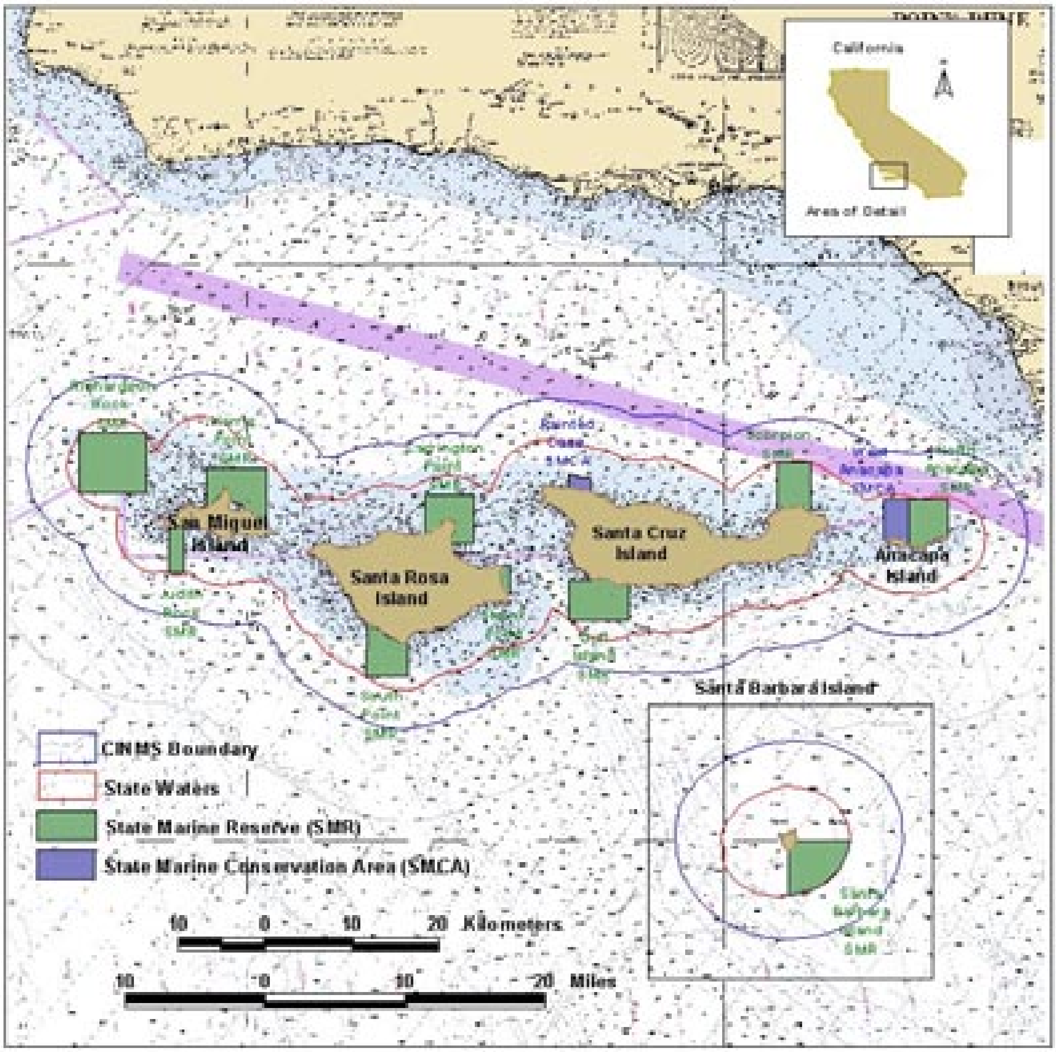
9.1.3. State Marine Protected Areas in the Sanctuary

The CDFG prepared environmental review documents pursuant to the California Environmental Quality Act (CEQA), which included an analysis of 5 alternatives reserves networks and the no project alternative. The reserve network developed by the CDFG and Sanctuary and shown above in Figure D-2 was identified as the preferred alternative. On October 23, 2002, with support from NOAA and the National Park Service, the Commission approved the preferred alternative and the establishment of 10 marine reserves and 2 conservation areas2 within State waters of the Sanctuary that encompass approximately 102 square nautical miles of the Sanctuary. The State's network went into effect on April 9, 2003.

The network alternatives analyzed in the CEQA document were split into an initial State waters phase and subsequent Federal phase. The State rulemaking process and the State environmental documents analyzed the potential cumulative effects of network alternatives in both state and federal waters of the sanctuary. The Commission's action implemented marine reserves and marine conservation areas only within the jurisdiction of the State of California. For enforcement purposes, many of the State marine reserve and marine conservation areas were "squared off," meaning that the outside boundary was drawn on a straight line of latitude, well inside the State's 3 nm jurisdiction. The Harris Point Marine Reserve off San Miguel Island and the Gull Island Marine Reserve off Santa Cruz Island illustrate this point. The State anticipated that the federal government would propose complementary reserves within the adjacent deeper waters to complete the network.

The State's designated marine reserve and marine conservation areas are considered part of the environmental baseline that needs to be taken into account as any additional federal marine reserve and marine conservation areas are considered and proposed in the Draft Environmental Impact Statement. See Figure D-3 below for a map of the State marine reserve and marine conservation areas in the Sanctuary.

FigureD-3: Existing State Marine Reserve And Marine Conservation Areas In The Channel Islands National Marine Sanctuary



9.2. Factors Considered in the Channel Islands Reserves Process and Also Considered in the Drafting of Alternatives 1-3

9.2.1. Administrative Capacity – Monitoring and Enforcement Criteria

To Be Included

A detailed biological and socioeconomic monitoring plan is provided in Appendix G.

9.2.2. Enforcement Considerations

State and Federal enforcement officers were consulted during the Channel Islands Marine Reserves Process as well as local recreational and commercial mariners who participated in the MRWG public forums. There was consistent agreement that any marine reserve proposals should be mapped with clear and discernable boundaries that match major points of land and terrestrial features, and that boundary coordinates should be set on the nearest whole minutes of latitude and longitude. In addition, "Specific to the extension of Marine Protected Areas from State waters to federal waters, the PFMC Enforcement Consultants believes rules should be consistent between the two jurisdictions. The concept of maintaining consistency in rulemaking should also apply in the development of sanctuary regulation in general" (Supplemental EC Report June 2003). This is why Alternatives 1-3 all propose to use consistent federal regulatory language to describe federal areas adjacent to established state areas.

Complementary regulations are called for in the Cooperative Enforcement Agreement between NOAA and the State of California, signed May 2002. The State of California and Secretary of Commerce agreed to promote the adoption of appropriate and complementary conservation, management and enforcement measures and regulations pursuant to the NMSA and the California Fish and Game statutes and regulations.

9.2.3. Ecological Criteria

The design of alternatives depends on the desired outcome of the management effort. One of the desired outcomes is to ensure the long-term protection of Sanctuary resources. The proposed actions to achieve the desired outcome include (1) setting aside representative habitats and natural biological communities and (2) restoring abundance, density, diversity and age structure of natural biological populations.

Ecological criteria for design of alternatives to address the desired outcomes have been described extensively in the ecological literature. The Science Advisory Panel assembled a set of ecological criteria for the design of a network of marine reserves to meet the desired outcomes of the MRWG. It is important to note that the ecological criteria were developed for the entire design process, including state and federal waters. The ecological criteria are described in more detail below and are summarized in Table D-2.

9.2.4. Biogeographic Representation

Protection of all biogeographic regions is essential for conservation of biodiversity (Roberts et al. 2003a). By definition, biogeographic regions are characterized by unique assemblages of species. Although ranges of some species may extend across several adjacent biogeographic regions, transitions between biogeographic regions are characterized by coincidence of range endpoints for many species. Reserves in one bioregion are not likely to serve an adjacent bioregion because connectivity across biogeographic boundaries is likely to be low (Roberts et al. 2003a). The transitions between major biogeographic regions are dynamic. Persistent thermoclines, which often mark the transition between biogeographic regions, may shift tens of miles or more during environmental fluctuations such as El Niño -Southern Oscillation (McGowan et al., 1998). Transition zones between biogeographic regions should be included in reserves because conservation of transitions will contribute to conservation of genetic diversity (Roberts et al. 2003a). In addition, shifts in species distributions, arising from large-scale factors such as climate change, can be detected most rapidly in a transition zone, where conditions already may be suboptimal for many species. Roberts et al. (2001) recommended an autonomous marine reserve network for each distinct biogeographic region contained within a planning region.

The Science Advisory Panel used available information on sea surface temperature (ICESS, 2001) and species distributions to identify the biogeographic regions in the Channel Islands. The Science Advisory Panel drew biogeographic boundaries in the areas of sharpest transition between large bodies of water, following 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). The Science Advisory Panel recommended one to four areas be designated within each of the three biogeographic regions, comprising approximately 30-50 percent of the area in the Channel Islands National Marine Sanctuary (CDFG 2002).

9.2.5. Habitat Representation And Heterogeneity

For biodiversity conservation, all representative and unique marine habitats should be protected within marine reserves (Roberts et al. 2001, Jones 2002, Stevens 2002, Roberts et al. 2003a). “Each habitat type has an intrinsic functional position in marine ecosystems and thus, an inherent conservation value” (Stevens 2002). By protecting representative habitats, marine reserves conserve ecosystems, including living marine resources and ecological linkages within those systems (NRC 2001). Unless management objectives identify particular habitats for conservation, the total area set aside for the protection of each habitat should be approximately related to its relative prevalence in the planning region (Sala 2002, Roberts et al. 2003b). Protecting the same habitat type in multiple reserves reduces the risk of catastrophic loss of any of the habitat types and supports the exchange of larvae and adults among sites, contributing to the persistence of local populations and metapopulations. A network design, with multiple patches of the same habitat in different reserves, is required to measure effects of the reserve in monitoring and research programs.

Classification by habitat type often represents marine community and ecosystems characteristics better than individual species distributions (Ward 1999). The number of species in a particular area generally increases with the number of habitat types. Thus, habitat heterogeneity, or the cooccurrence of many different habitat types, acts as a proxy for the number of species (Jones 2002, Roberts et al. 2003a). Because organisms often use more than one habitat, it is important to include several habitats within a reserve (Carr and Reed 1993) and thus adjacency of habitats is an important consideration. Some consideration must be given to the size of each patch of habitat. If a small area is divided into many habitats, there is a risk that each patch will be too small to support viable populations (Roberts et al. 2003a).

The Science Advisory Panel developed a simple, multidimensional habitat classification, using depth, exposure, substrate type, dominant plant assemblages, and a variety of additional features. The Science Advisory Panel distinguished four ecological zones: (1) the euphotic zone from 0 to 30 m, (2) the shallow continental shelf from 30 to 100 m, (3) the deep continental shelf from 100 to 200 m, and (4) the continental slope below 200 m. One important reason for the proposed addition of marine reserves and marine conservation areas in federal waters is that this will generally increase network representation of habitats in the deeper ecological zones 3 and 4.

Within each ecological zone, sediment types were identified from various sources, including a Shoreline Inventory Database (MMS, 2000) that describes a variety of coastal features in Santa Barbara County, a map 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, unpub. data,) and a substrate map 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 Channel Islands National Marine Sanctuary, divided into soft substrate (e.g., mud, sand, gravel) and hard substrate (e.g., rock, boulder, bedrock)" (CDFG 2002). 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). To achieve the desired outcome, the Science Advisory Panel recommended setting aside at least 30 – 50 percent of each habitat type within each ecological zone.

9.2.6. Vulnerable Habitats

Consider EFH definition and application

Vulnerable marine habitats require protection from human threats and catastrophic events (Roberts et al. 2003a). To ensure that such habitats were adequately represented, vulnerable habitats including seagrass meadows and deepwater sponges and corals were considered explicitly in the design of protected areas in the Channel Islands. Intertidal surfgrass meadows were mapped for the Bureau of Land Management using helicopter surveys (Littler and Littler 1979). Eelgrass meadows were mapped at six sites on Santa Cruz Island and two sites on both Anacapa and Santa Rosa Islands (Engle et al. 1998). The scarcity and relatively small size of eelgrass meadows in the Channel Islands restricted the potential locations of reserves. Eelgrass meadows were included in Carrington SMR, Scorpion Rock SMR, and Anacapa Island SMCA. Surfgrass beds are included in the majority of State marine reserve and marine conservation areas, including Harris Point SMR, Carrington Point SMR, Skunk Point SMR, Gull Island SMR, North Anacapa Island SMR and SMCA, and Santa Barbara Islands SMR.

Qualitative discussion of submersible observations of vulnerable habitats and conditions within Sanctuary/deepwater sponges, corals

9.2.7. Physical Processes

In marine environments, the water column is a dynamic habitat, influenced by physical processes such as currents, jets, eddies, waves, and upwelling. Currents and jets influence the distribution of organisms by transporting larvae from one place to another. Eddies contribute to retention of local production. Upwelling contributes to local production by transporting nutrients from depth to surface waters where the combination of light and nutrients supports rapid growth of phytoplankton.

Marine reserves may serve different functions depending on the physical processes within and around the reserves. Because upwelling sites support high productivity, they may be good locations for reserves if management goals are to restore and protect abundance and diversity of marine organisms. Reserves placed in an area exposed to a strong and directional current are likely to receive organisms from upstream sites. Additionally, these sites may be good locations for reserves because the increased level of production within reserves will be transported to surrounding areas on regional currents. Reserves in areas with reduced or no currents serve different goals, restoring and enhancing local production, but contributing little to surrounding waters.

The Science Advisory Panel considered physical processes in the design of marine reserves. The panel recommended that some reserves should be located in areas of strong and directional currents, in order to contribute to regional production, and that other reserves be located in areas of reduced or no currents, in order to restore and enhance local abundance, density and diversity of marine organisms. The panel also recommended that some upwelling sites be included in marine reserves, given sufficient data on the locations of such sites.

9.2.8. Species of Interest

One of the desired outcomes of the proposed action is to protect and restore abundance, density and diversity of marine species in the Channel Islands. Certain marine species are particularly vulnerable to extirpation and extinction (Roberts and Hawkins 1999). Species that depend on limited, vulnerable or patchy habitats may require special consideration. Species with small geographic ranges are vulnerable to environmental shifts and catastrophic events. Low fecundity, unpredictable recruitment and slow growth also are characteristics that make species vulnerable to fishing and other activities or events that remove large proportions of reproductive adults (Jones 2002).

Species may be vulnerable to fishing during one or several developmental stages. Many species have life histories that include migration, aggregation to spawn, larval dispersal, juvenile settlement, and other habitat-specific ontogenetic transitions (Roberts et al. 2003a). Marine reserves may be used to protect habitats that support vulnerable life stages (Jones 2002, Roberts et al. 2003a). The entire life cycles of species of interest should be considered in reserve design, because placing a reserve in one location, for example, to protect a spawning aggregation, may shift fishing effort to another critical habitat, such as a migration bottleneck (Roberts et al. 2003a).

Many targeted species, particularly the nearshore groundfishes, could benefit from protection by no-take marine reserves (Yoklavich 1998, Parrish et al. 2000, NRC 2001, Shipp 2003). Marine reserves will contribute to fisheries to the degree that they protect or have the potential to protect targeted species (Roberts et al. 2003a). In addition, reserves can be a useful tool for protecting non-targeted species that are susceptible to particular fishing gears (Shipp 2003). Non-targeted species may benefit from marine reserves established for targeted species through reduced incidental damage from fishing.

The MRWG and the Science Advisory Panel identified 119 species of interest in the Channel Islands, including plants, invertebrates, fish, seabirds, and marine mammals (shown in Table D-1, below). The final species list was agreed to by consensus of all MRWG members. The Science Advisory Panel recommended setting aside representative portions of all ecologically relevant habitat types to restore and enhance all species of interest and ecological linkages.

Insert Table D-1 here: list of 119 species of interest.

9.2.9. Reserve Size

The size and spacing of marine reserves depends on the specific goals of the reserves (Botsford et al. 2003). For biodiversity conservation, larger reserves will contain a greater variety of habitats and species of interest. Thus, larger reserves afford more protection for biodiversity (Daan 1993, Clark 1996, Sumaila 1998, Roberts and Hawkins 2000, NRC 2001, Roberts et al. 2003b). An interconnected network of medium and small reserves located throughout a management area will contribute more to fisheries than a few large reserves, unless the reserves become too small to contribute to local production (Jameson et al. 2002, Roberts et al. 2003b). Ideally, reserves for fisheries will be large enough to contribute to local production and small enough to allow spillover and export functions (Guenette et al. 1998, Hastings and Botsford 2003, Roberts et al. 2003b; Halpern and Warner 2003).

Given the diversity of marine habitats and life history strategies, no simple spatial target can describe the minimum area needed to conserve biodiversity of any given ecosystem (Agardy et al. 2003). Size of reserves depends on life history and dispersal characteristics of species of interest (Botsford et al. 2003). If juvenile and adult dispersal is high, larger reserves will be needed for their conservation (Gerber et al. 2003).

Fishing mortality rates in areas outside reserves also affect the size of reserves designed for biodiversity conservation and sustainable fisheries. Modeling efforts by Gerber et al. (2003) indicate that larger reserves are needed to sustain fisheries that are subjected to high fishing effort. Similarly, Pitcher et al. (2002) determined that, even with habitat enhancement, small reserves would do little to reverse fishery declines in a reef fishery.

Large reserves almost always initially contain more species, including rare species, than small reserves (Halpern 2003). Large reserves may be necessary to protect species of interest that use more than one habitat during their lives (Halpern 2003). Large reserves are necessary if the management goal is to create refuges for species with high dispersal (Salomon et al. 2002). Because of smaller edge-to-area ratios, large reserves experience fewer edge effects than small reserves. Although reserves designed to reduce edge effects will address biodiversity conservation, small edge-to-area ratios also limit the potential for spillover and export to fisheries (Frieldlander et al. 2003).

Small reserves with large edge-to-area ratios may export a greater proportion of larvae and adults than large reserves (Roberts et al. 2003a). However, small reserves may not be effective in sustaining species that have high dispersal potential (Friedlander et al. 2003). Further, small reserves can be susceptible to catastrophic events, such as large storms or extreme low tides that could wipe out a population within a single event (Halpern 2003, Roberts et al. 2003a). If small reserves cannot sustain populations within their boundaries, they will not achieve biodiversity, fishery, or other management objectives (Roberts et al. 2003a). Small reserves may be effective if they are designed to maintain essential ecological linkages between species of interest and the habitats they require. Small reserves can be effective if they are strategically located, for example, along migratory routes or on spawning grounds (Halpern 2003).

9.2.10. Suggested Sizes

Examination of fisheries indicates that the minimum threshold population size for long-term persistence varies with the life history characteristics of the species and that the fraction of natural settlement required for persistence falls within a broad range between 20 and 50 percent (NRC 2001, Roberts et al. 2003a), and possibly up to 70 percent (Mace and Sissenwine 1993, Hannesson 1998, Lauck et al. 1998). Modeling efforts by Doyen and Béne (2003) suggest that protecting 25 percent of a fishery stock in marine reserves would ensure the sustainability of the stock. Foran and Fujita (1999) recommend protecting 25 percent in reserves to rebuild reproductive output of an overfished species (Pacific Ocean Perch) and Guenette and Pitcher (1999) recommend setting aside at least 30 percent to provide a larger spawning biomass for cod. Mangel (2000) suggested 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 to 40 percent of the region of influence is needed to elevate overexploited stocks to sustainable target levels. 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. Collectively, these models suggest that marine reserves can contribute to a sustainable fishery if the reserve area includes a substantial proportion of critical habitats.

Another approach is to determine the area needed to conserve at least a portion of all representative species and/or habitats. Numerous studies have examined the distributions of species to determine the minimum area needed for representation of all habitats and/or species of interest. Bustamante et al. 1999 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 biogeographic zones encompassed by the archipelago in the reserve. Bustamante et al. (1999) 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 to 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). Ryers et al. (2000) found that 41 percent of locations were required for complete representation of all species, based on richness and rarity algorithms. Ward et al. (1999) found that complete representation of fish and invertebrate groups required protection of 80 percent of locations. In general, these studies indicate that substantial area must be set aside to protect the full complement of species and habitats, particularly if some species have specialized and unique habitat requirements (Gladstone 2002).

Another approach is to determine potential dispersal length of species of interest to identify necessary reserve size. Models suggest that reserves must be as large as the mean larval dispersal distance in order to sustain populations of interest (Palumbi 2003). An examination of genetic structure of marine populations indicates that reserves on the order of 10-20 km in size could sustain species that show genetic isolation by distance (Palumbi 2003). Shanks et al. (2003) determined that individual reserves, at least 4-6 km in diameter, are needed to allow larvae with short dispersal distances to settle within the reserve. Several experts have suggested that a network of medium and small reserves would encompass a broad array of dispersal potentials, contributing to biodiversity and fisheries conservation.

Although reserve size is an important component of effective design, it cannot be the sole criterion. Inclusion of representative habitats is equally important to the success of marine reserves. Further, reserves are likely to demonstrate the largest and most rapid changes in biomass in areas recently experienced high fishing effort. No matter what their size, reserves are not likely to increase production if they are placed within unproductive habitats where little fishing occurs (Gerber et al. 2003). Considering the results of fisheries models, species representation, and dispersal lengths, the Science Advisory Panel recommended that protecting at least 30 percent and possibly up to 50 percent of the representative habitats in each of the biogeographic regions of the Channel Islands would contribute to the desired outcomes of the proposed action.

9.2.11. Reserve Connectivity and Spacing

Large reserves, which contain representative habitats and sufficient larval settlement, may be used effectively to restore and enhance populations of interest (Roberts et al. 2003b, Shanks et al. 2003). However, a network of medium and small reserves may be the most efficient way to achieve objectives of conservation and fishery management (Hastings and Botsford 2003). Protecting several different sites in a network of reserves builds in the redundancy needed to include a greater proportion of representative habitats (Hastings and Botsford 2003) and prevent catastrophic and simultaneous loss of all reserves (Allison et al. 2003).

Although a small reserve may not sustain a particular population, the population may persist through recruitment of larvae produced by other reserves in a coordinated network (Palumbi 2003 and Hastings and Botsford 2003). For species with low larval retention, sustainability of the reserve population may depend on recruitment from reproductive populations in surrounding waters (Roberts et al. 2003a). If several reserves are placed within the dispersal range of species of interest, the reserves might serve as stepping-stones between populations (Roberts 1997).

The design of networks of marine reserves depends on larval dispersal distances and population connectivity (Botsford et al. 2001). Connectivity is estimated as the amount of exchange of larvae, recruits, juveniles, and adults between populations within a species' range (DeMartini 1993, Palumbi 2003).

Larval dispersal rates are influenced by time in the plankton, strength and direction of currents, and larval behavior (Palumbi 2003, Shanks et al. 2003). Species that spend a short time in the plankton tend to disperse short distances compared to species that have a longer developmental phase (Shanks et al. 2003). Larval swimming increases the probability of local retention, particularly when larvae swim down, avoiding entrainment in surface currents (Tankersley et al 1995).

When they have been estimated directly, dispersal distances for marine species range from meters to thousands of kilometers (Shanks et al. 2003). The presence of larvae of coastal marine species in the mid-ocean plankton suggests the potential for long-distance dispersal (Scheltema 1986). The spread of invasive species provides an estimate of potential annual dispersal distances (Palumbi 2003). Larval dispersal also can be estimated indirectly through population genetic structure (Kinlan and Gaines 2003). Palumbi (2003) estimated mean larval dispersal distances on the order of 25-150 km from isolation by distance comparisons.

Because of the diversity of life history strategies, no single reserve configuration will satisfy goals for biodiversity and fisheries conservation in all marine ecosystems. Reserve designs must consider the unique characteristics of the habitats and species of interest (Grantham et al. 2003).

Reserves afford the greatest amount of protection for species with low rates of dispersal, contributing to biodiversity conservation (Botsford et al. 2003). Species with intermediate rates of dispersal are likely to spend some time in reserves and some time in unprotected waters, contributing to sustainable fisheries (Botsford et al. 2003). Species with high rates of dispersal may not receive sufficient protection within a reserve or a network of reserves (Gerber et al. 2003); for species with high dispersal, other approaches to management are critical. To be sustainable, a single reserve must encompass the dispersal potential of species of interest (Grantham et al. 2003, Largier 2003). Larger reserves are needed to sustain species with longer larval distances (Botsford et al. 2003).

Reserves should be spaced at intervals less than the minimum dispersal distance of long-distance dispersers. Shanks et al. (2003) determined that the minimum dispersal distance among some species was 20 km/yr, suggesting that reserves should be spaced no more than 20 km apart. Based on larval dispersal patterns, Sala et al. (2002) determined that the distance between adjacent reserves in the Gulf of California should not exceed 100 km.

The predominant direction of dispersal also influences the spacing of reserves. In places where currents are strongly directional, reserves that are upstream are most likely to contribute to recruitment in the region (Gaines et al. 2003, Roberts et al. 2003b). If currents are strongly directional, multiple reserves are likely to contribute more than a single reserve of the same total area (Gaines et al. 2003). Protecting reserves in different locations takes advantage of high connectivity in systems with strong current patterns (Gaines et al. 2003). In places where currents are reduced or reverse directions, production in reserves is likely to contribute to local recruitment. Local eddies also may contribute to local retention of larvae (Lee et al. 1994 and Limouzy-Paris et al. 1997). If possible, marine reserves should capture some portion of local retention zones where larvae accumulate prior to settlement (Wing et al. 1998).

9.2.12. Human And Natural Threats

Human and natural threats may prevent marine reserves from achieving the desired outcomes (Allison et al. 2003). Reserves are unlikely to be effective if they are located in areas that a subjected to frequent stresses (Jameson et al. 2002, Roberts et al. 2003a). Natural threats include large storms, floods, epidemic diseases, hypoxic events, harmful algal blooms, and global climate change (Roberts et al. 2003a). Various human activities may threaten the integrity of marine ecosystems, including input of pollutants, fishing, anchoring, oil drilling, laying cable and other activities that alter the seafloor. Fishing may cause irreversible damage to habitats, rendering them unsuitable for marine reserves (Roberts et al. 2003a). Modified habitats are not likely to support the recovery of exploited species (Roberts et al. 2003a).

Planners should expect some loss of or damage to habitat within reserves due to unpredictable effects of human and natural threats. Reserves are more likely to achieve goals for biodiversity and fisheries conservation if the reserve area is not simultaneously impacted by catastrophic events (Allison et al. 2003). Increasing the number or size of individual reserves will reduce the risk of loss or damage due to human and natural threats (Allison et al. 2003, Roberts et al. 2003a). Allison et al. (2003) provide a mechanism for estimating the additional area required to buffer reserves against the effects of catastrophic events. This “insurance factor” is a function of the fraction of the coastline affected by catastrophes each year and the amount of time it takes a site to recover from the catastrophe (Allison et al. 2003).

Larger reserves will contain more species and larger populations are more likely to survive periodic disturbances (Roberts and Hawkins 2000). If possible, reserves should be spaced at sufficient distances to prevent adjacent reserves from experiencing loss from the same catastrophic event. Elimination of threats is impossible if the threats occur at the scale of marine ecosystems, such as global warming.

9.2.13. Site Monitoring

The biological diversity of the Channel Islands has attracted the attention of marine scientists for over a century. Thousands of articles, academic papers, and videos document the distributions and abundances of marine organisms and their habitats around the islands. Numerous studies document ecological processes, including interactions between species. The wealth of information about the biology of the Channel Islands region now provides an historical baseline, which can be used by management agencies to evaluate new management strategies, such as marine reserves.

Over 40 current monitoring programs investigate the ecological patterns and processes of marine populations, communities, and ecosystems in the Channel Islands region (Abeles et al. 2003). Many of these programs can provide the information necessary to assess ecological impacts of marine reserve and marine conservation areas. The Science Advisory Panel recommended locating monitoring sites inside and outside of marine reserve and marine conservation areas in order to detect the ecological impacts of marine reserve and marine conservation areas.

The state marine reserve and marine conservation areas, established in April 2003, include numerous shallow benthic monitoring sites. Six of 16 kelp forest monitoring sites are in state marine reserve and marine conservation areas. These sites are monitored annually for a variety of characteristics including algal cover, invertebrate and fish population levels and diversity. One of PISCO's historical subtidal monitoring sites is included in a state reserve and, after the marine reserve and marine conservation areas were established, PISCO conducted subtidal surveys in 7 of the 12 marine reserve and marine conservation areas during the summer of 2003. Paired monitoring sites were surveyed outside the reserves in order to detect differences between reserve and non-reserve sites.

Fewer monitoring programs exist in offshore and deep water than shallow nearshore habitats. Following the recommendation of the Science Advisory Panel, the proposed marine reserve and marine conservation areas should include some, but not all, of the offshore and deepwater monitoring sites. Midwater trawl surveys have been conducted in the Santa Barbara Channel and off of the Channel Islands since 1995 (Nishimoto, M., personal communication). Midwater trawl surveys were conducted in state marine reserve and marine conservation areas at Scorpion, Gull Island, South Point, and Anacapa Island. Midwater trawl surveys were conducted in proposed reserve areas at Harris Point, South Point, Gull Island, Scorpion, and Anacapa Island. Deepwater submersible surveys have been conducted throughout the Southern California Bight since 1995 (Love, M., personal communication). Deepwater submersible surveys have been conducted in state marine reserves at Richardson Rock, Gull Island, and Santa Barbara Island. Deepwater submersible surveys have been conducted in proposed reserves offshore of Harris Point, Richardson Rock, and Santa Barbara Island. Trawl surveys and sediment grabs were made throughout the Southern California Bight in 1998 and 2003 (Fangman, S., personal communication). Trawl surveys occurred in the areas designated as state marine reserve and marine conservation areas at Judith Rock, Harris Point, Gull Island, Scorpion, Anacapa Island, and Santa Barbara Island. Trawl surveys occurred in proposed reserves at Harris Point and Anacapa Island.

The existing monitoring programs were not designed within the context of the newly established marine reserve and marine conservation areas. As a consequence existing programs may need to be modified or expanded, and new programs may need to be developed, in order to assess the ecological impacts of protected areas. CDFG and the Sanctuary have worked together with other research and monitoring agencies, partners, and local stakeholders to develop a detailed monitoring plan, as shown in Appendix G. This monitoring plan will continue to be refined and adjusted, particularly if areas in deeper waters are added to the network.

9.3. Review of Ecological Criteria

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 Panel's 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 goal of limiting impacts to fisheries became the limiting factor for the upper bound.

Table D-1: Ecological Criteria For Marine Reserve Design

Ecological Criteria (Roberts et al. 2003)	Application to the Channel Islands
Biogeographic representation	Three major biogeographic regions were identified using data on biota and SST.
Habitat representation	Representative and unique marine habitats in each biogeographic region were classified using depth, exposure, substrate type, dominant plant assemblages, and a variety of additional features.
Physical processes	Currents were considered in the design of alternatives because they contribute to regional transport or retention of larvae. Areas of upwelling were considered because they contribute to high local production.
Species of special concern	Island coastlines and emergent rocks were weighted according to the distributions of pinniped haul-outs and seabird colonies. Habitats likely to support vulnerable and/or targeted species, especially rockfishes, were identified for the design process.
Size and connectivity	At least one, and no more than four, reserves were located in each of the three biogeographic regions. The distances between reserves were considered in the design process in order to maximize the transfer of organisms between protected areas.
Human threats and natural catastrophes	The reserve size recommended to achieve desired outcomes in a stable environment (30-50 percent) was multiplied by an "insurance factor" that accounts for the frequency of severe disturbances (1.2-1.8). No areas were excluded from the process because of equal risk throughout the islands.
Monitoring sites	Data from monitoring sites provide information about historical patterns and processes. Some monitoring sites were included in reserves and some remained outside reserves so that scientists will be able to determine the ecological impacts of reserves relative to natural variability.

9.3.1. Applying Analytical Data

The Science Advisory Panel used Sites V.1 to evaluate spatial data and develop options for marine reserve design. Versions of this tool have been applied to locate terrestrial reserves for The Nature Conservancy and marine reserves in Australia (Lewis et al. 2003), Canada (Ardron 2002), Mexico (Sala et al. 2003), and Florida (Leslie et al. 2003). A description of Sites and the Sites software are available on the internet at www.ecology.uq.edu.au/marxan.htm.

To generate a suite of marine reserve and marine conservation areas designs, Sites V.1 requires continuous data, a list of explicit criteria, and targets for representation of each criterion. In the Channel Islands case, scientists organized ecological data by biogeographic region. Scientists identified specific targets for different habitats and species, based on the overall abundance of these features in the study region. In different analyses, the Sites program included (in a set of potential reserve sites) 30%, 40%, and 50% of each habitat or feature in each biogeographic region.

Sites V.1 applies a process known as "simulated annealing" to identify components within the study areas that contribute to management goals (Possingham et al. 2000). The Sites program randomly generates an initial reserve system that includes the target percentage of each habitat and feature. The program then calculates an objective function based on the input parameters. The objective function consists of two main sections; the first is a measure of the cost of the reserve system (currently based on the boundary length of each planning unit) and the second is a penalty for violating various goals and objectives. For the Channel Islands case, the perimeter or "boundary length" of each 1 x 1 nmi2 planning unit was used as the cost in the ecological analysis. Sites V.1 attempts to minimize the boundary length in order to produce the most efficient solutions. The program evaluated 1,000,000 annealing iterations per run. At each iteration, a planning unit is chosen at random which might or might not already be in the reserve system. The program evaluates the change to the value of the reserve system that would occur if this planning unit were added or removed from the system. At each step, the new solution is compared to the previous solution, and the best one is accepted.

The minimum set approach does not account explicitly for the spatial relationships among the sites selected for the reserve system. Without some modification or additional constraints, the final reserve system will almost always be highly fragmented and, thus, inappropriate. Fragmentation is a problem because there are both ecological and economic reasons why reserves should be spatially contiguous with low edge to area ratios. Clustering of reserve sites can be achieved by including an adjacency constraint and minimizing the boundary length of the reserve system. The boundary length modifier was set to a value of 1, which clusters planning units into discrete potential reserve sites.

The Science Advisory Panel generated hundreds of potential options using Sites. A large number of good solutions may satisfy a single set of input criteria. Each solution is given a score equal to the conservation value minus the cost (boundary length) of the reserve. The "best" solution of all runs is the scenario with the greatest conservation value and the lowest cost. The summary details of each run include the target for each habitat or feature, whether or not the target was met, the proportion of the target met, and the actual area of the habitat or feature that was included in the best scenario. The data are grouped by biogeographic region and target percentage.

Sites V.1 provides an "irreplaceability analysis," which indicates the number of times each planning unit was included in the suite of design options. The irreplaceability analysis was converted to a list of percentages by dividing the number of times each planning unit was selected for the final scenario by the total number of planning units in the biographic region. For example, planning units that are selected in 70%, 80%, or 90% of the runs are likely to have high conservation value, whereas planning units that are selected in 5% or 10% of the runs are likely to have lower conservation value. The irreplaceability analysis is particularly valuable for advancing discussions about marine zoning because biodiversity "hotspots" can be identified from the map of irreplaceability values. In the Channel Islands process, the map of irreplaceability values provided the foundation for discussions about reserve design (See Development of Alternatives, below).

Because a large number of solutions may satisfy a single set of input criteria, it is important to understand the similarities and differences among solutions. Solutions were compared using cluster analysis in Primer v. 4, a statistical program developed by the Plymouth Marine Laboratory. The 100 top ranking solutions were selected from the total runs (which varied from

314 to 786 for each biogeographic region, depending on size of the region). For each run, planning units were assigned a value of 1 if they were included in the final solution or 0 if they were not. The Bray-Curtis similarity between solutions was calculated for the 100 top ranking solutions. The Primer statistical program created a dendrogram, or hierarchical branching diagram, showing the relationships between the 100 top ranking solutions. Similar solutions were clustered together whereas dissimilar solutions were placed more distantly from each other on the dendrogram.

Clusters of solutions were divided into groups based on Bray-Curtis similarity among clusters. For most analyses, solutions with more than 60% similarity were grouped together. However, the input criteria at 30% set-aside in the Oregonian Province and the Transition Zone produced large numbers of dissimilar solutions that exhibited high conservation value. Therefore, clusters of solutions at 30% set-aside for the Oregonian Province and the Transition Zone were grouped together above 40% similarity. Grouping based on Bray-Curtis similarity produced approximately 5 groups per analysis. If the grouping algorithm produced more than 5 groups, the group with the lowest high score was removed from the analysis. Solutions within each cluster were ranked according to conservation value. The top ranking solution in each cluster was selected for consideration by the MRWG.

9.3.2. Socioeconomic Criteria

A number of diverse data sources and methods were used to estimate both the total amount and spatial distribution of use 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 during the Channel Islands Marine Reserves Process. The following sources of information provided insight to the values and various uses of the Sanctuary:

- California Department of Fish and Game commercial fishing data showing where fish are caught and the ports where fish are landed 14 commercial species/species groups mapped on a 1-minute by 1-minute distributions of catch
- Socioeconomic profiles of the fishermen (e.g., experience, age, education, income, dependency on fishing, people and family members directly employed, investment/ownership of boat and equipment, place of residence and home and landing ports)
- Commercial fishermen costs and earnings
- Kelp harvesting and processing information (obtained from ISP Alginates)
- Surveys of recreational “for hire” operators (achieved a Census)
- National Marine Fisheries Service, Marine Recreational Fishing Statistics Survey for intercept/access points for those fishing from private household boats
- Aerial flyover data for boating activities from the Channel Islands National Marine Sanctuary
- An ethnographic survey of a variety of commercial and recreational sanctuary users

This information was provided to the MRWG and utilized in dozens of exercises to craft marine reserve proposals. Similarly, the CDFG and Sanctuary applied the same information in crafting the agency alternative for the State of California CEQA process. Sanctuary staff has relied on this data set in the development of the preliminary range of alternatives 1-3.

9.4. Biogeographic Description of the State Reserves

The following descriptions list habitats and species that are protected in the existing State marine reserve and marine conservation areas and potential additional Federal marine reserve and marine conservation areas. As noted above, the protection of habitats correlates to the protection of species and important species-habitat interactions. The following discussion applies generally to Alternatives 1-3.

9.4.1. Santa Barbara Island Marine Reserve

Santa Barbara Island SMR is located at the southeast side of Santa Barbara Island. 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 spp.) 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 _ 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 25-65 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.

9.4.2. Anacapa Island Marine Reserve

The North Anacapa Island SMR is located on the northeast side of Anacapa Island. Historically (early 1980s) kelp beds off Anacapa Island extended offshore to approximately _ 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.

Sea urchins and spiny lobsters are larger and their populations are more stable inside the Anacapa Natural Area than in fished areas (Lafferty and Behrens 2003). Pink abalone can be found in the Anacapa Natural Area, but populations are very small relative to historical sizes. In general the diversity of fishes is higher in the Anacapa Natural Area than in fished areas, but the number of large predatory fish has declined. Kelp bass, California sheephead and numerous rockfish species have declined relative to historical levels. 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, unpub. 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 northern shore of Anacapa Island. The 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 (DeWet Oleson, unpub. data).

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.

9.4.3. Anacapa Island Marine Conservation Area

The West Anacapa Island SMCA is located on the northwest side of Anacapa Island. The conservation area is an extension of the North Anacapa SMR that provides additional habitat and species protection. 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 West 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.

9.4.4. Footprint Marine Reserve

The Footprint, which is located in open waters in the passage south of Santa Cruz and Anacapa Islands, is proposed as a marine reserve in each alternative. The majority of the Footprint 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.

9.4.5. Santa Cruz Island, Scorpion Rock Marine Reserve

The Scorpion Rock SMR is located on the northeast side of Santa Cruz Island. 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. Scorpion Rock is one of the two primary nesting areas for Cassin's Auklets in the Channel Islands (Adams 2003).

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 Scorpion area, but populations are not stable. Because kelp populations are reduced, the Scorpion area 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.

9.4.6. Santa Cruz Island, Painted Cave Marine Conservation Area

The Painted Cave SMCA is located on the north side of Santa Cruz Island. The reserve includes 2 nmi of shoreline and an area of 1.1 nmi2 entirely within State waters. Recreational fishing for lobster and pelagic finfish is 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.

9.4.7. Santa Cruz Island, Gull Island Marine Reserve

The Gull Island SMR is located on the southwest side of Santa Cruz Island. 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 existing Gull Island Marine Reserve and proposed extension into deeper waters protects a variety of different habitat types from the nearshore to the continental slope. Sand beach (Johnson's Beach) is the predominant shoreline habitat at the border of the Gull Island SMR. Endangered Snowy Plovers may occur on Johnson's Beach. The beach also 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. Large populations of purple urchins occur in the vicinity of Gull Island. 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. Compacted sand and rubble sediments on the continental shelf drop steeply into the Santa Cruz Canyon.

9.4.8. Santa Rosa Island, Carrington Point Marine Reserve

The Carrington Point SMR is located on the north side of Santa Rosa Island. 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 spp.). 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.

9.4.9. Santa Rosa Island, Skunk Point Marine Reserve

The Skunk Point SMR is located on the east side of Santa Rosa Island. 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 Rock 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 Point and East Point. 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 spp.) 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. 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. 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.

9.4.10. Santa Rosa Island, South Point Marine Reserve

The South Point SMR is located on the south side of Santa Rosa Island. 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.

9.4.11. San Miguel Island, Harris Point Marine Reserve

The Harris Point SMR is located on the north side of San Miguel Island. 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 lobsters 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.

9.4.12. San Miguel Island, Richardson Rock Marine Reserve

The Richardson Rock SMR is located in open waters around Richardson Rock to the northwest of San Miguel Island. 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.

9.4.13. San Miguel Island, Judith Rock Marine Reserve

The Judith Rock SMR is located on the southwest side of San Miguel Island. 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 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.

10. Appendix E: Ecological and Socioeconomic Analyses

10.1. Description of Analyses By Alternative

10.1.1. Ecological Impact Analysis- the No Action Alternative

Given the increasing resource demands by the human population, it is likely that the health of marine ecosystems will continue to deteriorate without a change in management strategies (Agardy et al. 2003). Without action, the Sanctuary would have to primarily rely on species-specific fisheries management to attempt to achieve desired outcomes for ecosystem management. Existing fisheries management includes size and catch limits, gear restrictions, and seasonal closures as well as more drastic measures to restore declining fisheries, such as the Cowcod closure, which protects certain species below 300 ft in the area around Santa Barbara Island and the groundfish closure, which is a temporary management measure in the effort to restore groundfish fisheries. The Sanctuary would also rely on the existing state marine reserve and marine conservation areas, but they would not include the full suite of habitats in the Sanctuary, including deeper waters.

10.1.2. Alternatives 1-3

Alternatives 1-3 consist of networks of marine protected areas, including no-take marine reserves and limited-take marine conservation areas. Marine reserves, together with conventional fisheries management strategies, can have significant ecological benefits. Protection afforded by reserves may allow targeted species to rebound, increasing local recruitment and contributing to spillover of adults and export of larvae into fished areas (Guénette et al. 1998, Jones 2002). Additionally, reserves may protect critical life stages and spawning aggregations of targeted species (Shipp 2003). Reserves may provide insurance and resilience in an uncertain world with unpredictable environmental fluctuations (NRC 2001). Finally, reserves can serve as reference areas for research to determine the effects of fishing on marine ecosystems (NRC 2001).

Although it is difficult to predict the ecological impacts of establishing a particular reserve, a wealth of information is available on the ecological impacts of reserves worldwide and, more specifically, within the State of California and around the Channel Islands. Studies of other marine reserves were reviewed to provide an estimate of expected ecological impacts within and around reserves. These studies were conducted primarily in long-established reserves and provide estimates of what might occur in the Channel Islands over the long term. Particular emphasis has been placed on impacts of reserves in California and around the Channel Islands. However, because no two reserves are exactly the same, these results provide guidelines for what may occur and the proposed alternatives may not have exactly the same results.

10.1.2.1. Local Ecological Impacts

There is abundant evidence to demonstrate that protecting areas from all extractive activities leads to rapid increases in abundance, size, biomass, and diversity of targeted animals, regardless of where in the world reserves are located. Halpern (2003) reviewed 76 studies of reserves that were protected from at least one form of fishing. He derived aggregate measures of reserve performance, by combining responses of all the organisms studied for each of four variables: abundance, total biomass, average body size, and species diversity. Across all reserves, abundance (measured as density) approximately doubled. Biomass, or the weight of all organisms combined, increased 2.5 times in reserves as compared to fished areas. Average body size of organisms protected in marine reserves increased by approximately 30%. The increase in size contributes to greater reproductive potential (Béné and Tewfik 2003). In addition to changes in biomass, abundance, size, and reproductive potential, the number of species in each sample increased by 30%.

Ecological changes have been detected rapidly (within 1 year) in regions of high nutrient input due to upwelling (Fisher and Franks 2002, Witman and Smith 2003). Responses documented by Halpern (2003) occurred, on average, 3-5 years after reserves were established.

The time to detect ecological changes in marine reserves and the magnitude of those changes depends, in part, on the intensity of historical fishing effort in the region (Coté et al. 2001). Changes will occur rapidly in areas that recently experienced high fishing intensity. In the Channel Islands region, ecological changes are expected to occur more rapidly in the eastern islands (Anacapa and Santa Cruz Islands), where commercial and recreational fishing has been concentrated for a long period of time. Ecological responses are likely to be more subtle around the western islands (Santa Rosa and San Miguel Islands), where the intensity of recreational fishing has been lower. One exception may be certain commercial fisheries, including sea urchin, crab, and rockfish, that are concentrated around the western Channel Islands. Additionally, ecological responses are likely to be more rapid in shallow waters near shore, where fishing is concentrated in the highly productive euphotic zone. Ecological responses may be more subtle in deep waters offshore where fishing effort is limited by production and access. Certain unfished or very lightly exploited species are not expected to show changes within reserves.

Increases in abundance and density of targeted species have been detected in marine reserves in California. Paddack and Estes (2000) found mean densities for a variety of rockfish and other species 12-35% greater (all species combined) within three central California reserves (Hopkins Marine Life Refuge, Pt. Lobos Ecological Reserve, and Big Creek Marine Resources Protection Act Ecological Reserve) than adjacent fished areas, although their results were not significant due to lack of statistical power. In their study, average densities for kelp rockfish, gopher rockfish, cabezon, and lingcod were 31%, 83%, 22% and 100% greater inside the marine reserves than outside, respectively. California sheephead were much more abundant within one reserve in the study, but very infrequent or not seen at all in other areas. Central California is the northern edge of the geographic range of California sheephead, so results are likely not comparable to southern California.

Paddack and Estes (2000) also reported mean sizes for all rockfish species combined in their study. In two of the three reserves mean size was greater and in the third reserve (which had been established the least amount of time) mean size was nearly equal. On average over all three reserves mean size of rockfishes was about 14% greater within the reserves than outside.

Increases in abundance and density of targeted species also have been detected in marine reserves in the Channel Islands. Limited data were reviewed from surveys inside and outside the Catalina Marine Science Center reserve. Sheephead and kelp bass were 48% and 29% greater inside the reserve compared to outside, respectively (Caselle, unpublished data). In 2000-2001, the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) compared sites inside the Anacapa Island Ecological Reserve Natural Area with one site outside the reserve at Middle Anacapa Island (Caselle unpublished data). For estimates of density, the site inside the reserve with similar habitat was compared to the site outside the reserve, whereas all sites were used for estimates of average size. Sheephead and kelp bass densities were 137% and 103% greater inside the marine reserve compared to outside, respectively. Sheephead and kelp bass average sizes were 13% and 9% greater inside the marine reserve compared to outside, respectively.

The National Park Service compared relative densities and sizes of invertebrate species inside the Anacapa Ecological Reserve Natural Area and areas nearby (Kushner unpublished data). In all cases, data was analyzed from particular sites only if the focal species were present in more than 2 out of the most recent 10 years of data. In this analysis, average spiny lobster and warty sea cucumber densities were 592% and 141% greater inside the reserve, respectively. In contrast, average red urchin densities were 13% less inside the reserve. Although red urchins are less dense inside the reserve, individual urchins are significantly larger inside the reserve. Red urchins are approximately 60% larger inside the reserve compared to areas outside. In addition, while nearly 60% of red urchins were larger than the minimum legal commercial size inside the marine reserve on average, only about 11% were outside. Table E-1 below shows average densities and sizes of targeted species in marine reserves within the State of California as compared to fished areas nearby.

Table E-1. Average Densities And Sizes Of Targeted Species In Marine Reserves Within The State Of California As Compared To Fished Areas Nearby

Species	Status	Average Density	Average Size
Kelp bass[1]	Targeted	103% greater	9% larger
Kelp bass[2]	Targeted	29% greater	
California sheephead[1]	Targeted	137% greater	13% larger
California sheephead[2]	Targeted	48% greater	
California sheephead[3]	Targeted	More abundant within range	
Kelp rockfish[3]	Targeted	31% greater	14% larger
Gopher rockfish[3]	Targeted	83% greater	14% larger
Cabezon[3]	Targeted	22% greater	14% larger
Lingcod[3]	Targeted	100% greater	
Cowcod[4]	Targeted	32 and 8 times greater	
Bocaccio[4]	Targeted	408 and 18 times greater	
Spiny lobster[5]	Targeted	592% greater	
Warty sea cucumber[5]	Targeted	141% greater	
Red urchin[5]	Targeted	13% less	60% were larger than legal size

Key
[1] Data provided by PISCO from the Anacapa Ecological Reserve Natural Area.
[2] Data provided by PISCO from the Catalina Marine Science Center reserve.
[3] Data from Paddack and Estes (2000) from Hopkins Marine Life Refuge, Pt. Lobos Ecological Reserve, and Big Creek Marine Resources Protection Act Ecological Reserve.
[4] Data from Schroeder and Love (2002) showing the density of populations in a de-facto reserve (Platform Gail) as compared to a recreational fishing area and an unprotected area.
[5] Data provided by NPS from the Anacapa Ecological Reserve Natural Area.

10.1.3. Bycatch

Bycatch, or incidental take, can have significant, direct, ecological impacts on non-targeted species (Shipp 2003). Worldwide, scientists estimate that fishermen discarded about 25 percent of their catch during the 1980s and the early 1990s (Alverson et al. 1994, Alverson 1998 from Pew 2003). Gill net, drift net, longline, and trawl fisheries have some of the highest bycatch mortality among fisheries. By prohibiting fishing within their boundaries, marine reserves can eliminate bycatch of non-targeted species and undersized individuals of targeted species within reserve boundaries. Protection can improve productivity of targeted and non-targeted species and maintain structure and function of marine communities (NRC 2001). Protection in marine reserves can enhance spawning biomass of species that experience high discards and mortality of young fish (Horwood et al. 1998). Marine reserves may provide the only practical means of protecting vulnerable species caught as bycatch in the main fisheries (Horwood et al. 1998).

10.1.4. Non-Targeted Species

If non-targeted species are insulated ecologically from the impacts of fishing, then establishing a reserve is not likely to affect the abundance, density and size distribution of the non-targeted species. However, establishing a reserve may impact non-targeted species if strong ecological linkages (e.g., predation or competition) exist between non-targeted species and others that are fished. The range of ecological responses of non-targeted species to protection within reserves demonstrates the importance of indirect effects.

In 2000-2001, PISCO investigated the differences between non-targeted species in the Anacapa Ecological Reserve Natural Area and fished areas nearby. Rock wrasse, garibaldi, and black surfperch densities were 173%, 79%, and 398% greater inside the reserve at Anacapa Island compared to outside, respectively. Rock wrasse average size was 3% greater inside the reserve compared to outside, respectively. Garibaldi and black surfperch average sizes, however, were 4% and 24% smaller inside the reserve compared to outside, respectively.

National Park Service data (Kushner unpublished data) were examined to compare relative densities and sizes of invertebrate species inside the Anacapa Ecological Reserve Natural Area compared with areas nearby. Average purple urchin, bat star, and giant-spined star densities were 91%, 66%, and 77% less inside the reserve, respectively. Purple urchins were larger on average (26%) inside the reserve.

Table E-2: Average Densities And Sizes Of Unfished Species In The Anacapa Ecological Reserve Natural Area As Compared To Fished Areas Nearby.

Species	Status	Average Density	Average Size
Rock wrasse1	Unfished	173% more	3% larger
Garibaldi1	Unfished	79% more	4% smaller
Black surfperch1	Unfished	398% more	24% smaller
Purple urchin2	Unfished	91% less	26% larger
Bat star2	Unfished	66% less	
Giant-spined star2	Unfished	77% less	

Key
1 Data provided by PISCO.
2 Data provided by NPS.

The differences between ecological responses in the reserve as compared to surrounding waters indicate that indirect effects of reserves impact non-targeted species, sometimes in unexpected ways. Declines in abundance, density, or size of non-targeted species within a reserve may indicate that one or several predators have been released from fishing pressure and now exert predation pressure, causing the non-targeted species to decline. Increases in abundance or density of non-targeted species within a reserve may be a result of reduced competition for resources as production within the reserve increases over time. Complex indirect interactions, resulting from fishing and the subsequent establishment of a no-take marine reserve, have been documented in the Channel Islands region.

10.1.5. Indirect Ecological Effects

Historically, lobsters and other predators kept sea urchin populations at low levels and kelp forests flourished. However, lobster fishing has occurred throughout the Channel Islands for over 100 years (Leet et al. 2001). Over time, commercial and recreational fisheries for lobster reduced the population size and average length of individual lobsters (Tegner and Levin 1983). Reduced populations of smaller lobsters were not effective predators on urchins and, as a result, urchin populations increased. Intense grazing by purple urchins (which were not fished) caused dramatic declines in kelp growth, leading to the formation of bare rocky reefs covered with urchins (known as urchin barrens). Crustose coralline algae, resistant to urchin grazing, became the dominant algae on rocky substrate in urchin barrens (Harrold and Reed 1985).

In 1978, commercial and recreational fishing was prohibited in one area of the Channel Islands, the Anacapa Ecological Reserve Natural Area. Within the reserve, lobsters are six times more numerous and individual lobsters are larger than in nearby fished waters (Behrens and Lafferty, unpublished manuscript). Other targeted species, including California sheephead and kelp bass, also are more numerous and larger in the reserve (Tretault, unpublished data). Predation by large lobsters and other species in the reserve caused the urchin population to decline. On average, the density of urchins is 7.4 times greater in fished areas than in the reserve (Behrens and Lafferty, unpublished data). Released from the intense grazing pressure from urchins, kelp in the reserve flourished, supporting a variety of associated species. On average, kelp grew five times more densely and persisted longer in the reserve as compared to fished areas nearby (NPS, unpublished data). Data from the National Park Service show that the marine reserve supports some of the richest kelp forests in the Channel Islands.

In addition to greater density and diversity in the reserve, the protected kelp forests are more resilient to natural perturbations than those in fished areas. Kelp grows throughout the Channel Islands under good conditions, when upwelling of cool waters brings nutrients to the region. During El Niño events, low-nutrient warm water inhibits growth of kelp. Reduced growth of kelp combined with the effects of grazing by urchins can lead to decimation of the kelp forest in areas that are fished. At some point during the past 20 years, each kelp forest monitoring site in fished areas became an urchin barren for a period of time and urchin barrens have persisted some sites (Behrens and Lafferty, unpublished manuscript). In contrast, kelp forests protected in the Anacapa Ecological Reserve Natural Area were resilient to natural perturbations associated with El Niño during a period of twenty years since the reserve was established (Behrens and Lafferty, unpublished manuscript).

The high population density of organisms, released from predation pressure through the indirect effects of fishing, can contribute to the spread of disease. One study documented the spread of disease through dense urchin populations in the Channel Islands. During the study (1992-1998), urchin abundance increased over time as invertebrate predators (spiny lobsters) decreased under fishing pressure (Lafferty and Kushner 2000). Bacterial disease spread through populations with high densities of urchins. Sites with lower predator abundance had higher urchin abundance and higher incidences of the disease. An exception was the marine reserve at Anacapa Island where urchin density was lower, due to higher predation by lobsters, and the disease was nearly absent.

It is clear from this example that the effects of fishing may be carried beyond the target species to affect abundance and diversity of other marine organisms and weaken their resilience to natural perturbations, such as El Niño cycles and the spread of disease. The marine reserve at Anacapa Island, established in 1978, restored and enhanced populations of predators and kelp. These ecological changes increased the resilience of kelp populations to climate variation and increased the resilience of urchin populations to the spread of disease. These ecological changes are likely to occur in other reserves that contain suitable habitat around the Channel Islands.

10.1.6. Local Impacts on Marine Habitats

The abrasive contact of mobile fishing gear with the seafloor, particularly used in trawling and dredging, can damage or destroy benthic habitats and faunas (Rodwell et al. 2003, JNCC 2004). In 1999, 176 commercial permits were issued to operators in the Channel Islands region to deploy trawl gear. Typical trawl fisheries in California trawl the same section of sea bottom more than once per year on average (Friedlander et al. 1999). In 2002, the federally managed groundfish fishery was closed from 3-200 nautical miles off California, with the exception of sanddabs. Within that area, commercial fishing was closed for federally managed groundfish in waters from 0-150 fathoms and commercial trawl fishing was closed from 0-200 fathoms. Commercial fixed-gear sanddab fishery is open in all waters. Although regulations currently prohibit the use of mobile fishing gear throughout a large portion of the project area, the regulations were imposed only 2 years ago and they are not permanent closures. It is anticipated that the groundfish closure area will be opened to trawl fishing once the fishery recovers. Fully protected marine reserves may provide the only long-term means of protecting marine habitats from the destructive impacts of mobile fishing gear.

Static fishing gears have a lower impact on smaller areas of the seabed than active gears. In the Channel Islands, traps are set for lobster, prawn, and the live fish industries. The lobster industry included 46 fishers in 1999 (Leeworthy and Wiley, 2002/2003). Studies have shown that lost lobster pots and other traps may continue catching (and killing) animals for months (JNCC 2004). It is unlikely that traps, lost from unprotected areas, would have significant ecological impacts in marine reserves, unless the traps are transported on strong currents or storm-generated waves into the reserve areas.

10.1.7. Regional Ecological Impacts

Effective reserves may support a greater biomass of targeted species and larger individuals than areas that are managed using conventional methods (Shipp 2003). The benefits to fisheries depend on the degree of connectivity between targeted populations in the reserve and surrounding waters. Reserves will not contribute to increased yield unless reserves export individuals to unprotected waters where they can be fished (Gaines et al. 2003).

Increased densities of adults in reserves may contribute to spillover into surrounding non-reserve areas (Roberts and Polunin 1991, DeMartini 1993, Russ and Alcala 1996, McClanahan and Mangi 2000), particularly if population dynamics are controlled by density-dependent habitat use (Jennings 2000). Many temperate groundfish populations are likely to exhibit spillover from reserves because they exhibit density-dependent habitat use (Jennings 2000 from Fisher and Frank 2002).

Several studies have documented the movement of individuals from reserves to surrounding areas (Attwood and Bennett 1994, McClanahan and Kaunda-Arara 1996, Johnson et al. 1998, Davis and Dodrill 1980). Increases in biomass of target species outside marine reserves provide indirect evidence for spillover and export (Russ and Alcala 1996b, Ratikin and Kramer 1996, Murawski et al. 2000, Roberts et al. 2001, Fisher et al. 2002). Shifts in the distribution of fishing effort provide additional indirect evidence for spillover (Alcala and Russ 1990, Yamaski and

Kuwahara 1990, Polunin and Roberts 1993, Ramos-Espla and McNeill 1994, McClanahan and Kaunda-Arara 1996, Roberts et al. 2001). In some cases, fishermen have shifted their effort to the edges of marine reserves, a phenomenon known as "fishing the line." A shift in fishing effort may indicate that (1) targeted species are more abundant near the reserve and (2) the reserve is contributing to the fishery through spillover.

Marine reserves may contribute to fisheries through the increased production of eggs within reserves and the subsequent dispersal of larvae to areas outside of the reserve (Bohnsack 1996, Sladek Nowlis and Roberts 1997, Béné and Tewfik 2003). The ability of reserves to contribute larvae to areas outside the reserve depends on several variables, including the dispersal ability of larvae, the direction of current-mediated transport, and the size and spacing of reserves (Gerber et al. 2003). Although it is difficult to track larvae during dispersal, estimates of larval dispersal have been made using population genetics (Kinlan and Gaines 2003) and duration of the larval phase (Shanks et al. 2003). Small reserves are not likely to contribute to sustainable fisheries because small populations of targeted species within reserves are not likely to export substantial quantities of larvae (Halpern 2003).

Detecting spillover may be difficult if source populations within reserves are small relative to the surrounding fished waters. The ecological benefits of larval export from reserves are not likely to be detected until the combined area of reserves reaches a substantial fraction of the project area. Models of fisheries (summarized in Chapter 2) suggest that reserves may contribute to spillover of adults and export of larvae if the combined area of reserves protects between 20 and 50 percent of the targeted stock. The cumulative impacts of Alternatives 2 and 3, combined with the existing state marine reserves and marine conservation areas, may contribute to spillover of targeted populations in the Channel Islands. However, within the context of the Southern California Bight, none of the alternatives includes more than 0.02% of the total area. Therefore, it may be difficult to detect spillover from the reserves into surrounding waters.

10.1.8. Ecological Impacts of Marine Conservation Areas

Marine conservation areas (which allow limited recreational and/or commercial fishing) can contribute to conservation and fisheries objectives (Agardy et al. 2003). However, multiple uses may be allowed at the expense of primary conservation objectives (Jones 2002). When marine protected areas allow multiple uses, they often provide mainly for exploitation rather than conservation (Prideaux et al. 1998 from Jones 2002). When socioeconomic criteria are given equal or greater weight than ecological criteria, decision-makers may choose marine protected areas with little biological value that may fail to meet many of the desired objectives (Roberts et al. 2003a). Targeted populations may decline and habitat may be degraded, even with low levels of fishing in conservation areas (Rodwell et al. 2003).

Schroeder and Love (2002) compared rockfish density within a de-facto marine reserve (an oil platform where fishing does not occur), an area allowing only recreational fishing, and an unprotected area (where both recreational and commercial fishing are allowed) in the Channel Islands region. Rockfish density was an order of magnitude less within the recreational fishing area than in the unprotected area. Community composition also was significantly different. Cowcod densities were 8 and 32 times greater in the de facto reserve than in the recreational area or unprotected area, respectively. Similarly, bocaccio densities within the de facto reserve were 18 and 408 times greater than in the recreational area or unprotected area, respectively. The authors conclude that recreational fishing in a marine conservation area can have measurable effects on targeted species.

10.1.9. Monitoring and Evaluation

Needs to include some information from the monitoring sites criterion and the summary of monitoring programs and the DFG and Sanctuary monitoring programs.

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) will also provide baseline data to compare with future monitoring inside and outside MPAs. The Science Advisory Panel recommended that some monitoring sites be included both inside and outside marine reserve and marine conservation areas to allow researchers to track changes associated with protection over time (CDFG 2002).

The MRWG recommended adaptive management of marine reserves, so that we can learn from the initial network of reserves and adjust management strategies as appropriate. Many scientists encourage a responsive and flexible management framework for marine reserves so that new information can be incorporated and management can accommodate shifts in socioeconomic conditions (Salomon et al. 2002, Agardy et al. 2003).

We know enough about coastal and marine ecosystems to improve their management. With better information we could do much more. Public and private institutions need to work together to fill gaps in our knowledge to ensure that decision-makers have timely access to the information they need to protect the public interest. In addition, scientists need to provide the public with understandable information about the structure and functioning of coastal and marine ecosystems, how ecosystems affect our daily lives, and how we affect ecosystems (Pew Oceans Commission 2003).

Monitoring and evaluation, also recommended by the MRWG, are critical components of the marine reserve strategy. Ecological monitoring can gather the data necessary to detect the effects of marine reserves on marine habitats and species of interest. The effects of fishing, which are poorly understood, can be detected by comparing reserve and fished areas, assuming adequate enforcement. Socioeconomic monitoring is essential to gauge effects on local economies, and to detect shifts in fishing effort and changes in the spatial distribution of activities in response to the reserves. Changes within reserves depend, in part, on the intensity of historical fishing effort (Wilen et al. 2002). Areas that experienced high levels of fishing are likely to respond to protection more rapidly than areas that are not heavily impacted. See Monitoring Plan And Recommendations In Appendix G.

Table E-3: Summary of The Alternatives' Ecological Impacts

ALTERNATIVES				
	No Action Alternative	Alternative 1	Alternative 2	Alternative 3
IMPACT WITHIN NETWORK				
Abundance of species				
Intensity of Impact1	N	B (PA for some species)	B (PA for some species)	B (PA for some species)
Impact Duration2	-	Long-term	Long-term	Long-term
Impact Target3	-	Direct	Direct	Direct
Context4	-	Local	Local	Local
Individual size of species				
Intensity of Impact	N	B (PA for some species)	B (PA for some species)	B (PA for some species)
Impact Duration	-	Long-term	Long-term	Long-term
Impact Target	-	Direct	Direct	Direct
Context	-	Local	Local	Local
Density of species				
Intensity of Impact	N	B (PA for some species)	B (PA for some species)	B (PA for some species)
Impact Duration	-	Long-term	Long-term	Long-term
Impact Target	-	Direct	Direct	Direct
Context	-	Local	Local	Local
Diversity of species				
Intensity of Impact	N	B (PA for some species)	B (PA for some species)	B (PA for some species)
Impact Duration	-	Long-term	Long-term	Long-term
Impact Target	-	Direct	Direct	Direct
Context	-	Local	Local	Local
Biomass				
Intensity of Impact	N	B (PA for some species)	B (PA for some species)	B (PA for some species)
Impact Duration	-	Long-term	Long-term	Long-term
Impact Target	-	Direct	Direct	Direct
Context	-	Local	Local	Local
Community Structure				
Intensity of Impact	N	B	B	B
Impact Duration	-	Long-term	Long-term	Long-term
Impact Target	-	Direct/Indirect	Direct/Indirect	Direct/Indirect
Context	-	Local	Local	Local
Habitat Quality				
Intensity of Impact	N	PB	PB	PB
Impact Duration	-	Long-term	Long-term	Long-term
Impact Target	-	Direct	Direct	Direct
Context	-	Local	Local	Local

ALTERNATIVES				
	No Action Alternative	Alternative 1	Alternative 2	Alternative 3
IMPACT OUTSIDE NETWORK				
Larval Dispersal				
Intensity of Impact	N	N	PB	PB
Impact Duration	-	-	Long-term	Long-term
Impact Target	-	-	Direct	Direct
Context	-	-	Regional	Regional
Adult Spillover				
Intensity of Impact	N	PB	PB	PB
Impact Duration	-	Long-term	Long-term	Long-term
Impact Target	-	Direct	Direct	Direct
Context	-	Regional	Regional	Regional

<u>Key</u>

1) Intensity of Impact Ratings: Rating is based on empirical and theoretical studies conducted in the study area and/or literature review of marine reserve performance.
Potential Adverse (PA): Potential adverse ecological impact. Potential Adverse is assigned when some information indicates that a negative ecological impact may occur, but the probability, intensity and significance is undetermined.
2) Impact Duration: Period of time over which the ecological impact is expected to persist
3) Impact Target: A direct ecological impact is one that will exhibit a direct, observable effect as a result of implementation of the alternative. An indirect ecological impact is one that occurs to a non-targeted species through ecological linkages such as predation and competition
4) Context: The geographic region over which the ecological impact is expected to be detected.
(N) No Impact: No ecological impact
(PB) Potential Benefit: Potential beneficial ecological impact. Potential Benefit is assigned when some information indicates that a positive ecological impact may occur, but the probability, intensity and magnitude is undetermined
(B) Significant Benefit: Beneficial ecological impact.

10.2. Socioeconomic Criteria and Impact Analysis

The following sections provide a description of the potential impacts on the human environment based on socioeconomic information gathered and analyzed on the range of impacts associated with the use of the natural resources and non-consumptive uses of the project area. 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 Channel Islands Marine Reserves process over two years. A Socioeconomic Panel report to the MRWG focused on the potential costs associated with alternatives developed during the Channel Islands Marine Reserves Process (Leeworthy and Wiley 2002 and revised per reviews Leeworthy and Wiley 2003). 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 analytical approach is 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 and revised per reviews Leeworthy and Wiley 2003). Also provided is 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 included consumptive recreational activities based on data collected for 1999 (Leeworthy and Wiley 2002 and revised per reviews Leeworthy and Wiley 2003). The recreational analysis uses 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 provides a complete list of potential costs and benefits, but because there are limited data and scientific studies related to consumptive and non-consumptive values of the project area, not all costs and benefits could be quantified. However, the data collected and generated by the Socioeconomic Panel represent an important step toward the development of baseline information and analyses.

A description of the socioeconomic setting is provided in Chapter 3 (Affected Environment). As noted above, the Socioeconomic Panel was not able to quantify all cost and benefits that may be associated with the establishment of marine reserve and marine conservation areas within the 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 use 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:

California Department of Fish and Game commercial fishing data showing where fish are caught and the ports where fish are landed;

- 14 commercial species/species groups mapped on a 1-minute by 1-minute distributions of catch;
- Socioeconomic profiles of the fishermen (e.g., experience, age, education, income, dependency on fishing, people and family members directly employed, investment/ownership of boat and equipment, place of residence and home and landing ports);
- Commercial fishermen costs and earnings;
- Kelp harvesting and processing information (obtained from ISP Alginates);
- Surveys of recreational "for hire" operators (achieved a Census);
- National Marine Fisheries Service, Marine Recreational Fishing Statistics Survey for intercept/access points for those fishing from private household boats;
- Aerial flyover data for boating activities from the Channel Islands National Marine Sanctuary; and

- An ethnographic survey of a variety of commercial and recreational sanctuary users

10.2.1. Analytical Approach

The socioeconomic analyses are based on a two-step approach. The Step 1 Analyses describes 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 and as revised in Leeworthy and Wiley 2003). The analyses also provide an aggregate consumptive impact assessment for Step 1 Analyses. Step 2 analyses are less quantitative. The Step 2 Analyses qualitatively describe factors that contribute to potential costs and, when possible, the benefits of the establishment of marine reserve and marine conservation areas within the project area (Leeworthy and Wiley 2002 and as revised in Leeworthy and Wiley 2003). 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 marine reserve and marine conservation areas and change Step 1 estimates. All the benefits and costs of marine reserve and marine conservation areas cannot be quantified, and so a formal benefit-cost analysis was not conducted.

The Step 1 analyses are very quantitative and include 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 marine reserve and marine conservation areas are not addressed in Step 1 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. On the other hand, losses may be overestimated where offsetting factors such as effort reduction are instituted.

It is rare that there would not be possibilities for substitution and relocation to mitigate impacts. Human beings have proven to be quite ingenious, adaptive and resilient in the face of change and often develop surprising solutions. Step 2 analyses are by their nature less quantitative. The Socioeconomic Panel was simply not able to forecast all the human responses as well as the ecological-biological responses, and the interactions of these systems that will result from a network of marine protected areas.

The Step 2 Analyses focus on the potential costs of each alternative for commercial fishing and kelp harvesting and consumptive recreational activities. The analyses also include 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 are used to guide the Step 2 analyses and to identify future costs and benefits associated with the reserve alternatives.

Overall, the analyses provides 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.

10.2.2. 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-wetfish samples but was 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.

10.2.3. Ethnographic Data Survey

The Sanctuary conducted an ethnographic data survey in 1999 (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.

10.2.4. 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 and Leeworthy and Wiley 2003). Socioeconomic information and analysis were generated over a two-year time period from a number of other surveys described below that was funded as part of the Channel Islands Marine Reserves 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.

Fourteen maps developed from the fisheries and kelp harvesting are used in the socioeconomic impact analyses. Because of restrictions placed on the Socioeconomic Panel by the Commercial

Fishermen's Data Committee, only the maps for squid, wetfish, tuna, and kelp were released during the Channel Islands Marine Reserves process. All maps compare ex-vessel value from specific sites within the project area. Maps (1996-1999 annual averages) 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 (2003).

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 represented 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, other than squid and wetfish, 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 3. 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 only one company, ISP Alginates, located in San Diego, California, harvests it. 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 and the revised version in Leeworthy and Wiley 2003).

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 and Leeworthy and Wiley 2003).

10.2.5. 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 marine reserve and marine conservation areas resulted in increased supplies and lower prices to consumers. To estimate consumer 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. However, an assessment was conducted on percent of supply provided from the Sanctuary and the Socioeconomic Panel concluded that the proportions of supply that would be impacted by any marine protected area would not significantly impact supply nor impact prices, thus no changes in consumer surpluses are expected.

10.2.6. Recreational Uses

Recreation was divided into consumptive activities and non-consumptive activities for the purposes of the socioeconomic analysis. Consumptive recreation 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 marine reserve and marine conservation areas. 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 marine reserve and marine conservation areas under various conditions. As described earlier, the potential benefits from marine reserve and marine conservation areas are determined by the size and location of marine reserve and marine conservation areas, 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 marine reserve and marine conservation areas are underestimated.

The Socioeconomic Panel included an analysis of information for years 1993 to 2000 from the NMFS's Marine Recreational Fisheries Statistics Survey (MRFSS) (Leeworthy and Wiley 2002 and Leeworthy and Wiley 2003). MRFSS data show a downward trend in fishing trips and catch for southern California over this period. Total trips had declined 39.6 percent from 1993 to 1999. In 2000, there was a significant increase in the number of trips. So the decline for 1993 to 2000 was reduced to 6.3 percent. In the 1993 to 1998 period, 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. In 1999 and 2000, all the rockfish species previously among the top 20 between 1993 and 1998 dropped out of the top 20, except Vermillion Rockfish and Bocaccio. Species ranked number 11 to 20 in 1993 were all out of the top 20 in 2000, even though only three of these species showed downward trends in catch between 1993 and 1998. 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 conduct a census, or contact all charter/party boat or guide services that operated in the Sanctuary in 1999. Information obtained included 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. Private household boat use data were obtained from multiple sources explained below.

10.2.7. 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.

NOAA provided nautical charts with the 1-minute by 1-minute cell grid overlaid to the Kolstad team. 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 3.

10.2.8. Economic Impact and Valuation Model for Recreational Fishing Operation

The model used person-days of activity for each of the consumptive and non-consumptive recreation activities for 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.

10.2.9. 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.

Later, 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 is provided in Leeworthy and Wiley 2002 and Leeworthy and Wiley 2003.

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 (this doesn't make sense-check) , 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 counted because they represent part of the multiplier impacts of other basic or export industries. Leeworthy and Wiley 2002 and Leeworthy and Wiley 2003 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.

10.2.10. 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 (Leeworthy and Wiley 2002). However, after receiving the review comments from the Pacific Fishery Management Council, Science and Statistical Committee, one study was dropped (Rowe et al 1985) and all values were converted to 1999 dollars. The resulting estimate increased to $34.75 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. In Appendix I (table I.1) of Leeworthy and Wiley (2003) a comparison of consumptive and nonconsumptive recreation consumer's surplus numbers is presented from Rosenberger and Loomis (2001). There was no significant difference between fishing and wildlife viewing. Non-motorized boating did have significantly higher values.

10.2.11. 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.

Determining the character of economic and social impact is predicated on the scale used in analysis. One way to look at significance is to consider administrative definitions: for example, Presidential Executive Order 12866 defines a significant impact for Federal Regulations as, among other things, 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.

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 marine reserve and marine conservation areas 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 alternatives being proposed for marine protected areas would reach the $100 million level of impact. Although the Panel estimated a baseline 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 and Leeworthy and Wiley 2003). 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 marine reserve and marine conservation areas in the Sanctuary (Leeworthy and Wiley 2002 and Leeworthy and Wiley 2003). Judgments of significance of individual or group impacts are normative or value judgments that are best left to a representative political body, not the purview of social scientists. Social scientists can only measure impacts on individuals and groups; it is not part of social science to make value judgments as to significance of the impacts.

10.3. Potential Economic Impacts

NOTE TO REVIEWER

Because this is the Step 1 analysis and does not take account for potential mitigating circumstances, what is presented simply adds the data available in each 1x1 cell and calculates the potential impact to commercial and recreational consumptive and non-consumptive users. The next level of analysis (Step 2) will factor in recent regulatory actions including fisheries closures (i.e., Rockfish Conservation Area and prawn trawling). One anticipated analytical challenge is the lack of finely scaled (1x1 minute resolution) data for certain fishing gear types in the Sanctuary.

Following are summary tables the detail potential impacts to commercial and recreational consumptive activities for each alternative broken down by additional state and federal water marine reserve and marine conservation areas and the total cumulative impacts (including the existing State MPAs). Commercial fishery impacts tables detail potential impacts by county, ex-vessel value by port and species group, and total employment impacts by county. Recreational fishing impacts are measured in person-days, income and employment and by industry (charter boat fishing and diving and private boat fishing and diving). Table E-4 below shows potential impacts for all consumptive activities for each alternative.

Table E-4: Potential Impacts For All Consumptive Activities For Each Alternative

Aggregate Consumptive Activities: Summary of Impacts by Alternative - Step 1 Analysis

	Additional State		Federal		Total: New Proposed		Existing State		Cumulative Total	
Alternative	Amount	% [1]	Amount	%	Amount	%	Amount	%	Amount	%
					Income [2]					
1	$1,332,904	1.2%	$1,016,243	0.9%	$2,349,148	2.2%	$12,565,222	11.7%	$14,914,370	13.9%
2	$786,534	0.7%	$1,637,213	1.5%	$2,423,747	2.3%	$12,565,222	11.7%	$14,988,969	13.9%
3	$934,206	0.9%	$2,318,697	2.2%	$3,252,903	3.0%	$12,565,222	11.7%	$15,818,125	14.7%
					Employment [3]					
1	37	1.2%	27	0.9%	64	2.2%	360	12.2%	425	14.3%
2	22	0.7%	45	1.5%	67	2.3%	360	12.2%	427	14.4%
3	27	0.9%	64	2.1%	90	3.0%	360	12.2%	451	15.2%

1. Percents are the percent of total baseline amounts from the aggregate data.
2. Total income, including multiplier impacts, is equal to $107,600,471 (Baseline Study Area Total).
3. Total employment, including multiplier impacts, is equal to 2,961 jobs (Baseline Study Area Total).

Additional analysis on impacts to recreational consumptive activities for the existing State marine reserve and marine conservation areas is provided in Appendix E.

10.3.1. Step 1 Analysis - Impacts to Commercial Fishing, Alternative 1

The establishment of marine reserve and marine conservation areas 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 marine conservation areas.

10.3.1.1. Step 1 Analysis

Alternative 1 would potentially impact $493,167 in annual ex-vessel revenue or 1.75 percent of ex-vessel revenue within the deeper waters of the Sanctuary (Table E-5). The cumulative impacts might result in a maximum potential impact of approximately $3.6 million in annual ex-vessel revenue, or 12.86 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 are 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 the deeper waters of the Sanctuary.

The socioeconomic analysis is constrained to potential economic impacts. As a percent of total Sanctuary catch, the highest maximum potential impacts to fisheries in the additional state water and federal water reserves are to squid and prawn. Cumulative impacts are highest for squid and urchin at approximately $1.7 million and $879,761 respectively.

Table E-5: Commercial Fishing - Summary of Impacts on Ex Vessel Value By Species Group

Commercial Fishing: Summary of Impacts of Alternatives on Ex Vessel Value by Species Group

	Alt. 1									
	Additional State		Federal		Total: New Prop.		Existing State		Total: Cumulative	
Species Group	Value	%	Value	%	Value	%	Value	%	Value	%
Squid	$ 132,343	1.01	$ 12,807	0.10	$ 145,150	1.11	$ 1,596,682	12.24	$ 1,741,831	13.35
Kelp	$ 70,010	1.17	$ -	0.00	$ 70,010	1.17	$ 328,568	5.48	$ 398,578	6.65
Urchins	$ 82,574	1.57	$ 2,687	0.05	$ 85,261	1.62	$ 794,500	15.09	$ 879,761	16.71
Spiny Lobster	$ 12,150	1.32	$ -	0.00	$ 12,150	1.32	$ 143,343	15.55	$ 155,493	16.86
Prawn	$ 65,642	9.33	$ 60,384	8.59	$ 126,026	17.92	$ 21,436	3.05	$ 147,462	20.97
Rockfish	$ 4,204	0.77	$ 8,458	1.54	$ 12,662	2.31	$ 66,740	12.15	$ 79,402	14.45
Crab	$ 2,890	0.84	$ -	0.00	$ 2,890	0.84	$ 48,675	14.17	$ 51,565	15.01
Tuna	$ 3,384	1.11	$ 10,910	3.57	$ 14,294	4.68	$ 4,546	1.49	$ 18,840	6.16
Wetfish	$ 6,437	2.14	$ 6,186	2.05	$ 12,623	4.19	$ 22,074	7.32	$ 34,697	11.51
CA Sheepshead	$ 296	0.13	$ -	0.00	$ 296	0.13	$ 38,326	16.24	$ 38,622	16.37
Flatfishes	$ 2,625	1.43	$ 2,325	1.26	$ 4,950	2.69	$ 20,027	10.89	$ 24,977	13.58
Sea Cucumbers	$ 1,740	1.04	$ -	0.00	$ 1,740	1.04	$ 26,512	15.81	$ 28,252	16.85
Sculpin & Bass	$ 1,534	2.54	$ 2,487	4.12	$ 4,021	6.67	$ 5,331	8.84	$ 9,352	15.50
Shark	$ 536	1.54	$ 558	1.61	$ 1,094	3.15	$ 4,456	12.82	$ 5,550	15.97
Total	$ 386,366	1.37	$ 106,802	0.38	$ 493,167	1.75	$ 3,121,215	11.10	$ 3,614,382	12.86

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.

Step 1 Analysis - Impacts to Recreational Consumptive Uses, Alternative 1

Table E-6 below shows the aggregate maximum potential loss to annual income for all recreational consumptive activities in alternative 1 is approximately $1.03 million dollars or 4.2 percent of the $24.7 million in annual income generated by recreational consumptive activities in the project area. The cumulative impact when including the existing state marine reserve and marine conservation areas is potentially $3.99 million or 16.2 percent, of the $24.7 million in annual income.

Table E-6: Recreational Consumptive Activities – Step 1 Analysis

Summary: Recreation Consumptive Activities - Alternative 1 - Step 1 Analysis

	Additional State		Federal		Total: New Proposed		Existing State		Cumulative Total	
Person-days	4,435	1.0%	11,561	2.6%	15,996	3.7%	58,451	13.3%	74,447	17.0%
Market Impact										
Direct Sales	$ 386,497	1.1%	$ 1,022,292	2.9%	$ 1,408,788	4.0%	$4,383,967	12.5%	$ 5,792,755	16.5%
Direct Wages and Salaries	$ 161,661	1.1%	$ 429,498	3.0%	$ 591,159	4.2%	$1,690,233	12.0%	$ 2,281,391	16.2%
Direct Employment	5	1.1%	13	3.0%	18	4.1%	53	12.3%	71	16.4%
Total Income										
Upper Bound	$ 282,906	1.1%	$ 751,622	3.0%	$ 1,034,528	4.2%	$2,957,907	12.0%	$ 3,992,435	16.2%
Lower Bound	$ 242,491	1.1%	$ 644,247	3.0%	$ 886,738	4.2%	$2,535,349	12.0%	$ 3,422,087	16.2%
Total Employment										
Upper Bound	7	1.1%	19	3.0%	27	4.1%	80	12.3%	107	16.4%
Lower Bound	6	1.1%	16	3.0%	22	4.1%	67	12.3%	89	16.3%
Non-Market Impact										
Consumer's Surplus	157,109	1.0%	409,854	2.7%	$ 566,963	3.7%	$2,056,480	13.3%	$ 2,623,443	17.0%
Profit[1]	5,244	1.2%	14,045	3.3%	$ 19,289	4.6%	$45,943	10.9%	$ 65,232	15.5%

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

10.3.2. Step 1 Analysis - Impacts to Commercial Fishing, Alternative 2

10.3.2.1. Step 1 Analysis

Alternative 2 would potentially impact $353,089 in annual ex-vessel revenue or 1.26 percent of ex-vessel revenue within the deeper waters of the Sanctuary (Table E-7). The cumulative impacts might result in a maximum potential impact of approximately $3.5 million in annual ex-vessel revenue, or 12.36 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 are 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 the deeper waters of the Sanctuary.

The socioeconomic analysis is constrained to potential economic impacts. As a percent of total Sanctuary catch, the highest maximum potential impacts to fisheries in the additional state water and federal water reserves are to squid and prawn. Cumulative impacts are highest for squid and urchin at approximately $1.7 million and $799,874 respectively.

Table E-7: Commercial Fishing – Summary of Impacts of Alternatives on Ex Vessel Value By Species Group

Commercial Fishing: Summary of Impacts of Alternatives on Ex Vessel Value by Species Group

	Alt. 2									
	Additional State		Federal		Total: New Prop.		Existing State		Total: Cumulative	
Species Group	Value	%	Value	%	Value	%	Value	%	Value	%
Squid	$ 25,614	0.20	$ 51,230	0.39	$ 76,843	0.59	$ 1,596,682	12.24	$ 1,673,525	12.83
Kelp	$ -	0.00	$ -	0.00	$ -	0.00	$ 328,568	5.48	$ 328,568	5.48
Urchins	$ -	0.00	$ 5,374	0.10	$ 5,374	0.10	$ 794,500	15.09	$ 799,874	15.19
Spiny Lobster	$ 1,266	0.14	$ -	0.00	$ 1,266	0.14	$ 143,343	15.55	$ 144,609	15.68
Prawn	$ 65,642	9.33	$ 65,991	9.38	$ 131,633	18.72	$ 21,436	3.05	$ 153,069	21.77
Rockfish	$ 23,347	4.25	$ 29,653	5.40	$ 53,000	9.65	$ 66,740	12.15	$ 119,740	21.80
Crab	$ 38	0.01	$ -	0.00	$ 38	0.01	$ 48,675	14.17	$ 48,713	14.18
Tuna	$ 3,872	1.27	$ 31,991	10.47	$ 35,863	11.73	$ 4,546	1.49	$ 40,409	13.22
Wetfish	$ 6,103	2.02	$ 33,162	11.00	$ 39,265	13.02	$ 22,074	7.32	$ 61,339	20.35
CA Sheepshead	$ 296	0.13	$ -	0.00	$ 296	0.13	$ 38,326	16.24	$ 38,622	16.37
Flatfishes	$ 975	0.53	$ 3,075	1.67	$ 4,050	2.20	$ 20,027	10.89	$ 24,077	13.09
Sea Cucumbers	$ -	0.00	$ -	0.00	$ -	0.00	$ 26,512	15.81	$ 26,512	15.81
Sculpin & Bass	$ 1,221	2.02	$ 3,267	5.42	$ 4,488	7.44	$ 5,331	8.84	$ 9,819	16.28
Shark	$ 234	0.67	$ 738	2.12	$ 972	2.80	$ 4,456	12.82	$ 5,428	15.62
Total	$ 128,608	0.46	$ 224,480	0.80	$ 353,089	1.26	$ 3,121,215	11.10	$ 3,474,304	12.36

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.

10.3.3. Step 1 Analysis - Impacts to Recreational Consumptive Uses, Alternative 2

Table E-8 shows the aggregate maximum potential loss to annual income for all recreational consumptive activities in alternative 2 is approximately $1.4 million dollars, or 5.9 percent, of the of the $24.7 million in annual income generated by recreational consumptive activities in the project area. The cumulative impact when including the existing state marine reserve and marine conservation areas is potentially $4.4 million or 17.8 percent, of the $24.7 million in annual income.

Table E-8: Recreational Consumptive Activities – Alternative 2 – Step 1 Analysis

Summary: Recreation Consumptive Activities - Alternative 2 - Step 1 Analysis

	Additional State		Federal		Total: New Proposed		Existing State		Cumulative Total	
Person-days	7,391	1.7%	14,572	3.3%	21,963	5.0%	58,451	13.3%	80,414	18.4%
Market Impact										
Direct Sales	$ 644,484	1.8%	$ 1,321,253	3.8%	$1,965,737	5.6%	$4,383,967	12.5%	$ 6,349,704	18.1%
Direct Wages and Salaries	$ 269,134	1.9%	$ 557,151	3.9%	$ 826,285	5.9%	$1,690,233	12.0%	$ 2,516,517	17.8%
Direct Employment	8	1.9%	17	3.8%	25	5.7%	53	12.3%	78	18.0%
Total Income										
Upper Bound	$ 470,985	1.9%	$ 975,014	3.9%	$1,445,998	5.9%	$2,957,907	12.0%	$ 4,403,905	17.8%
Lower Bound	$ 403,701	1.9%	$ 835,726	3.9%	$1,239,427	5.9%	$2,535,349	12.0%	$ 3,774,776	17.8%
Total Employment										
Upper Bound	12	1.9%	25	3.8%	37	5.7%	80	12.3%	118	18.0%
Lower Bound	10	1.9%	21	3.8%	31	5.7%	67	12.3%	98	18.0%
Non-Market Impact										
Consumer's Surplus	261,788	1.7%	516,971	3.3%	$ 778,759	5.0%	$2,056,480	13.3%	$ 2,835,240	18.3%
Profit[1]	8,680	2.1%	18,497	4.4%	$ 27,177	6.5%	$45,943	10.9%	$ 73,120	17.4%

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

10.3.4. Step 1 Analysis - Impacts to Commercial Fishing, Alternative 3

10.3.4.1. Step 1 Analysis

Alternative 3 would potentially impact $542,191 in annual ex-vessel revenue or 1.93 percent of ex-vessel revenue within the deeper waters of the Sanctuary (Table E-9). The cumulative impacts might result in a maximum potential impact of approximately $3.7 million in annual ex-vessel revenue, or 13 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 are in the State waters portion of the Sanctuary. Most of the potential impact on tuna and wetfish, and over half the potential prawn impact, are in the deeper waters of the Sanctuary.

The socioeconomic analysis is constrained to potential economic impacts. As a percent of total Sanctuary catch, the highest maximum potential impacts to fisheries in the additional state water and federal water reserves are to squid and prawn. Cumulative impacts are highest for squid and urchin at approximately $1.8 million and $797,187 respectively.

Table E-9: Commercial Fishing – Summary of Impacts of alternatives on Ex Vessel Value By Species Group

Commercial Fishing: Summary of Impacts of Alternatives on Ex Vessel Value by Species Group

	Alt. 3									
	Additional State		Federal		Total: New Prop.		Existing State		Total: Cumulative	
Species Group	Value	%	Value	%	Value	%	Value	%	Value	%
Squid	$ 81,112	0.62	$ 85,381	0.65	$ 166,493	1.28	$ 1,596,682	12.24	$ 1,763,175	13.51
Kelp	$ -	0.00	$ -	0.00	$ -	0.00	$ 328,568	5.48	$ 328,568	5.48
Urchins	$ -	0.00	$ 2,687	0.05	$ 2,687	0.05	$ 794,500	15.09	$ 797,187	15.14
Spiny Lobster	$ 2,532	0.27	$ -	0.00	$ 2,532	0.27	$ 143,343	15.55	$ 145,875	15.82
Prawn	$ 65,642	9.33	$ 169,337	24.08	$ 234,979	33.42	$ 21,436	3.05	$ 256,415	36.46
Rockfish	$ 16,966	3.09	$ 27,501	5.01	$ 44,467	8.09	$ 66,740	12.15	$ 111,207	20.24
Crab	$ 3,329	0.97	$ -	0.00	$ 3,329	0.97	$ 48,675	14.17	$ 52,004	15.14
Tuna	$ 4,188	1.37	$ 30,686	10.04	$ 34,874	11.41	$ 4,546	1.49	$ 39,420	12.90
Wetfish	$ 6,771	2.25	$ 31,082	10.31	$ 37,853	12.56	$ 22,074	7.32	$ 59,927	19.88
CA Sheepshead	$ 296	0.13	$ -	0.00	$ 296	0.13	$ 38,326	16.24	$ 38,622	16.37
Flatfishes	$ 1,941	1.06	$ 4,800	2.61	$ 6,741	3.67	$ 20,027	10.89	$ 26,768	14.56
Sea Cucumbers	$ -	0.00	$ -	0.00	$ -	0.00	$ 26,512	15.81	$ 26,512	15.81
Sculpin & Bass	$ 1,493	2.47	$ 5,061	8.39	$ 6,554	10.86	$ 5,331	8.84	$ 11,885	19.70
Shark	$ 234	0.67	$ 1,152	3.32	$ 1,386	3.99	$ 4,456	12.82	$ 5,842	16.81
Total	$ 184,505	0.66	$ 357,687	1.27	$ 542,191	1.93	$ 3,121,215	11.10	$ 3,663,407	13.03

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.

10.3.5. Step 1 Analysis - Impacts to Recreational Consumptive Uses, Alternative 3

Table E-10 shows the aggregate maximum potential loss to annual income for all recreational consumptive activities in alternative 3 is approximately $1.7 million dollars or 6.9 percent, of the of the $24.7 million in annual income generated by recreational consumptive activities in the project area. The cumulative impact when including the existing state marine reserve and marine conservation areas is potentially $4.7 million or 18.9 percent, of the $24.7 million in annual income.

Table E-10: Recreational Consumptive Uses – Alternative 3 – Step 1 Analysis

Summary: Recreation Consumptive Activities - Alternative 3 - Step 1 Analysis

	Additional State		Federal		Total: New Proposed		Existing State		Cumulative Total	
Person-days	5,925	1.4%	19,201	4.4%	25,127	5.7%	58,451	13.3%	83,578	19.1%
Market Impact										
Direct Sales	$ 517,009	1.5%	$ 1,777,051	5.1%	$2,294,061	6.5%	$4,383,967	12.5%	$ 6,678,028	19.0%
Direct Wages and Salaries	$ 216,232	1.5%	$ 755,134	5.4%	$ 971,367	6.9%	$1,690,233	12.0%	$ 2,661,599	18.9%
Direct Employment	7	1.5%	23	5.2%	29	6.7%	53	12.3%	83	19.0%
Total Income										
Upper Bound	$ 378,407	1.5%	$ 1,321,485	5.4%	$1,699,891	6.9%	$2,957,907	12.0%	$ 4,657,799	18.9%
Lower Bound	$ 324,349	1.5%	$ 1,132,701	5.4%	$1,457,050	6.9%	$2,535,349	12.0%	$ 3,992,399	18.9%
Total Employment										
Upper Bound	10	1.5%	34	5.2%	44	6.7%	80	12.3%	124	19.0%
Lower Bound	8	1.5%	28	5.2%	37	6.7%	67	12.3%	103	19.0%
Non-Market Impact										
Consumer's Surplus	209,903	1.4%	681,813	4.4%	$ 891,716	5.8%	$2,056,480	13.3%	$ 2,948,196	19.1%
Profit[1]	7,015	1.7%	25,371	6.0%	$ 32,386	7.7%	$45,943	10.9%	$ 78,329	18.6%

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

10.3.6. Step 2 Analysis

Step 2 Analysis is a discussion of the results of the Step 1 analysis and the factoring in of changing conditions and possible mitigating and offsetting factors over short and long time frames.

10.3.6.1. Step 2 Analyses of Commercial Fisheries and Kelp

To be included.

10.3.6.2. Step 2 Analysis of Recreation Consumptive Activities

To be included.

10.3.6.3. Step 2 Analysis of Recreation Non-Consumptive Users

The establishment of marine reserve systems is expected to result in benefits to non-consumptive recreational users. These increased benefits take the form of increases in diversity of wildlife, viewing opportunities from increased abundance of fish and invertebrates, water quality, etc. Benefits may also be derived from the decrease in the density of users or in the reduction in conflicts with consumptive users. There is no data currently available to directly estimate the magnitude of these benefits. In light of this fact a simulation is conducted for each alternative using a range of increases in quality and of quality elasticities. Quality elasticities show the percentage change in consumer's surplus for a percentage change in quality. In a paper by Freeman (1995), 13 studies were summarized on marine recreation, which contained enough information to calculate quality elasticities. Catch rate was the quality variable in all the studies in Freeman (1995). In a paper by Bockstael et al. (1989) there was enough information to calculate quality elasticities for swimming, boating and fishing in Chesapeake Bay. These quality elasticities are in Appendix I of Leeworthy and Wiley (2003). Using the range of quality elasticities and the assumption of a 10%, 50% and 100% increase in quality, benefit estimates were calculated for each alternative. To avoid skewed results from outliers, the highest and lowest elasticities were dropped from this range (Leeworthy and Wiley 2003).

The summary tables below show the extent of activity, measured in person days, aggregated for all non-consumptive uses for each alternative, and the associated income and employment generated by this activity.

Table E-11: Economic Impact Associated with Non-consumptive Activities – Alternative 1 – Summary

Economic Impact Associated with Non-consumptive Activities - Alternative 1 - Summary

	Additional State		Federal		Total: New Proposed		Existing State		Cumulative Total	
Person-days	209	0.5%	556	1.3%	765	1.8%	6,670	15.9%	7,435	17.7%
Market Impact										
Direct Sales	$ 34,413	0.5%	$ 95,237	1.3%	$ 129,650	1.8%	$1,145,310	16.1%	$ 1,274,960	18.0%
Direct Wages and Salaries	$ 16,763	0.5%	$ 46,229	1.3%	$ 62,992	1.8%	$555,828	16.2%	$ 618,821	18.0%
Direct Employment	1	0.5%	2	1.3%	2	1.7%	19	15.8%	21	17.5%
Total Income										
Upper Bound	$ 29,335	0.5%	$ 80,901	1.3%	$ 110,237	1.8%	$972,700	16.2%	$ 1,082,936	18.0%
Lower Bound	$ 25,144	0.5%	$ 69,344	1.3%	$ 94,488	1.8%	$833,743	16.2%	$ 928,231	18.0%
Total Employment										
Upper Bound	1	0.5%	2	1.3%	3	1.8%	28	15.8%	31	17.6%
Lower Bound	1	0.5%	2	1.3%	3	1.8%	23	15.9%	26	17.7%
Non-Market Impact										
Consumer's Surplus	7,532	0.5%	20,070	1.3%	$ 27,602	1.8%	$240,761	15.9%	$ 268,363	17.7%
Profit[1]	856	0.4%	2,372	1.1%	$ 3,227	1.4%	$30,645	13.7%	$ 33,873	15.1%

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

Table E-12: Economic Impact Associated with Non-consumptive Activities – Alternative 2 – Summary

Economic Impact Associated with Non-consumptive Activities - Alternative 2 - Summary

	Additional State		Federal		Total: New Proposed		Existing State		Cumulative Total	
Person-days	427	1.0%	603	1.4%	1,030	2.5%	6,670	15.9%	7,700	18.3%
Market Impact										
Direct Sales	$ 70,551	1.0%	$ 103,308	1.5%	$ 173,858	2.4%	$1,145,310	16.1%	$ 1,319,169	18.6%
Direct Wages and Salaries	$ 34,153	1.0%	$ 50,209	1.5%	$ 84,362	2.5%	$555,828	16.2%	$ 640,190	18.6%
Direct Employment	1	1.0%	2	1.4%	3	2.4%	19	15.8%	22	18.1%
Total Income										
Upper Bound	$ 59,767	1.0%	$ 87,866	1.5%	$ 147,633	2.5%	$972,700	16.2%	$ 1,120,333	18.6%
Lower Bound	$ 51,229	1.0%	$ 75,314	1.5%	$ 126,543	2.5%	$833,743	16.2%	$ 960,285	18.6%
Total Employment										
Upper Bound	2	1.0%	2	1.4%	4	2.4%	28	15.8%	32	18.2%
Lower Bound	1	1.0%	2	1.4%	4	2.4%	23	15.9%	27	18.3%
Non-Market Impact										
Consumer's Surplus	15,402	1.0%	21,778	1.4%	$ 37,181	2.5%	$240,761	15.9%	$ 277,942	18.3%
Profit[1]	1,690	0.8%	2,550	1.1%	$ 4,241	1.9%	$30,645	13.7%	$ 34,886	15.6%

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

Table E-13: Economic Impact Associated with Non-consumptive Activities – Alternative 3 – Summary

Economic Impact Associated with Non-consumptive Activities - Alternative 3 - Summary

	Additional State		Federal		Total: New Proposed		Existing State		Cumulative Total	
Person-days	433	1.0%	1,818	4.3%	2,251	5.4%	6,670	15.9%	8,921	21.2%
Market Impact										
Direct Sales	$ 70,761	1.0%	$ 303,726	4.3%	$ 374,487	5.3%	$1,145,310	16.1%	$ 1,519,797	21.4%
Direct Wages and Salaries	$ 34,555	1.0%	$ 148,045	4.3%	$ 182,599	5.3%	$555,828	16.2%	$ 738,428	21.5%
Direct Employment	1	1.1%	5	4.3%	6	5.4%	19	15.8%	25	21.2%
Total Income										
Upper Bound	$ 60,471	1.0%	$ 259,078	4.3%	$ 319,549	5.3%	$972,700	16.2%	$ 1,292,249	21.5%
Lower Bound	$ 51,832	1.0%	$ 222,067	4.3%	$ 273,899	5.3%	$833,743	16.2%	$ 1,107,642	21.5%
Total Employment										
Upper Bound	2	1.1%	8	4.4%	10	5.4%	28	15.8%	38	21.2%
Lower Bound	2	1.1%	6	4.4%	8	5.4%	23	15.9%	32	21.3%
Non-Market Impact										
Consumer's Surplus	15,630	1.0%	65,602	4.3%	$ 81,232	5.4%	$240,761	15.9%	$ 321,993	21.2%
Profit[1]	2,519	1.1%	11,417	5.1%	$ 13,937	6.2%	$30,645	13.7%	$ 44,582	19.9%

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

10.3.7. Evaluating Displacement and the Potential for Congestion

The following section is excerpted from the State's CEQA Document (2002).

It has been suggested that congestion of fishing effort and the resulting impacts on populations outside marine reserve and marine conservation areas may have negative environmental impacts. This possibility has not been documented in other areas where marine reserve and marine conservation areas have been established. Even so, the potential impacts of congestion outside marine reserve and marine conservation areas should 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 marine reserve and marine conservation areas have shown negative environmental impacts. Therefore, the Sanctuary 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), the spot prawn trap fishery (which is reducing total effort) need update on the groundfish fishery management plan, coastal pelagic FMP, highly migratory species FMP. 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 or marine reserves and marine conservation areas.

10.3.8. Monitoring Displacement and Accounting for Potential Congestion

NOTE TO READER
The following section is in development and provides some examples of pre and post State marine reserve and marine conservation area establishment and evaluates one of the proposed preliminary alternatives.

The Sanctuary Aerial Monitoring and Spatial Analysis program is designed to monitor and analyze the physical and anthropogenic phenomena within the Sanctuary such as sanctuary users, commercial and recreational vessel traffic, effects of shore runoff, oil spill emergencies, and collect data on both marine mammals and the kelp forest using a GIS and aerial GPS collection strategy. Photography and video are used to record sightings. Position information can be downloaded instantly to register the location of objects in Sanctuary waters. The aerial monitoring program allows near-real time collection of data vital to management and resource protection. Data collected on flora and fauna are used to monitor kelp distribution, marine mammal populations and migration patterns, and general resource health within the Sanctuary. Surveys of vessel traffic and vessel type allow anthropogenic use patterns to be studied, e.g., displacement of fishing effort due to marine reserves and marine conservation areas. Data downloaded into the Sanctuary's GIS are used to analyze historical trends and detect correlations across data types.

Following are preliminary consumptive use statistics within the Sanctuary for the 9 month period April 2003 – December 2003 (from implementation of the State marine reserve and marine conservation areas network to the end of 2003). Note that these are draft statistics and have not as yet been through quality assurance and quality control. Final results may vary slightly from those described here.

The total number of consumptive use6 vessels counted in the period was 439 vessels. The total number of survey flights was 15 (3 of which were surveys of Anacapa and Santa Barbara Islands only). As a comparison, the raw vessel counts for consumptive use vessels for the 9 month period prior to implementation of the State marine reserve and marine conservation areas network was 433 vessels counted in 16 survey flights. Though the raw numbers pre and post implementation are very close, it should be noted this may be coincidental. Further data accumulation is necessary to verify if the raw numbers can be comparatively repeated over other survey periods.

The charts and tables on the following pages show monthly statistical information for vessel time/space distributions over the post implementation period. The data are shown as both raw numbers and normalized numbers. Data were normalized by dividing raw monthly numbers by number of flights per month.

Figures E-1 & E-2 show distribution of consumptive use vessels over the 9 month post implementation period. NEPA reserve alternative 1 has been used as an example set to show consumptive use vessel proximity to existing State marine reserve and marine conservation areas and proposed MPAs. The percentage of consumptive use vessels recorded within the current State reserves was 0.025%. No vessels were recorded within the proposed offshore waters. Figure E-3 displays all pre-implementation (July 1997 – March 2003) consumptive use distributions surveyed via SAMSAP.

[6] Consumptive use vessels are: commercial fishing vessels (urchin, lobster, trawlers, etc.), recreational "head" or party boats, and private sportfishing boats.

Figure E-1: Raw Vessel Count

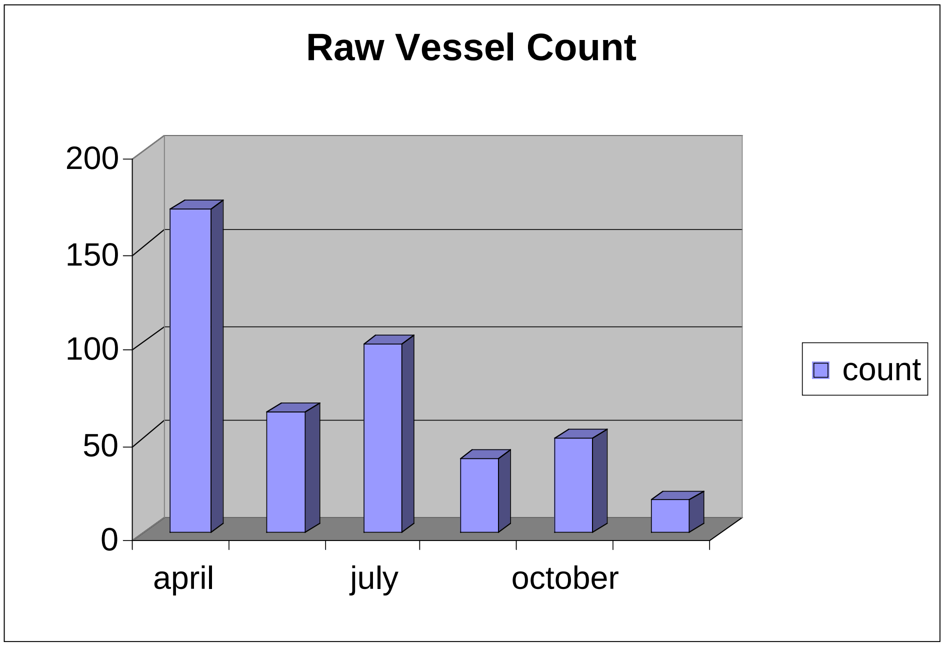


Figure E-2: Normalized Data

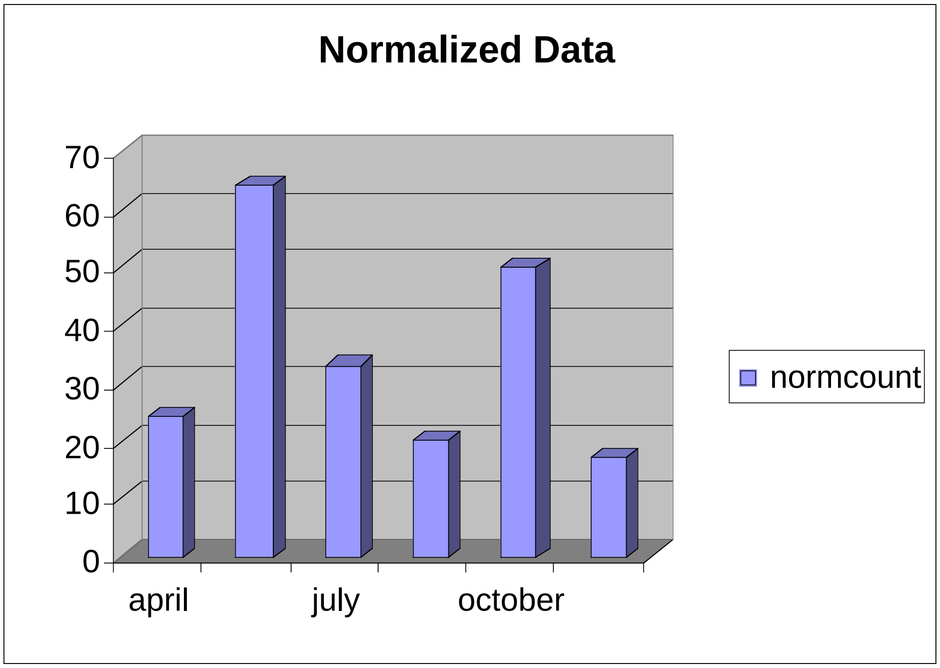


Figure E-3: Sanctuary Consumptive Vessel Use Pre Reserve Implementation

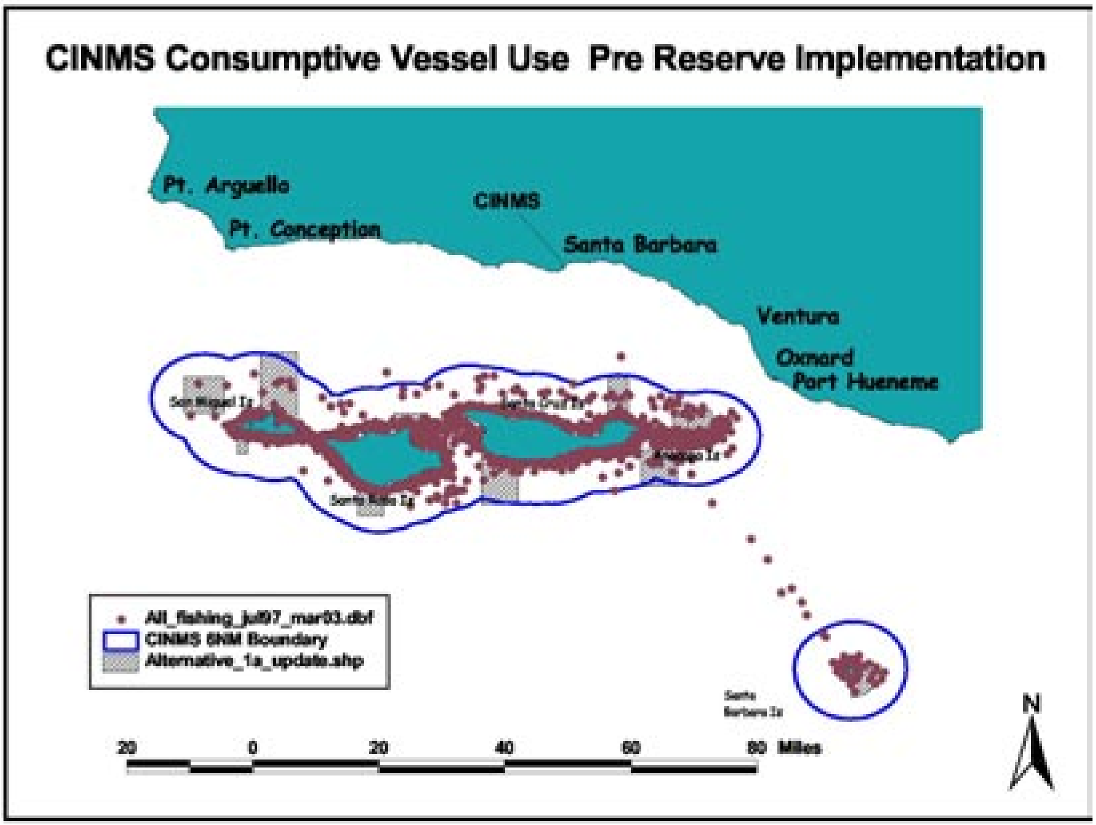


Figure E-4: Eastern Sanctuary Consumptive Vessel Use Post Reserve Implementation

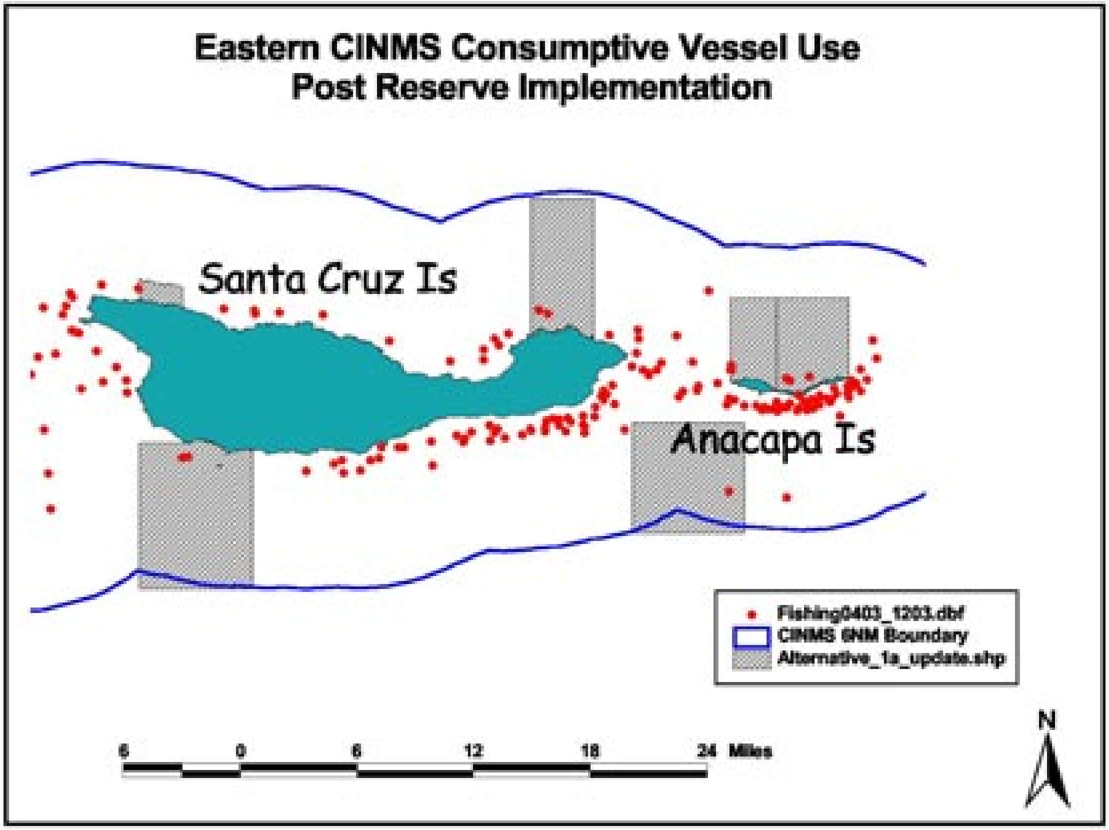
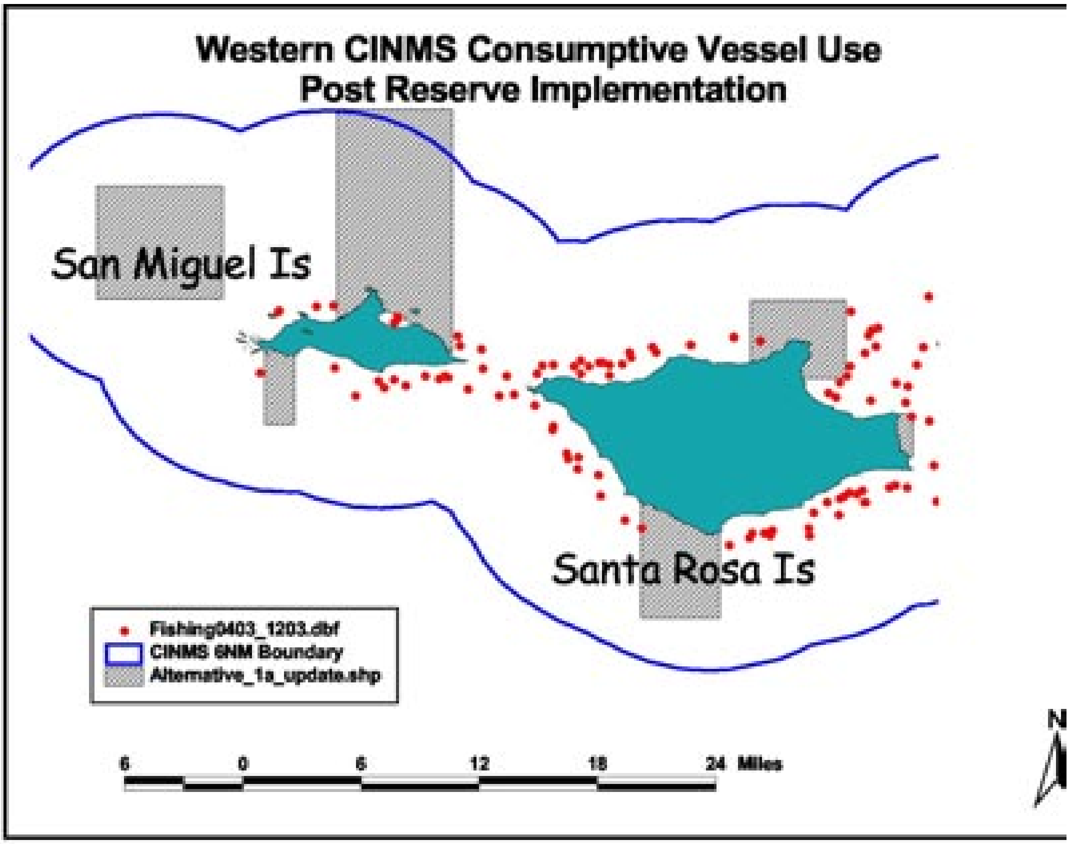


Figure E-5. Western Sanctuary Consumptive Vessel Use Post Reserve Implementation



10.3.9. Other Potential Benefits - Scientific Use and Education

Marine reserve and marine conservation areas can support scientific and educational activities. Educational activities 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 contribute to the management and enhancement of marine species and would be compatible with the purposes of the proposed marine reserve and marine conservation areas.

For example, educational activities such as wildlife surveys would be allowed, as well as certain scientific projects to assess and study the marine environment. These activities would have to be carefully planned to avoid disruption to other research or critical habitats, and would have to contribute to the management and enhancement of marine resources.

Existing research activities include various monitoring programs that track natural trends. These programs would benefit from the establishment of marine reserves because such establishment would eliminate human consumptive uses within reserves, thereby removing this variable's influence on temporal changes.

Research activities also provide a needed baseline of information to gauge the function and effectiveness of the both the existing state network and the proposed federal network. In addition, one of the goals of the marine reserve and marine conservation areas is to promote scientific research that will enhance the knowledge and management of marine resources.

Although it may be difficult or impossible to quantify the economic value of marine reserve and marine conservation areas for education or science, measuring the number of educators and researchers using marine reserve and marine conservation areas may serve as indicators of the education and scientific values of marine reserve and marine conservation areas (CDFG 2002 and Leeworthy and Wiley 2003).

10.3.10. Non-Use or Passive Economic Use Values – Net Benefit Analysis

> *NOTE TO REVIEWER:*
> *The NMSP is currently involved in a process to estimate the passive economic use value for no-take zones in both Hawaii's Main and Northwest Islands. Six focus groups have been conducted so far with about 50 people (two groups each in Hawaii, Madison, Wisconsin and San Diego, California). So far, results are revealing that our assumption on the percent of households willing to pay some amount for no-take zones is extremely conservative.*
>
> *The net benefit assessment section will also address the issue of benefit-cost analysis versus economic impact assessment.*

In Step 2 analysis, we will do a policy simulation that incorporates non-use or passive economic use values. Non-use or passive economic use values are people's willingness to pay to protect a resource in a given condition even though they never plan to visit and use the resources. Other terms to describe these values are based on underlying motives (e.g., bequeath value or the willingness to pay to ensure future generations have the opportunity to experience the resources in a given condition, or existence value or the willingness to pay just to know the resource will exist in a certain protected condition). Passive economic use value requires knowledge of what people are valuing. People receive information about what they are valuing through a variety of media (e.g., newspapers, books, magazines, radio, television, etc.).

To support a policy simulation we provide information to support a lower bound range of passive economic use values for marine reserve and marine conservation areas in the Sanctuary. There are no available studies on the passive economic use values for marine reserve and marine conservation areas in the Sanctuary or elsewhere in the world. Currently, we know of 19 studies on non-use or passive economic use values. In deriving the range of estimates of passive economic use values, we provide information about both the supply and demand for marine reserve and marine conservation areas . National and California State-wide public opinion surveys are summarized to show the extent of public support for marine reserve and marine conservation areas . On the supply side, we address the uniqueness of the Sanctuary and the marine reserve and marine conservation areas relative to Prince William Sound (site of the Exxon Valdez oil spill and one of the studies where passive economic use values have been measured). We use the combination of this information to establish a lower bound range of estimates on the percent of U.S. households that would be willing to pay some amount per year for the Sanctuary marine reserve and marine conservation areas.

The net benefit assessment compares the consumer's surpluses from all consumptive uses (maximum potential loss assumption) with the lower bound range of passive economic use values. Consumer's surplus and producer's surplus (economic rent) are both zero for the commercial fisheries. Economic rents are likely negative in the Sanctuary (fishermen earning below normal returns to investment, i.e., economic overfishing). Policy simulation shows net benefits to Sanctuary marine reserve and marine conservation areas (see Leeworthy and Wiley, 2003).

11. Appendix F: Fishermen's Proposals

NOTE TO READER
Local Santa Barbara and Ventura commercial fishermen submitted four alternatives proposals to the Sanctuary in late January 2004. Their proposals were to be included in this Appendix. The fishermen also presented these proposals to the Fish and Game Commission in February, 2004 and to the Pacific Fishery Management Council in September, 2003.

The Sanctuary, in concert with the National Marine Fisheries Service and State of California, needs to review these proposals further, prior to the release of a formal DEIS. CINMS does not consider these proposals to be feasible alternatives at this time. Based on an initial assessment, the Sanctuary believes that these proposals have the following problems in their current form:

- Each proposal calls for altering or eliminating existing State MPAs, which is beyond the jurisdiction of the Sanctuary.
- Each proposal suggests marine protected areas significantly outside the current Sanctuary boundary.
- Detailed ecological and economic data with spatial resolution comparable to available data within the current Sanctuary boundary is unavailable, which makes a quantitative comparative analysis more difficult.
- All proposals appear to focus on maximizing benefits to groundfish, rather than on meeting the Sanctuary's purposes and needs described in Chapter 1.

The Sanctuary has discussed these issues with these fishermen as well as other fishing interests in meetings of the Sanctuary Advisory Council's Recreational and Commercial Fishing Working Groups. These groups are now developing a new proposal for Sanctuary and PFMC consideration. It is our expectation that this proposal will be available for analysis shortly after release of this preliminary working draft document.

This January, 2004 proposal is available upon request to the Sanctuary. Information about ongoing efforts by the SAC Recreational Fishing Working Group and Commercial Fishing Working Group, including contact information, can be found on line at:
http://www.cinms.nos.noaa.gov/sac/sacwgsub.html

12. Appendix G: Biological and Socioeconomic Monitoring Plans

TO BE ADDED

13. Appendix H: References

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