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Marine Protected Areas Along California's Central Coast: A Multicriteria Analysis of Network Design

A Group Project submitted in partial satisfaction of the requirements for the degree of Master of Environmental Science and Management for the Donald Bren School of Environmental Science and Management.

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The Group Project is required of all students in the Master's of Environmental Science and Management Program. It is a four-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimension of a specific environmental issue. This Final Group Project Report is authored by the above members and has been reviewed and approved by:

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Abstract

California's Marine Life Protection Act directed the state's Department of Fish and Game (CDFG) to establish and manage a state-wide network of marine protected areas (MPAs) based on the best available science. In 2005, CDFG created the MLPA Initiative, which began by designating the Central Coast Study Region between Point Conception and Pigeon Point. A task force and science advisory team (SAT) evaluated network proposals for this region. We provided to the SAT a comprehensive list of species likely to benefit from a network of MPAs, including life history traits, habitat and depth zone boundaries, and legal protection status. We identified depth and dominant habitat(s) for each square nautical mile of California state waters in the Study Region. We used the conservation planning tool MARXAN to identify areas that meet biophysical conservation, recreational, and educational targets, while minimizing potential impact on commercial and recreational fishing industries. In addition, we compiled a list of design factors that increase compliance and ease enforcement for MPAs, and we evaluated and recommended improvements for the proposed network packages based on those criteria. For cost-effective outreach and education for the new network, we recommend that the CDFG establish a partner program with non-governmental organizations, harbormasters, and others to disseminate information; we identified potential partners for such a program on the Central Coast. Our major findings suggest that MARXAN analysis and evaluation of compliance criteria are valuable tools that should be incorporated earlier in the network design process - rather than during the evaluation phase - as California expands its network of MPAs to the north and south of the Central Coast Study Region.

Executive Summary

Introduction

The purpose of our project was to apply principles of conservation planning, as well as lessons learned from past marine protected area (MPA) design challenges, in the context of the Marine Life Protection Act (MLPA) Initiative and the design of a network of MPAs for the Central Coast Study Region of California (Central Coast). In order to develop potential networks of MPAs, data are needed on the distribution of habitat types and species of interest. One also needs to consider how to minimize the negative socioeconomic impacts of MPAs. Additionally, MPAs will only meet conservation goals when user groups comply with MPA regulations. Thus, compliance and enforcement mechanisms are critical elements of network design. All of these considerations are essential to successfully designing and implementing a network of MPAs for the MLPA and were used in developing our project's goals and objectives.

Our analyses provided members of the MLPA Initiative process with the only tool that integrates both biophysical features and socioeconomic considerations. Our work on enforcement and education/outreach could aid in the revision of proposals and the implementation of the resulting network. In addition, our analyses and results have the potential to aid in the design and evaluation of future network proposals along California's north and south coasts, as well as in other regions of the United States.

Background

In 1999, the California Legislature responded to declines in the health of the state's marine environment by adopting the MLPA. The MLPA directs the state to design and manage a network of MPAs to protect marine life and habitats, ecosystems, and natural heritage, as well as improve recreational, educational, and study opportunities provided by marine ecosystems (1999). In the process of recommending a preferred siting alternative for a statewide network of MPAs, the MLPA calls for an analysis of the state's current MPAs. The Initiative is fulfilling the MLPA one region at a time within California State waters, beginning with the Central Coast from Pigeon Point to Point Conception.

The Initiative Process

The Initiative is a cooperative effort between the California Resources Agency and California Department of Fish and Game (CDFG), strengthened by the advice of scientists, resource managers, experts, stakeholders and members of the public. The Initiative established a Blue Ribbon Task Force (BRTF) that is responsible for guiding the implementation process, a stakeholder group, and a science advisory team. The Science Advisory Team (SAT) assisted the BRTF in developing a Master Plan Framework. Additionally, the SAT helped the stakeholder group develop alternative MPA proposals. The Central Coast Regional Stakeholder Group (CCRSG) members are responsible for working with the SAT, professional staff, and

CDFG to help improve the design and management of the Central Coast network of MPAs. Additionally, the CCRSG, in consultation with the SAT, is responsible for developing proposals for potential MPAs. The six proposal packages as of February 9^{th} 2006 include three proposals from the CCRSG, one from an external group, one that comprises existing MPAs only, and the package developed and recommended by MLPA Initiative staff. These were the packages used in our analyses.

Goals and Objectives of our Project

Our project goal was to integrate biological, physical, and socioeconomic data with policy to help the BRTF evaluate and recommend a network of MPAs for the Central Coast Study Region. In consultation with the SAT, we identified key objectives based on the needs of the Initiative and used these objectives to guide our analyses. Our objectives were to:

- Compile reliable data on species likely to benefit from the establishment of an MPA network in the Central Coast Study Region.
- Through the use of the optimization tool, MARXAN, identify and map areas of biophysical, recreational, research and educational conservation value, taking into account socioeconomic data.
- Identify key features of MPAs that maximize compliance. Use these features to evaluate proposed networks and make recommendations for improved MPA design.
- Attend SAT and BRTF meetings in order to follow the process and provide results of our analyses as needed. Present results of our analyses in forms useful to the SAT in the MLPA Initiative process for the Central Coast, as well as in the future for Northern and Southern California.

Species Likely to Benefit

The MLPA requires that the Master Plan Framework includes, “select species or groups of species likely to benefit from MPAs, and the extent of their marine habitat, with special attention to marine breeding and spawning grounds” (CDFG 2005b). The SAT prepared a master list that was used in the Initiative to identify species found in each region and within each proposed MPA network during the development of a recommended network of MPAs. Our group was asked to help formulate a revised list of such species. We provided the SAT with specific life history characteristics, habitat and depth zone boundaries, and species status. Additionally, we helped the SAT re-categorize their initial species list to correspond to the habitat definitions in the MLPA Framework, as well as those used by the MLPA Initiative’s Geographic Information System team. Furthermore, our addition of mammals and birds to the species list may have prompted the inclusion of a “Special Status Species” section in the Central Coast Regional Profile document.

Biophysical Considerations

The MLPA, Master Plan Framework, and SAT identified a list of conservation targets which encompass a variety of habitats, depth zones, and species (CDFG 2005). In addition, the CCRSG identified areas of biodiversity significance and a list of species with special status within the study region (CDFG 2005a). Spatial data, which were available for many of these biophysical considerations, were used in our analysis of optimal MPA locations. We conducted our biophysical and socioeconomic analyses using MARXAN software (version 1.8.2 developed by Ian Ball and Hugh Possingham), which helped us identify potential MPA sites that represent a portion of the biophysical conservation targets identified in the MLPA and Master Plan Framework. MARXAN examines the values of individual planning units and then adds and removes planning units in an attempt to meet user-defined conservation targets while minimizing planning unit costs and reserve-system boundary length (Ardron et al. 2002; Stewart and Possingham 2005). The resulting output is one possible "solution" to meeting the targets while minimizing costs. For each analysis, we ran MARXAN 100 times; our output maps provide an irreplaceability index for each planning unit. The irreplaceability index represents the frequency that the microblock was chosen out of 100 individual solutions. The higher the irreplaceability index, the more likely the microblock will be required as part of a network of MPAs that meet the conservation goals.

The CDFG divided the study region into one nautical mile microblocks, which we used as planning units in our MARXAN analysis. Several parameters must be defined before running MARXAN, including the degree to which selected microblocks should be clustered and the proportion of each target that should be included in the solution. As we increased the clustering factor, or "boundary length modifier" (BLM), the total area of microblocks chosen by MARXAN increased and the perimeter decreased, even while keeping conservation proportion constant. With increases in conservation proportion, while keeping the BLM constant, both area and perimeter increased. After testing a variety of combinations of these factors, we decided to focus our analyses primarily on a conservation proportion of 30% and BLMs of 0 and 0.0001. For the purpose of our biophysical analyses, we defined the cost of selecting each microblock as the area of the microblock to account for the uneven sizes of the microblocks. Our biophysical output maps identified areas in the Central Coast Study Region of high conservation value; these were planning units that were chosen repeatedly by MARXAN to fulfill conservation targets we input, without regard for socioeconomic considerations.

Socioeconomic Considerations

While the biophysical targets were identified from the MLPA, we used the *Adopted Regional Goals and Objectives Package* (Appendix D) developed by the CCRSG to determine which socioeconomic targets to include in our analysis and to identify the best available data to quantify these targets for MARXAN analysis. We designed our analysis to incorporate several socioeconomic considerations along with the biophysical targets. For each of our socioeconomic analyses, we set a conservation goal of 30 percent for each target and ran MARXAN with a clustering factor (BLM) of 0 as well as 0.0001. For comparison, we considered the SAT and CCRSG biophysical MARXAN outputs with the same proportion conserved and clustering factors. For our first socioeconomic analyses, we included the biophysical targets and added the presence of monitoring sites, adjacency to research institutions and adjacency to population centers as conservation targets. For this analysis, we used area as cost. However for the second analyses, in addition to area, we added recreational fishing effort (the number of fishing trips made to each microblock over the survey period) and the relative importance of a microblock to commercial fishermen to represent the cost associated with selecting microblocks in MARXAN. For the third and fourth analyses, recreational and commercial fishing were incorporated separately into the cost function so as to understand how they individually impacted the output. Recreational and commercial fishing were then combined in the fifth analysis to direct MARXAN to reach our conservation goals at the lowest potential impact to both industries. Lastly, adjacency to shoreline parks was included as a target in our sixth socioeconomic analysis providing an output integrating all of our targets and "costs."

Our first analysis incorporated infrastructure with a BLM of 0 and 0.0001 while conserving 30 % of each biophysical and infrastructure target. Without a clustering factor, this increase in targets did not change regional patterns of the results substantially. However, adding the infrastructure targets led to local shifts in microblock selection. With the addition of a moderate clustering factor (BLM 0.0001), regional shifts are more evident with the addition of infrastructure and biophysical targets The addition of recreational fishing in the cost function produced an output in which most microblocks were clearly defined as having either very high or very low irreplaceability and significant clumping of microblocks. These patterns suggest that including recreational fishing as a cost resulted in more frequent selection of microblocks in areas where less recreational fishing effort was exerted, and very little selection of microblocks in areas with significant recreational fishing effort. Clumping of microblocks also occurred in our third analysis, which included commercial fishing alone. Locations of clumping varied significantly between these two analysis, which is likely to due to differing locations of recreational and commercial fishing within the study region. When recreational and commercial fishing were combined in the cost function, the spatial patterns of microblocks resembled a blend of the patterns seen with recreational and commercial fishing alone. Including shoreline parks did not result in significant variation in the number of times microblocks were chosen.

Enforcement and Compliance Considerations

If MPA regulations are not enforced, their effectiveness in conserving biological diversity and viable populations is decreased. There will, however, always be some number of violations with MPAs (Sutinen et al. 1990). As a result, the MLPA calls for adequate enforcement, the CCRSG developed several design considerations to address enforcement issues, and the BRTF has indicated that compliance considerations should be a priority. This prompted us to evaluate and make recommendations for improvement of the proposed MPA networks with respect to enforcement and compliance factors, and to make network implementation recommendations based on a literature search and communication with stakeholders and enforcement officials.

We summarized our findings in a comprehensive list of design considerations to reduce the burden on enforcement agencies, and we evaluated the extent to which MPA network packages proposed by stakeholders address those considerations. We concluded that the design of MPA boundaries is the factor that can most easily be adjusted on MPA network proposals to increase compliance and ease enforcement along the Central Coast. Additionally, we provided several recommendations to improve the efficiency of enforcement efforts for the Central Coast. An interagency memorandum of agreement (MOA) for enforcement between CDFG and the US Coast Guard (USCG), National Oceanographic and Atmospheric Administration (NOAA), the state parks, and any other state or federal agency with an appropriate mandate should be created before a new network is implemented. In addition, CDFG should increase the numbers of boats and staff along the Central Coast to provide adequate enforcement. Also, in the early stages of implementation, CDFG and enforcement partners should issue warning citations coupled with educational information in order to inform users of the new regulations. Lastly, we introduced education and outreach partnerships as a cost-effective potential tool for the CDFG to encourage compliance, and we provided a list of potential outreach partners for the Central Coast.

Conclusions and Application to the MLPA

The overarching goal of our project was to integrate biological, physical, and socioeconomic data with policy to help the BRTF establish a network of MPAs in accordance with the MLPA Initiative. Our list of species likely to benefit provided the SAT with detailed information on species ranges, distributions, habitat preferences, and life history. Our MARXAN analyses provided the SAT, BRTF, and MLPA staff with the only tool in the MLPA Initiative that considered both biophysical features and socioeconomic considerations. Our compliance analyses and recommendations will be submitted to the BRTF to assist them in determining which network proposal package(s) lend themselves to increased compliance and will be easiest to enforce, and we will provide our enforcement and education/outreach recommendations to the CDFG. Time constraints and the limited availability of data early in the MLPA process restricted our ability to provide analyses that could have been used in the design phase – rather than the evaluation phase – of the process. We therefore recommend that MARXAN analyses as well as enforcement considerations be used in the early stages of designing MPA network proposals for the Northern and Southern Study Regions.

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List of Abbreviations

BLM	Boundary Length Modifier
BRTF	Blue Ribbon Task Force
Central Coast	Central Coast Study Region, from Pigeon Point to Point Conception
CCRSG	Central Coast Regional Stakeholder Group
CDFG	California Department of Fish and Game
CINMS	Channel Islands National Marine Sanctuary
The Commission	California Fish and Game Commission
COPPS	Community Oriented Policing and Problem Solving
GBRMPA	Great Barrier Reef Marine Park Authority
GBRMP	Great Barrier Reef Marine Park
GIS	Geographic Information System
HMS	Highly migratory species
MLPA	Marine Life Protection Act
MMS	Minerals Management Service
MOA	Memorandum of Agreement
MPA	Marine protected area
MRWG	Marine Reserves Working Group
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuaries
NOAA	National Oceanographic and Atmospheric Administration
OLE	Office of Law Enforcement
SAT	Science Advisory Team
SMCA	State Marine Conservation Area
SMP	State Marine Park
SMR	State Marine Reserve
SMRMA	State Marine Recreational Management Area
SET	Sanctuary Education Team
TNC	The Nature Conservancy
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
VMS	Vessel monitoring system

Chapter 1: Introduction

1.1. Introduction

1.2. Background

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1.2.2. MLPA History

1.2.3. MLPA Present

1.3. Study Region Profile

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1.4. Goals and Objectives of our Project

1.1. Introduction

The design of marine protected areas (MPAs) has recently moved to the forefront of conservation planning. Past marine conservation planning projects have taught us that it is crucial to apply the best available scientific and ecological information, ensure stakeholder involvement, consider socioeconomic information, and integrate compliance and enforcement design criteria early in the process.

The purpose of our project was to apply these principles of conservation planning, as well as lessons learned from past MPA design challenges, in the context of the Marine Life Protection Act (MLPA) Initiative. The MLPA declares the need for modification of California's existing MPAs consistent with clear, conservation-based goals and guidelines (MLPA 1999). The goals of the MLPA are outlined in Section 2853 of the California Fish and Game Code:

1. To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems.
2. To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.
3. To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity.
4. To protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value.
5. To ensure that California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.

6. To ensure that the state's MPAs are designed and managed, to the extent possible, as a network.

Our project's goals and objectives were developed to be consistent with the goals of the MLPA. They are built on key elements of a marine conservation planning project. In order to develop potential networks of MPAs, data are needed on the distribution of habitat types and species of interest. One also needs to consider how to minimize the negative socioeconomic impacts of MPAs, and thus the distribution and extent of commercial and recreational activities in the study region should be included in the design. Additionally, MPAs will only meet conservation goals when user groups comply with MPA regulations. Therefore, compliance and enforcement mechanisms are critical elements of network design. All of these considerations are essential to successfully designing and implementing a network of MPAs for the MLPA and were used in further developing our project's goals and objectives. In this chapter, we provide an overview of MPAs as well as the history and current status of the MLPA. We also provide an overview of the study region of our project, California's Central Coast. Finally, we outline the goals and objective of our project.

1.2. Background

1.2.1. An Overview of Marine Protected Areas

The MLPA, in Section 2852 of the California Fish and Game Code, defines the term marine protected area as "a named, discrete geographic marine or estuarine area seaward of the high tide line or the mouth of a coastal river, including any area of intertidal or subtidal terrain, together with its overlying water and associated flora and fauna that has been designated by law, administrative action, or voter initiative to protect or conserve marine life and habitat" (MLPA 1999). MPAs have different shapes, sizes, and management characteristics. MPAs have been created for many purposes including protecting and restoring natural and cultural resources, conserving biological diversity, providing a sanctuary for sea life, enhancing recreational and educational opportunities, providing a control site for scientific research, and rebuilding depleted fisheries (CDFG 2005b). MPAs in the United States include national marine sanctuaries, fishery management zones, national seashores, national parks, national monuments, critical habitats, national wildlife refuges, national estuarine research reserves, state conservation areas, state reserves, and others (CDFG 2005b). The state of California defines four types of MPAs, including state marine reserves (SMRs) in which all extractive activities are prohibited, state marine parks (SMPs), which allow recreational fishing and prohibit commercial extraction, state marine conservation areas (SMCAs), which allow for specified commercial and recreational activities, and state marine recreational management areas (SMRMA).

Strong scientific evidence indicates that MPAs are an effective means to increase the abundance, diversity, and size of sea life within reserves (Halpern 2003). A recent study by Halpern (2003) reviewed the empirical data on the effects of the establishment of 89 marine reserves throughout the world on species density, biomass, size of organisms, and diversity. Halpern determined that, with the exception of invertebrate biomass and size, protection from fishing leads to rapid increases in all four factors. In California, recent work on the effect of reserves further supports the conclusion that temperate ocean reserves have a positive effect on sea life (Starr et al. 2002). Fish abundance, size, and species composition were modestly, but statistically significantly, greater inside Point Lobos Ecological Reserve, protected since 1973, and Hopkins Marine Life Refuge, protected since 1984, in comparison to surrounding waters. In the Anacapa Island Nature Reserve, protected since 1978, harvested species were found in higher numbers and were larger inside than outside the reserve (Starr et al. 2002).

The level of protection conferred by a MPA also determines the effectiveness of the reserve for species recovery. For instance, one case study in New Zealand compared a partially closed MPA, a marine park, with two reference areas that were open to all fishing, as well as a no-take marine reserve. The abundance and size of snapper, a species targeted by recreational fishermen, at the marine park were most similar to the fished reference areas. Additionally, the marine park had the lowest mean numbers and sizes of snapper of all areas studied. The study found that the marine park did not result in any recovery of the target species (snapper). However, the no-take marine reserves that were part of the study, displayed a marked recovery of the snapper both in size and number, suggesting that no-take marine reserves provide the most effective protection of all types of MPAs (Denny and Babcock 2004).

The size of an MPA also can affect its impact on a particular species. Small reserves can prove to be inadequate to meet some marine protection goals (Halpern 2003). Small reserves may contribute to species conservation, but the total benefit is much larger in large reserves (Halpern 2003). Halpern also noted that small reserves may not produce significant spillover effects and may be more susceptible to catastrophic events. However, MPA size may be limited by factors such as population pressure, the location of ports, shipping lanes, dumping sites, and oil fields, among other factors (Roberts et al. 2003a).

A network of MPAs allows for different levels of protection with a range of sizes, for a range of habitats and their resident species. MPA networks are typically designed to conserve overall biological diversity from an ecosystem-based management perspective (Gell and Roberts 2003).

1.2.2. MLPA History

In 1999, the California Legislature responded to declines in the health of the state's marine environment by adopting the Marine Life Protection Act (MLPA). The MLPA directs the state to design and manage a network of marine protected areas (MPAs) to protect marine life and habitats, ecosystems, and natural heritage, as well as improve recreational, educational, and study opportunities provided by marine ecosystems (MLPA 1999). In the process of recommending a preferred siting alternative for a proposed statewide network of MPAs, the MLPA calls for an analysis of the state's current MPAs. The analysis shall include "recommendations as to whether any specific MPAs should be consolidated, expanded, abolished, reclassified, or managed differently so that, taken as a group, the MPAs best achieve the goals" of the MLPA and conform to MLPA guidelines (MLPA 1999). According to the MLPA, the state's network of MPAs, including both modified existing MPAs as well as newly designated MPAs, must be designed, implemented, managed, and monitored according to the best available scientific information (MLPA 1999).

The MLPA has not been implemented as quickly as intended (CDFG 2005b). Between the MLPA's passage in 1999 and the creation of the MLPA Initiative in 2004, there were two attempts to implement the MLPA. The attempts failed due to a lack of adequate resources and a lack of robust multi-stakeholder involvement (CDFG 2005b). During the first attempt to implement the law, the California Department of Fish and Game (CDFG) developed a Master Plan Team to produce a draft proposal for a network of MPAs in California. The Master Plan Team comprised eight marine scientists from academia in addition to staff from state and federal resource agencies (CDFG 2005b). CDFG and the MLPA Master Plan Team developed a set of initial proposals for a statewide network of MPAs without significant stakeholder input. This approach was met with great criticism and protest from stakeholder groups when the draft proposal was presented to the public. As a result, the CDFG retracted the draft proposal, and restructured the process in order to receive more input and community support.

The second attempt to implement the MLPA involved seven stakeholder working groups, composed of a range of ocean users and local communities, formed to provide input to the Master Plan Team. Unfortunately, the implementation process was suspended in 2003 due to a lack of funding. The two unsuccessful attempts to fulfill the MLPA provided strong evidence that it would be a very complex and costly process to successfully execute in accordance with the law.

1.2.3. MLPA Present

Governor Schwarzenegger signed the California Ocean Protection Act in 2004, aimed at coordinating state efforts to protect ocean resources and protect and conserve coastal waters and ocean ecosystems more effectively. As a result, the Governor released an Ocean Action Plan on October 18, 2004 titled "Protecting Our Oceans: California's Action Strategy." One objective of the Ocean Action Plan is full implementation of the MLPA (CDFG 2005b). Recognizing the importance of protecting the state's ocean heritage and, therefore, implementing the goals of the Act and the Ocean Action Plan, an alliance of California State agencies prioritized the MLPA by pursuing the California MLPA Initiative (the Initiative). The Initiative is fulfilling the MLPA one region at a time within California State waters (in general extending 3 nautical miles seaward from the mean high tide line), and the first region to receive attention is the Central Coast Study Region from Pigeon Point (37.18521° Lat., -122.3915° Long.) to Point Conception (34.449° Lat., -120.4707° Long.).

Figure 1.1 shows a map of the Central Coast, with the shaded grey area encompassing the entire Central Coast Study Region (Central Coast).

Figure 1.1: Central Coast Study Region of the MLPA Initiative. The shaded grey area indicates the Central Coast Study Region, California State waters from Pigeon Point to Point Conception.

The Initiative is a cooperative effort between the California Resources Agency and California Department of Fish and Game (CDFG), funded by a public-private partnership with the Resources Legacy Fund Foundation and strengthened by the advice of scientists, resource managers, experts, stakeholders and members of the public (CDFG 2005b). Unique to this process, the Initiative established a Blue Ribbon Task Force (BRTF) that is responsible for guiding the implementation process, local and regional stakeholder groups, and a science advisory team. The BRTF is a nine-member panel selected by the Secretary of the California Resources Agency to work with the CDFG to accomplish four MLPA-directed goals by December 2006 (CDFG 2005b):

1. Oversee preparation of a statewide guide for developing a Master Plan Framework for implementing the MLPA.
2. Create a pilot project, in an area along the central coast, which will identify potential networks of MPAs.

3. Develop a strategy for long-term MLPA funding.
4. Make recommendations for improved coordination of MPAs with key federal agencies.

In addition to the BRTF, a Science Advisory Team (SAT) was convened by the CDFG. The SAT includes staff from the CDFG, the Department of Parks and Recreation, the State Water Resources Control Board, and Sea Grant, as well as leading scientists knowledgeable in marine ecology, fishery science, marine protected areas, economics, and social science. The role of the SAT is to assist the BRTF in developing a Master Plan Framework. Additionally, a sub-team of the SAT works closely with the Central Coast project. The sub-team helped develop alternative MPA proposals by reviewing supporting and draft documents, public comments, addressing scientific issues and information provided by the central coast stakeholder group, and framing and referring policy challenges to the BRTF (CDFG 2005b).

The Central Coast Regional Stakeholder Group (CCRSG) includes a representation of affected members of the Central Coast region who are able and willing to provide information that will assist in the development of the proposed alternative networks of MPAs along the Central Coast. The 29 CCRSG members and 27 alternates are responsible for working with the SAT regional sub-team, professional staff, and CDFG to help improve the design and management of the Central Coast network of MPAs. Additionally, the CCRSG, in consultation with the SAT sub-team, is responsible for developing proposals for potential MPAs. The six proposal packages as of February 9th, 2006 include three proposals from the CCRSG, one from an external group, one that is comprised of existing MPAs only, and the MLPA Initiative staff recommendation package. See Appendix A for maps of the six proposals.

The MLPA Initiative envisions the establishment of a statewide network of MPAs by 2011, as required by the law, from a series of regional processes, beginning with an area along the Central Coast (CDFG 2005b). A Master Plan Framework document will guide the process. A general overview of the process and the role of the groups involved are outlined in Figure 1.2. The Fish & Game Commission formally adopted the Master Plan Framework in August 2005.

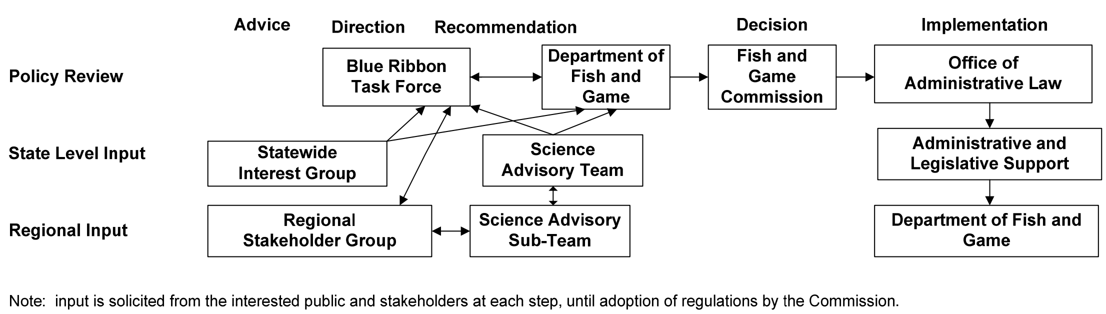

Figure 1.2. An overview of the Marine Life Protection Act Initiative. Adapted from Figure 1 of the Master Plan Framework (CDFG 2005b).

1.3 Study Region Profile

1.3.1. Biophysical Setting of the Study Area

California's Central Coast contains a diverse array of ecosystems, habitats, and species that provide a multitude of uses, aesthetic, commercial, and recreational values, and natural heritage to the region. The Central Coast Study Region includes a broad variety of habitats from deep submarine canyons and rocky shores to estuaries and lagoons. As a result of this diverse array of habitats, the waters are host to a plethora of species of fish and marine plants and algae. Thousands of species of marine invertebrates inhabit the sea floor, while dozens of species of coastal and offshore birds and 35 species of marine mammals spend at least some part of the year in California's waters (CDFG 2005b).

The California Current, which flows through the study region, is highly productive and supports a large number of species. It is one of only four temperate upwelling zones in the world where seasonal winds blow surface water away from the coast, causing cold nutrient-rich water from the deep ocean to rise to the surface. Thus, the waters off California's Central Coast are rich in nutrients and fuel highly productive and diverse ecosystems, such as giant kelp forests upon which large numbers of invertebrates, fish, seabirds, and marine mammals depend (CDFG 2005b). The California Current is also characterized by periodic El Niño - Southern Oscillation (ENSO) climatic events, and decadal climatic shifts. El Niño events tend to reduce the productivity of coastal waters, which can cause some fisheries and seabird and marine mammal populations to decline and others to increase. These events can also lead to the re-distribution of certain species. For instance, warm El Niño waters flowing northward can carry the larvae of California sheephead and lobster from their usual geographic range in Mexico into the waters off California. Other natural fluctuations can be longer term, such as decadal climatic shifts, which can have significant impacts on the health and composition of marine life. In these regime shifts, water temperatures can rise or fall significantly, causing dramatic changes in the distribution and abundance of marine life (CDFG 2005b). These natural phenomena and their impact on species' range and distribution are important to consider when designing and evaluating a network of MPAs, as outlined in the Master Plan Framework as well as Central Coast Regional Profile.

1.3.2. Socioeconomic Setting of the Study Area

The Central Coast consists of five coastal counties – Monterey, San Luis Obispo, San Mateo, Santa Barbara, and Santa Cruz. The major population centers within these counties are the cities of Salinas, Santa Cruz, the Monterey Peninsula, and Santa Maria (CDFG 2005b). The Central Coast has many research institutions and programs which could potentially aid in the research and monitoring efforts of an MPA network. In fact, there are forty in the greater Monterey Bay Area alone (CDFG 2005b).

The fishing industry in the Central Coast includes both commercial and recreational fishing, both of which contribute to local and regional economies. Commercial fishing is concentrated in two main port areas – Monterey Bay and Morro Bay (CDFG 2005b). The Monterey Bay area includes the major ports of Monterey, Moss Landing, and Santa Cruz, while the Morro Bay port area consists of Morro Bay, Port San Luis/Avila, and San Simeon. The average annual value of these fisheries for the Monterey Bay and Morro Bay port areas for the period from 1999-2004 was $10,739,012 and $4,425,427 respectively (CDFG 2005b). Recreational fishing is an important component of the highly-lucrative tourism and recreation industry in the Central Coast. The CDFG-funded California Recreational Fisheries Survey (CRFS) identified four basic modes of recreational fishing: Commercial passenger fishing vessels, private and rental skiffs, beach and bank, and manmade structures (CDFG 2005b). Recreational fishing activities not covered by the CRFS include the charter consumptive dive industry and competitive free-diving. In 2004, over 150 species of finfish were caught by recreational fishermen within the study region (CDFG 2005b).

Other popular forms of tourism and recreation in the study region include swimming, diving, kayaking, birdwatching, whalewatching, tidepooling, and hiking (CDFG 2005b). The counties of the Central Coast contain some of the most popular recreational destinations in California, including the Monterey Bay Aquarium and the Santa Cruz Beach and Boardwalk (CDFG 2005b).

1.3.3. Existing MPAs of the Study Area

In 2006, the Central Coast has 12 existing state MPAs and 1 existing state Special Closure area. Five of these MPAs are marine reserves and seven are conservation areas. Additionally, Elkhorn Slough is a National Estuarine Research Reserve and Morro Bay is protected in the National Estuary Program. There also are many state beaches, state parks, Department of Defense properties, and other protected lands along the coastline (CDFG 2005b). In order to achieve its goals and guidelines, the MLPA required that these MPAs be evaluated and possibility supplemented, upon selection of a preferred network design alternative. The CCRSG considered the existing MPAs during their development of network package proposals. Additionally, the SAT, in consultation with the CCRSG, considered these existing MPAs during their evaluation of package proposals from the CCRSG and development of the MLPA Initiative staff-recommended package.

1.4. Goals and Objectives of our Project

Our project goal was to integrate biological, physical, and socioeconomic data with policy to help the BRTF evaluate and recommend a network of MPAs in accordance with the Act. Our research focused on the Central Coast Study Region established by the BRTF, which extends from Pigeon Point to Point Conception. Throughout our project, we aided the SAT and BRTF in evaluating draft network proposals through biological, physical, and socioeconomic analyses. The aim of this thesis is to provide an overview of our analyses and describe how they were incorporated into the process. In consultation with the SAT, we identified four key objectives based on the needs of the Initiative and used these objectives to guide our analyses:

1. Compile reliable data on species likely to be affected by the establishment of a MPA network (Chapter 2).
2. Through the use of the optimization tool, MARXAN, identify and map areas of biophysical, recreational, research and educational conservation value, taking into account socioeconomic data (Chapters 3 and 4).
3. Identify key features of marine protected areas that could maximize compliance, evaluate proposed networks based on those features, and make recommendations for improved MPA design (Chapter 5).
4. Attend SAT and BRTF meetings in order to follow the process and provide results of the above analyses as needed. Provide results of our analyses in forms useful to the SAT in the MLPA Initiative process for the Central Coast, as well as in the future for Northern and Southern California regions (Chapter 6).

Chapter 2: Species Likely to Benefit

2.1. Introduction

2.2. Methods

2.3. Results and Discussion

2.1. Introduction

Under direction of the Marine Life Protection Act (MLPA), the network of marine protected areas (MPAs) must be designed, implemented, managed, and monitored according to the best available scientific information (MLPA 1999). Many studies have explored how MPAs impact particular species. Halpern (2003) found that fully protected marine reserves have led to increases in abundance, body size, biomass, and reproductive output of previously exploited species throughout the world (Halpern 2003). However, the level of effectiveness of an MPA can depends on the mobility of the species of interest and on the level of protection, size, and design of the area (Gell and Roberts 2003). While sedentary species certainly benefit from MPAs, the benefits to mobile species are debated. MPAs designed to benefit highly mobile species must offer protection at key places and times when the species are most vulnerable, such as at migration bottlenecks, aggregation sites, and nursery grounds. By designing a MPA in such a manner, both sedentary and mobile species could benefit from MPAs (Gell and Roberts 2003).

The goals of the MLPA are broader than protecting a specific species, calling for protection of “the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems” (MLPA 1999). In evaluating MPA design from an ecological perspective, one needs to consider species likely to benefit from the network and their range, distribution, and life history characteristics. This entails a detailed evaluation of habitat requirements of the species likely to benefit from MPAs in the study region. Section 2856(a)(2)(B) of the MLPA explicitly identifies this, requiring that the Master Plan Framework identify, “select species or groups of species likely to benefit from MPAs, and the extent of their marine habitat, with special attention to marine breeding and spawning grounds, and available information on oceanographic features, such as current patterns, upwelling zones, and other factors that significantly affect the distribution of those fish or shellfish and their larvae” (MLPA 1999). The Science Advisory Team (SAT) prepared a draft master list of such species in July 2004.

In June 2005, MLPA Initiative staff asked our group to help formulate a revised list of species likely to benefit from MPAs. We provided the SAT with a revised species list containing life history characteristics, habitat and depth zone boundaries, and species status. Additionally, we helped the SAT re-categorize their initial species list to correspond to the habitat definitions in the MLPA Framework, as well as those used by the MLPA Initiative’s Geographic Information System (GIS) team. Using this information as well as data provided by SAT members, the SAT prepared a final master list "Fishes, Invertebrates and Plants Likely to Benefit From the Establishment of MPAS in Central California", which was approved by CDFG in September 2005. This list was used in the Initiative process during the development of proposed networks of MPAs to identify species found in each region and within the proposed MPA network.

2.2. Methods

We conducted a comprehensive literature review and obtained information about species' ranges and distributions, life history characteristics, conservation status, and depth ranges. We documented habitat preferences for each of the species using the habitats defined by the SAT, as well as corresponding habitat data layers used by the MLPA Initiative's GIS team. In addition, we noted which life stages of the species were found in each habitat – adult, larva, or juvenile. For most species, potential larval and adult dispersal were not well documented, and thus were not included in our list. We also added certain mammal and bird species (taxa which were not previously included) to the list based on their protection under pertinent laws such as the Endangered Species Act, the Marine Mammal Protection Act, the Marine Life Mammal Act and the Migratory Bird Treaty Act. This addition may have prompted the inclusion of a *Special Status Species* section (Appendix B) to the Central Coast Regional Profile document that includes species protected by such environmental laws.

2.3. Results and Discussion

Appendix C shows the list of species that we submitted to the SAT. The list includes information on species' status, north and south range endpoints (how far north or south the species of interest is known to be distributed), depth range, larval type, habitat suitability (based on the habitat definitions in the Master Plan Framework) for adults, juveniles and larvae, as well as additional notes such as more general life history characteristics. An interesting feature to note is that the vast majority of the species likely to benefit from MPAs have ranges that extend far north and south of the Central Coast Study Region (Central Coast). The only species whose range is within the Central Coast is the southern sea otter. The species found our list (Appendix C) are also broadly distributed among the habitats. As described above, we classified habitats by definitions developed by the SAT and described in the Master Plan Framework as well as corresponding to habitat data layers used by the MLPA Initiative's GIS team. Table 2.1 below summarizes the number of species likely to benefit from the network of MPAs found in each of these habitats, the percentage of each of these habitats found in the Central Coast and the number of species with at least one life stage endemic to each habitat. Habitat percentages were outlined in the Central Coast Regional Profile Document, by the SAT (CDFG 2005c). The habitat classification used in our species table (Appendix C), and thus in Table

2.1 below, is slightly different from that defined in the Regional Profile document due to differences in habitat data layer classification used by the Initiative GIS team. The intertidal and shallow subtidal category encompasses both soft and hard substrate intertidal habitat as well as the 0 to 30 m depth category. This classification was established by the GIS team at an early stage in the process, prior to any modeling. More recently in the process, the intertidal/shallow subtidal category was separated into three categories: intertidal, 0-30m soft bottom and 0-30m rocky habitats. Furthermore, for some species, specific depth categorization was not available in our literature review, and thus we created categories for undefined depth zones. Accordingly, these do not have areas associated with them.

In observing the summary provided in Table 2.1, sandy/soft bottom substrate, rocky reefs, and kelp forests support the greatest number of species in the Central Coast. However, note that most species on the list are found in more then one habitat, and thus it is important to consider habitats that contain the most species' life stages associated with a particular habitat. Based on the summary in Table 2.1, several habitats, including sandy/soft bottom substrate, the intertidal and shallow subtidal zone, and rocky reefs, support the greatest number of species with at least one life stage endemic to each habitat.

Table 2.1. Approximate amount of each habitat and number of species likely to benefit in the Central Coast Study Region

Habitat	Number of Species Likely to Benefit	% of Study Region Area	Number of Species with one Life Stage Endemic to Habitat
Nearshore			
Estuary	26	0.8	7
Intertidal and Shallow Subtidal	40	NA	28
Seagrass: Eelgrass	4	0.1	0
Kelp Forest	43	0.93	8
Rocky Reef	56	NA	21
Offshore			
Sandy/Soft (undefined depth)	76	NA	46
Sandy/Soft (30 - 100m)[1]	25	25.8	5
Sandy/Soft (100-200m)	13	5.1	1
Sandy/Soft (> 200m)	11	9.3	1
Hard Bottom (undefined depth)	37	NA	19
Hard Bottom (30 - 100m)	8	2.4	2
Hard Bottom (100 - 200m)	6	1.2	0
Hard Bottom (> 200m)	7	1.4	0
Submarine Canyons	15	4.7	2
Pelagic Zones	11	NA	3
Upwelling Zones	3	NA	2

Notes: 1. for the purposes of our species table, "intertidal and shallow subtidal" includes soft and hard intertidal and seafloor habitat from 0-30 m depth range .

A discussion of how our list was used in the MLPA Initiative can be found in Chapter 6. As more detailed information, such as marine mammal breeding and spawning grounds, larval dispersal potential, and upwelling zones and current patterns, becomes available, the information should be included in subsequent planning processes to more effectively meet the goals of the MLPA. Additionally, a list of species that is more comprehensive than the one used in the MLPA Initiative could be used to effectively identify species found in each region and within each proposed MPA network during the development of designs for networks of MPAs.

Chapter 3: Biophysical Considerations

3.1. Introduction

3.2. Overview of MARXAN software

3.3. Methods

3.4. Limitations

3.5. Results and Discussion

3.1. Introduction

The Marine Life Protection Act (MLPA) indicates that "marine life reserves in each bioregion should encompass a representative variety of marine habitats and communities across a range of depths" (MLPA 1999). By recommendation of the Blue Ribbon Task Force (BRTF), the Fish and Game Commission adopted two bioregions for the purpose of implementation of the MLPA: north of Point Conception and south of Point Conception (CDFG 2005b). The Central Coast Study Region (Central Coast), defined as Point Conception to Pigeon Point, contains a portion of the bioregion north of Point Conception. Within the MLPA and Master Plan Framework, several conservation targets (*i.e*. habitats, areas of biodiversity significance, and species of special status) were identified as areas that should be included in a network of marine protected areas (MPAs). The MLPA specifically mentions the following habitats in reference to their inclusion in a system of MPAs: rocky reefs, intertidal zones, sandy or soft ocean bottoms, underwater pinnacles, seamounts, kelp forests, submarine canyons, and seagrass beds (MLPA 1999). With the exception of seamounts, all of these habitats are found in state waters within the Central Coast.

The Science Advisory Team (SAT) recommended that the list of habitats referenced in the MLPA be expanded to include specific depth zones (intertidal, intertidal-30 m, 30-100 m, 100-200 m, >200 m), estuaries, upwelling areas, retention areas, and freshwater plumes. The specific depth zones were identified based on fish depth distributions in California (CDFG 2005b). In addition, the SAT identified two different types of kelp habitat (*Macrocystis pyrifera* and *Nereocystis lutkeana)* and three different types of rocky reef habitat (granite, sandstone or shale, and the Franciscan Complex) in the Central Coast. These habitats are referred to as the SAT's biophysical conservation targets throughout this document.

In addition to the SAT's biophysical conservation targets, the Central Coast Regional Stakeholder Group (CCRSG) identified *areas of biodiversity significance* (CDFG 2005c):

- Areas where numerous habitats are found in close proximity and areas with unique combinations of habitats

- Large estuaries (Elkhorn Slough and Morro Bay estuaries) with eelgrass beds, tidal flats, and coastal marsh
- Small estuaries with presence of coho or steelhead populations
- Submarine canyon heads and large submarine canyons, including those that are either soft or hard substrata-dominated
- Marine areas off headlands with adjacent upwelling centers, especially those with kelp forests and rocky reefs in retention areas in the lee of the upwelling center
- Persistent kelp beds and nearshore rocky reefs
- Areas of high bathymetric complexity which provide topographic relief and a variety of habitats in close proximity
- Shallow and deep pinnacles
- Rocky substrata in all depth zones, since rocky habitat is more rare than soft-bottom habitat
- Shelf-slope break (100-200m) where the continental shelf slopes downward
- Rocky intertidal shores, especially wave-cut rocky platforms (which provide habitat at diverse tidal elevations) and rare sheltered rocky shores
- Seabird colonies
- Marine mammal rookeries and haulouts
- Areas of high fish diversity and/or density as identified by the 2004 NOAA Biogeographic Assessment
- Areas of high seabird diversity and/or density as identified by the NOAA Biogeographic Assessment

Finally, the CCRSG recommended the inclusion of *species with special status* in the study region (CDFG 2005c). Special status species include any species found in the Central Coast that are protected under the Endangered Species Act, the Marine Mammal Protection Act, or the Migratory Bird Treaty Act (Appendix B). Included in this list are various seabirds, anadromous fish, one invertebrate, sea otters, pinnipeds, and cetaceans. The Central Coast Regional Profile highlights coho salmon, steelhead trout, pinnipeds, seabirds, and cetaceans (CDFG 2005c). The *areas of biodiversity significance* and *species with special status* are referred to as the CCRSG's biophysical conservation targets throughout this document.

Not all of the biophysical conservation targets identified by the SAT and CCRSG were used in our analyses because peer reviewed spatial data were not available for every target. Our analyses were conducted using the SAT's and CCRSG's biophysical conservation targets with peer reviewed spatial data available through the

California Marine Geodatabase (Table 3.1). After we identified a list of biophysical conservation targets, members of the CCRSG created a package of *Regional Goals and Objectives* to guide the group in designing networks of MPAs. The BRTF adopted these goals and objectives into the Initiative and they are referred to as the *Adopted Regional Goals and Objectives Package (*Appendix D). We identified how the biophysical conservation targets used in our analyses met the *Adopted Regional Goals and Objective*s *Package* (Appendix E).

Table 3.1. Biophysical conservation targets identified by the SAT and CCRSG supported by peer reviewed spatial data in the California Marine Geodatabase. These conservation targets were used in our MARXAN analyses.

SAT's Biophysical Conservation Targets	CCRSG's Biophysical Conservation Targets
Rocky reef (granite)	Large estuaries (Elkhorn Slough and Morro Bay estuaries)*
Rocky reef (sandstone and shale)	Small estuaries with presence of coho or steelhead populations estuaries*
Rocky reef (Franciscan Complex)	Submarine canyon heads and large submarine canyons*
Sandy or soft ocean bottoms	Persistent kelp beds
Underwater pinnacles	Nearshore rocky reef*
Kelp forest (*Macrocystis pyrifera*)	Areas of high bathymetric complexity
Kelp forest (*Nereocystis lutkeana*)	Shallow and deep pinnacles
Submarine canyons	Rocky subtrata in all depth zones*
Eelgrass beds	Shelf-slope break (100-200m)
Surfgrass beds	Rocky intertidal shores*
Estuaries	Seabird colonies
	Marine mammal rookeries and haulouts
	Areas of high fish diversity and/or density
	Areas of high seabird diversity and/or density
	Sea otter habitat
*Estuaries, rocky reef, and submarine canyons were identified by both the SAT and CCRSG. In our analyses consisting of both SAT and CCRSG targets, each of these habitats were represented only once.	

We conducted several analyses using MARXAN software (version 1.8.2 developed by Ian Ball and Hugh Possingham) in order to identify potential MPA sites that include the SAT's and CCRSG's biophysical conservation targets with peer reviewed spatial data (Table 3.1). Although estuaries, rocky reef, and submarine canyons were conservation targets identified by both the SAT and CCRSG, they were not represented twice in our analyses. We chose MARXAN software because it has been used in several different marine planning efforts (Groves 2003) and its flexibility allows for the integration of biophysical and socioeconomic considerations. The focus of this chapter is on modeling the biophysical targets, and in Chapter 4 we describe the integration of biophysical and socioeconomic considerations.

3.2. Overview of MARXAN Software

MARXAN software was developed to aid in the design of MPAs that meet particular biophysical and socioeconomic criteria (Ball and Possingham 2000). MARXAN software selects planning units that meet a set of user-defined conservation goals while minimizing a linear combination of planning unit costs and reserve system boundary length (Stewart and Possingham 2005) as potential MPAs. One way that MARXAN works is by performing an algorithm called simulated annealing. Using simulated annealing, individual planning units are examined for their values and then a collection of these units are selected to meet the collective conservation targets. The algorithm adds and removes planning units in an attempt to improve the efficiency of the MPAs (Ardron et al. 2002). At the beginning of process, the algorithm selects and discards random planning units, allowing the selection of less optimal planning units; better choices can potentially be found later in the process. There are many solutions to the same problem and re-running the algorithm with a different starting portfolio will likely find a different locally optimal solution. It is often useful to identify how often a planning unit is included in a set of locally optimal solutions. The results from all runs can be added together to show how many times each planning unit was selected in the total number of runs. An example of how individual run solutions are added together to create a summed solution, or irreplaceability index, is illustrated in Figure 3.1.

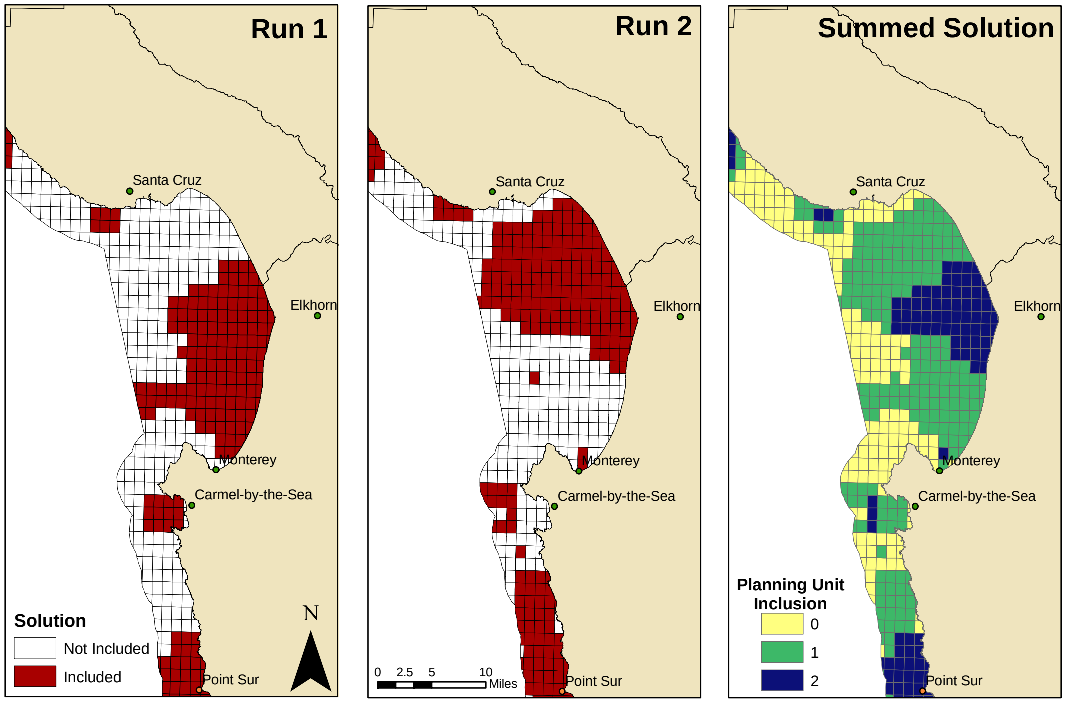

Figure 3.1. Individual MARXAN runs can be added together to create a summed solution.

3.3. Methods

To run our MARXAN analysis, we used the best available peer-reviewed biophysical data provided by the California Marine Geodatabase developed by the MLPA Initiative's GIS team (Table 3.1). If the SAT's biophysical conservation targets were represented in more than one of the recommended depth zones (intertidal, intertidal-30 m, 30-100 m, 100-200 m, >200 m), we separated them into these depth zones and treated each target within each zone as a separate target in MARXAN.

Many parameters must be set when using MARXAN (Appendix F). We used MARXAN with the simulated annealing, summed irreplaceability heuristic, and normal iterative improvement features. We ran MARXAN with the adaptive annealing schedule and performed 100 repeat runs for each scenario using different conservation targets and cost functions. Each run consisted of 5,000,000 iterations of the simulated annealing algorithm.

The Boundary Length Modifier (BLM) is a variable that controls the importance of minimizing the MPA system boundary length relative to the planning unit cost (Stewart and Possingham 2005). In other words, the BLM is a parameter that directs the model to cluster groups of planning units together rather than selecting several disconnected planning units. With a small BLM, the algorithm concentrates on minimizing planning unit cost while a larger BLM places greater emphasis on minimizing the boundary length (Stewart and Possingham 2005). A low BLM will allow the program to select several smaller areas with high conservation value, whereas a larger BLM will force fewer, larger areas be selected. We explored the effect of the BLM ranging from 0 to 1 resulting in solutions that range from unclustered to highly clustered. The magnitude of the BLM is dependent upon the geometry of the study region and must be determined through experimentation (Ardron et al. 2002). We identified the most efficient BLM using the method of Stewart and Possingham (2005) by determining which BLM achieves spatial compactness with acceptable trade-offs between area and boundary length.

MARXAN was run with biophysical conservation targets identified by the SAT alone and then with the additional biophysical targets identified by the CCRSG. The purpose of modeling the SAT identified targets was to provide the scientists with a spatial representation of their biophysical objectives. In the Central Coast Regional Profile, the CCRSG adopted the biophysical targets identified by the SAT, and identified additional biophysical features (CDFG 2005c). Due to the importance of incorporating stakeholder knowledge into designing a network of MPAs, we modeled the SAT and CCRSG identified targets together. Each scenario was modeled at three different target levels: to protect 10% of each conservation target, consistent with general minimum recommendations (Gell 2003); 30%, consistent with international recommendations (IUCN 2003); and 50% of each conservation target. The representation of a portion (i.e. 10%, 30%, 50%) of the conservation targets are referred to as conservation goals in this document. An overview of the approach is presented in Figure 3.2.

We used the California Department of Fish and Game's (CDFG) microblocks in state waters as the planning units for this project. The study area includes 1381 microblocks. We chose the microblocks as the planning units for this study because they were the standard analysis units used in the MLPA Initiative. However, we recognize that the results of MARXAN analyses are affected by the size and shape of the planning units (Leslie 2003). The microblocks are typically one nautical mile square, but their shape and size vary on the coast and at the border with federal waters. Using ArcGIS, the CDFG's microblocks were clipped to the Central Coast and the biophysical data were divided into microblocks for use in MARXAN. We present an overview of the data analysis performed in ArcGIS to divide the biophysical data in Appendix G.

As discussed above, MARXAN calculates the cost of each microblock it selects during the simulated annealing process. We defined cost as the area of the microblock because of the uneven sizes of some of the microblocks, especially on the shoreline and at the boundary of the state waters. The cost was normalized to be proportional to the area of the largest microblock with a maximum cost value for a microblock of 1. In Chapter 4, the cost of each microblock incorporates the "cost" of conserving a microblock to fisheries but is always normalized so that the maximum cost value per microblock is 1; this allows us to compare the biophysical output with the output containing socioeconomic considerations with the same BLM and conservation goal. Using area as a cost, the model will select areas that meet the conservation goals in the minimum amount of space possible. Due to use-conflicts within MPAs, representing conservation targets in the least amount of area is politically more favorable than proposing a larger area representing the conservation targets.

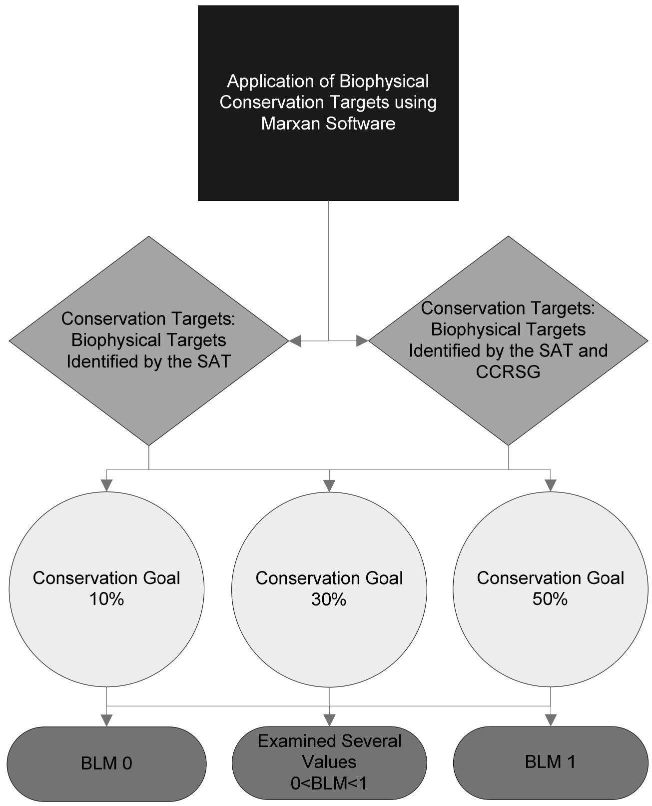

Figure 3.2: Biophysical scenarios analyzed using MARXAN software.

3.4. Limitations

Data availability: Our analyses were limited to the available data. The SAT identified ocean circulation features (freshwater plumes, retention areas, and upwelling centers) as a “key habitat” to be protected. However, these data are not available because the existing data sets were incomplete. Therefore, these features were not set as conservation targets and, as a result, were not included in our analyses. Although there are no comprehensive studies for eelgrass and surfgrass along the Central Coast, the data were used in MARXAN. Therefore, these habitats were incompletely represented in our analyses.

Data quality: Although the data were peer-reviewed by the MLPA Initiative staff and approved for use in the MLPA, the data are of various qualities. Some of the data are not considered good quality data but are the best available data and were used in the process. For example, the underwater pinnacles data are considered to be poor quality data because they only represent locations where some underwater pinnacles do exist and not where they do not exist (CDFG 2005d). The MARXAN output is limited by the quality of data.

Scale of data: Raw data were collected on various scales, causing some of the data to be less precise than other data. For example, some of the region's substrate (i.e. sandy bottom and rocky reef in the Monterey Bay area) data have a higher resolution than substrate data for other regions of the study area.

Variability in data: The static nature of most data on habitat distributions does not account for environmental variation and climate change (Airame et al. 2003). Certain habitats vary seasonally and/or annually, making it difficult to parse the data into static microblocks. For example, kelp forest area and location vary both seasonally and annually. Kelp data from a four year study were compiled to create one kelp forest data layer. Therefore, certain areas that were selected in MARXAN based on the kelp layer may not contain kelp in any given season or year.

Representation: The raw data were available in different forms which may influence the representation of the data in MARXAN. Most of the data were available in polygon format and are represented in MARXAN as an area per microblock. However, three datasets were in line format (surfgrass, nearshore rocky reef, and nearshore soft bottom) and were treated as presence/absence data per microblock. This could impact the results in MARXAN because a microblock with a large amount of this habitat was considered to have equal conservation value to a microblock with a very small amount of this habitat.

Political Limitations: The objectives outlined by the SAT were developed for the entire state. They recommended that the biophysical objectives be met within each "bioregion". During the MLPA process, the BRTF determined that California has two bioregions (one north of Point Conception and one south of Point Conception). However, the Central Coast planning region was decided before the number of bioregions was determined. The region between Point Conception and Pigeon Point was selected as the first region to identify MPAs, encompassing only part of one of the bioregions. Since the SAT's biophysical objectives were intended for the entire bioregion, the area from Point Conception to Pigeon Point does not need to meet all of objectives. The missing objectives may be met in northern California. However, continuing this process is contingent upon funding from private sources. The State does not have the budget to finance the MLPA in other regions in a manner that is consistent with the law and will rely on private contributions.

3.5. Results and Discussion

All results are displayed as a summed solution of 100 runs in order to identify microblocks with a high conservation value. Each run represents a potential solution that satisfies the biophysical conservation goals. The results from each run were added to produce maps indicating the relative contribution (*i.e.* conservation value) and irreplaceability in the set of solutions of each microblock to the conservation goals (Airame 2005).

Holding all other parameters constant, we varied the BLM for each scenario. Changes in the BLM affected the spatial configuration of the identified areas (Figure 3.3) for this and other scenarios. As we increased the BLM, the total area increased and the perimeter decreased for the scenarios with and without the targets identified by the CCRSG (Table 3.2). Application of MARXAN with a BLM of 0 resulted in a highly fragmented network (Figure 3.3a). Increases in the BLM to 0.0001 and 1 contributed to clustering of the identified areas (Figure 3.3b, c).

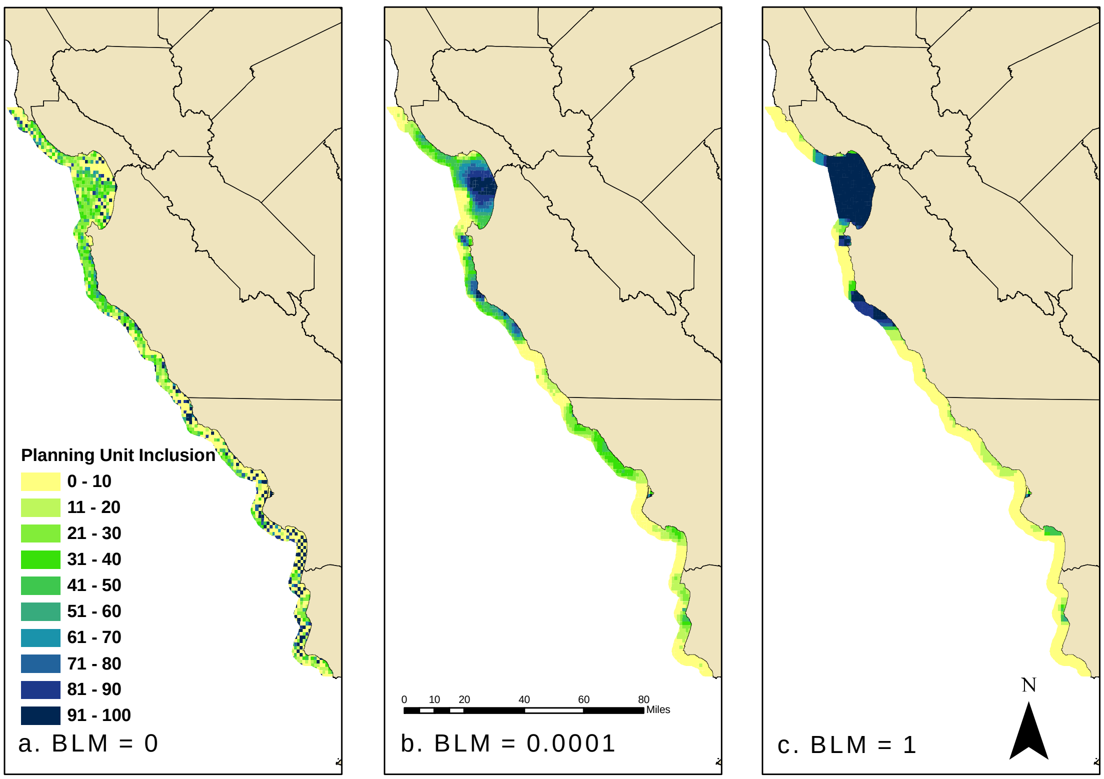

Figure 3.3. Application of MARXAN with the biophysical targets identified by the SAT and CCRSG with a conservation target of 30%. Changes in the boundary length modifier (BLM) allow the operator to control the spatial configuration of the areas selected in MARXAN. A BLM of 0 results in highly fragmented areas (a). Increases in the boundary length modifier contribute to clustering of the selected areas (b and c).

Table 3.2. Area and perimeter of MARXAN solutions for three boundary length modifiers (BLM). Solutions generated at three different BLMs with a constant conservation target of 30% with biophysical targets identified by the SAT and CCRSG. Area and perimeter are expressed as mean ± standard deviation across 100 individual runs.

BLM	Area (km^2)		Perimeter (km)	
	SAT & CCRSG	SAT	SAT & CCRSG	SAT
0	881.2 ± 2.2	878.2 ± 3.1	1977.7 ± 28.2	1972.8 ± 24.8
0.0001	886.4 ± 1.6	886.5 ± 1.4	494.4 ± 26.9	470.8 ± 23.6
1	1051.5 ± 16.8	1037.2 ± 16.9	339.5 ± 7.6	321.1 ± 3.4

We experimented with the BLM, running the model with several values ranging from 0 to 1. The effect the BLM has on boundary length and area of the selected microblocks is shown in Figure 3.4 for six different spatial clustering scenarios. We determined the desired level of spatial compactness using a method identified by Stewart and Possingham (Stewart and Possingham 2005) that considers the effect of increasing the BLM and minimizing boundary length on the total MPA network area. In selecting the optimal scenario, we traded off area and boundary length to achieve reasonably compact MPA networks. A BLM of 0.0001 proved to be the scenario that had minimal increases in area for large gains in spatial clustering (minimizing boundary length). Running the model with a BLM of 0 allows the model to select microblocks that are richest in biophysical features (*i.e*. high conservation value) without spatial constraints. A BLM of 0.0001 produces solutions that are more likely to meet standards for management, enforcement, and monitoring as described in Roberts *et al*. (Roberts et al. 2003b) because groups of microblocks with high conservation values are selected. Using any BLM value greater than zero directs MARXAN to cluster microblocks to varying degrees.

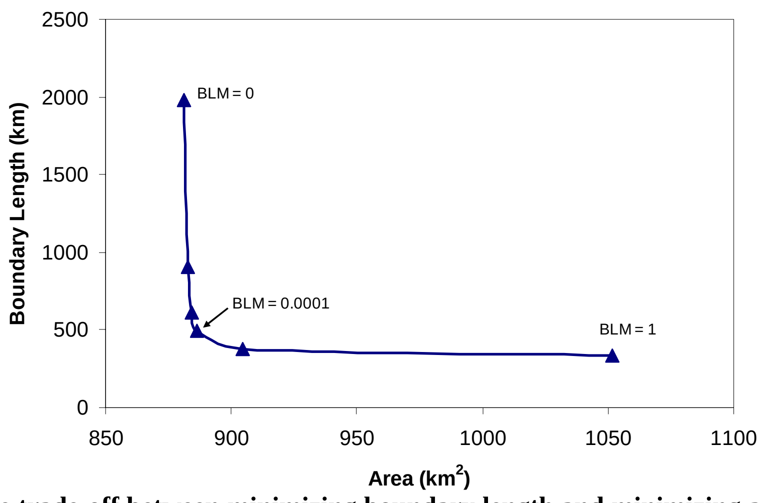

Figure 3.4. The trade-off between minimizing boundary length and minimizing area for various boundary length modifiers (BLM). The scenario with a BLM of 0.0001 achieves spatial compactness with acceptable trade-offs. The average values for area and boundary length across 100 runs are shown.

A change in the conservation goal also affected the total area and perimeter of the regions selected. Conservation goal is the portion of each target (*i.e.* habitat or area of biodiversity significance) that will be protected; a 10% conservation goal, for example, means that 10% of the kelp forest, 10% of the rocky reef, and 10% of every other target (habitat or species) will be identified in the solution. Figure 3.5 shows the results for conservation goals of 10%, 30%, and 50% with a BLM of 0.0001. With an increase in the conservation goal for each target, the average area and perimeter of the selected areas increased with and without the CCRSG identified biophysical targets (Table 3.3). At low conservation goals, the algorithm selects the rarest conservation targets for core locations (Airame 2005). At high conservation goals, the algorithm produces a greater number of alternative locations by comparing several similar microblocks that contain common conservation targets. The results with higher conservation targets both highlight the areas where rare conservation targets are found and indicate alternatives for protecting more common conservation targets in a variety of locations (e.g., not just in the area adjacent to rare habitats) (Airame 2005). However, if the conservation target is too high, a large region is selected and it is difficult to identify priority areas. Therefore, we will display the remainder of the results with a moderate conservation goal of 30% and a BLM of 0.0001. Appendix H includes results for all scenarios with a BLM of 0, 0.0001, and 1, with conservation targets of 10%, 30%, and 50%.

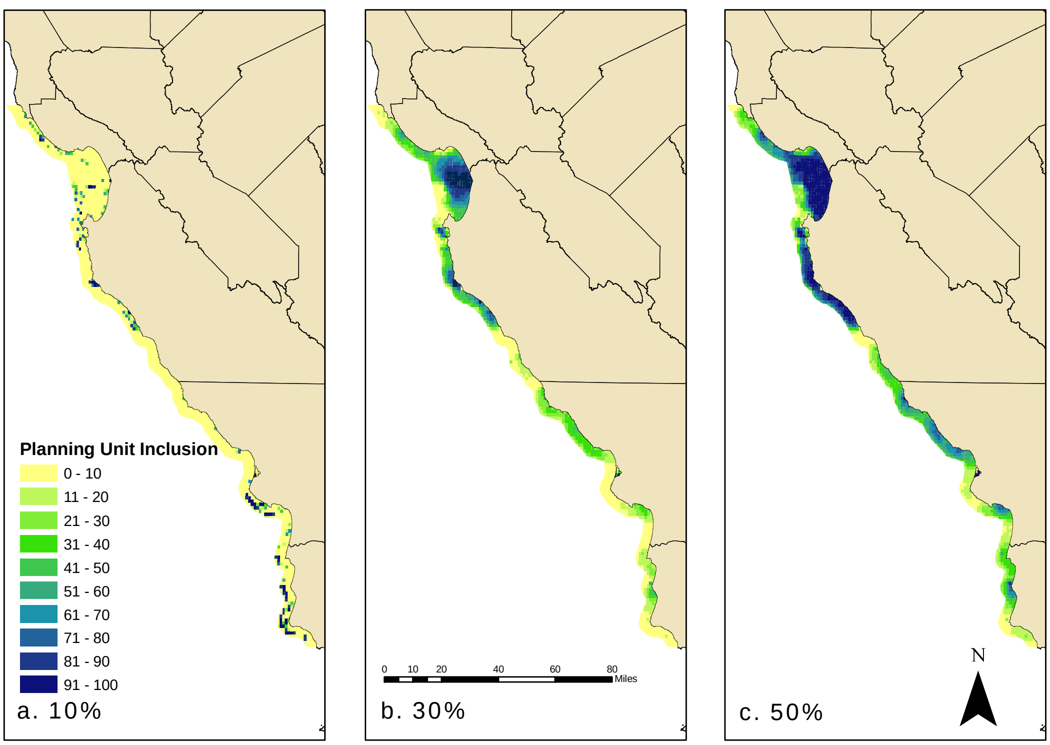

Figure 3.5. Application of MARXAN with the biophysical targets identified by the SAT and CCRSG with a BLM of 0.0001. Changes in the conservation goals after the spatial extent and configuration of the areas selected. Conservation goals were set at (a) 10%, (b) 30%, and (c) 50%.

Table 3.3. Area and perimeter of MARXAN solutions for three conservation goals. Solutions generated at two different BLMs with conservation goals of 10%, 30%, and 50% with biophysical targets identified by the SAT and CCRSG. Area and perimeter are expressed as mean ± standard deviation across 100 individual runs.

BLM	Goal	Area (km^2)		Perimeter (km)	
		SAT & CCRSG	SAT	SAT & CCRSG	SAT
0	10%	293.6 ± 1.8	292.3 ± 1.5	893.4 ± 19.6	897.6 ± 19.1
	30%	881.2 ± 2.2	878.2 ± 3.1	1977.7 ± 28.2	1972.8 ± 24.8
	50%	1471.4 ± 1.1	1470.3 ± 0.8	2414.7 ± 37.7	2428.9 ± 32.3
0.0001	10%	295.7 ± 1.3	295.3 ± 1.1	264.1 ± 20.5	240.1 ± 18.5
	30%	886.4 ± 1.6	886.5 ± 1.4	494.4 ± 26.9	470.8 ± 23.6
	50%	1476.9 ±1.5	1476.6 ± 1.4	712.3 ± 27.5	693.4 ± 26.7

Changes in the BLM and conservation target also affected the spatial configuration of the identified areas using the biophysical targets identified by the SAT alone. As the BLM increased, the area increased and the perimeter decreased (Table 3.2). With an increase in the conservation goal for each target, the average area and perimeter of the selected areas increased (Table 3.3). Figure 3.6 (BLM 0, Conservation Target 30%) and Figure 3.7 (BLM 0.0001, Conservation Target 30%) show a spatial comparison of the results with and without the biophysical targets identified by the CCRSG. The spatial configuration changed slightly between the two scenarios. A comparison of the area and perimeter with and without the CCRSG's biophysical conservation targets reveals no significant difference, when the BLM and conservation target are equal.

Microblocks in Monterey Bay, the Big Sur coast from Point Pinos to Lopez Point, and Morro Bay were chosen frequently, indicating their relative irreplaceability in the solution (Figure 3.7). These areas have a high irreplaceability because they contain several and/or rare conservation targets. In Monterey Bay and along the Big Sur coast, there is both high habitat heterogeneity and rare conservation targets. The areas selected often in Monterey Bay contain several rare conservation targets (submarine canyons, estuaries, eelgrass, and sandstone/shale rocky reef) in addition to a more common habitat, sandy bottom. Along the Big Sur coast from Point Pinos to Lopez Point, the areas selected often contain several rare conservation targets (underwater pinnacles, submarine canyons, and granite rocky reef) in addition to more common habitats (sandy bottom, surfgrass, and giant kelp). Lastly, microblocks in Morro Bay were selected often across all scenarios because two rare habitats, estuaries and eelgrass, are found in the region.

Although some areas are chosen less often, this does not necessarily mean that these areas have a low value for conservation. Areas may be chosen less often for a final solution if they contain fewer conservation targets or if they are similar to other areas.

For example, if a conservation target or a combination of conservation targets can be found in two microblocks of the same size, MARXAN may select one microblock in certain solutions and the other microblock in other solutions. Areas that are not selected often in final solutions offer some flexibility for planning and may contribute to conservation goals in solutions that do not minimize the area of proposed MPAs. Planners must evaluate the original input data and their individual knowledge of the study region in order to understand the behavior and output of the model.

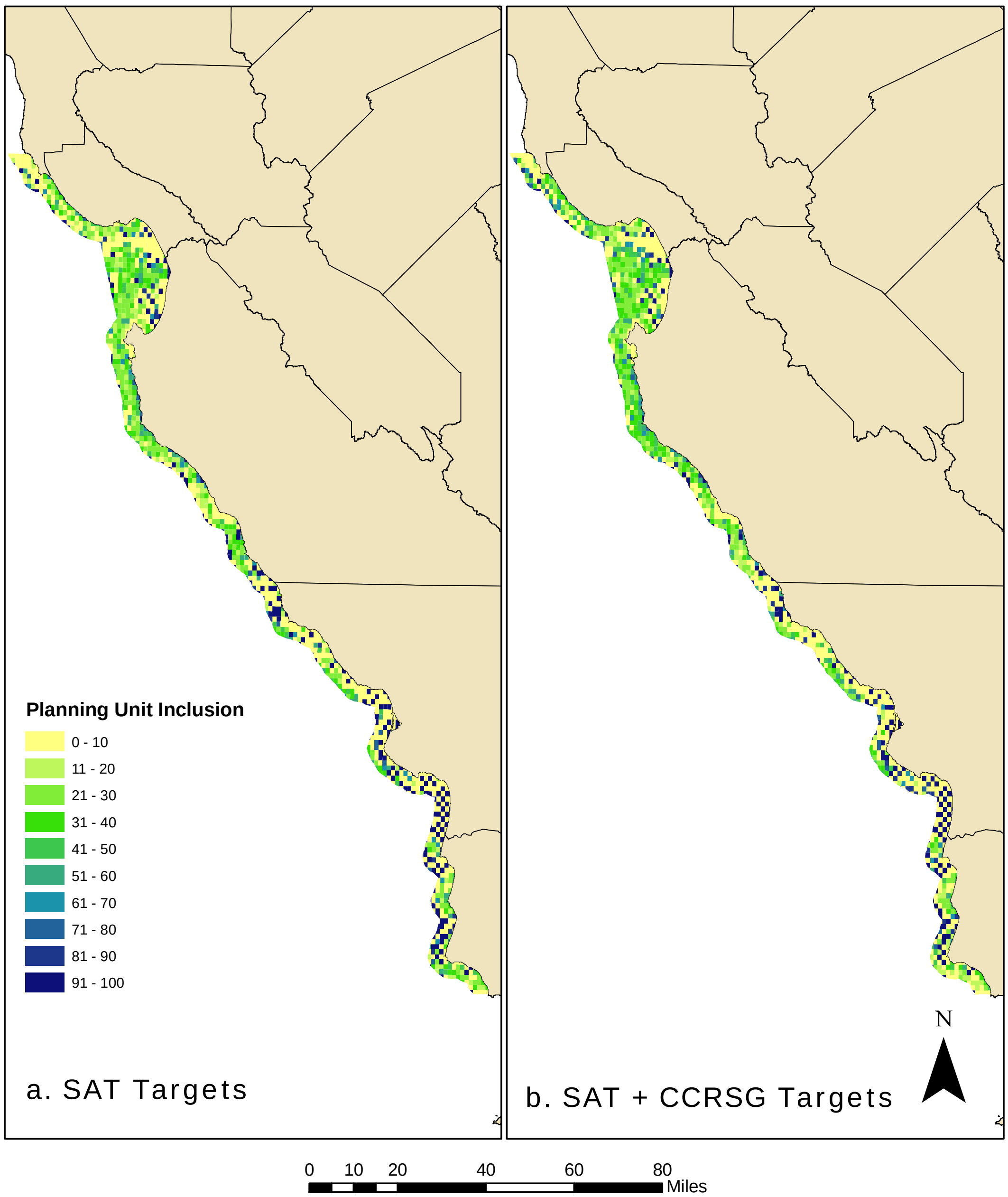

Figure 3.6. Comparison of MARXAN solutions with biophysical targets identified by the (a) SAT and (b) SAT & CCRSG with a BLM of 0 and a conservation target of 30%.

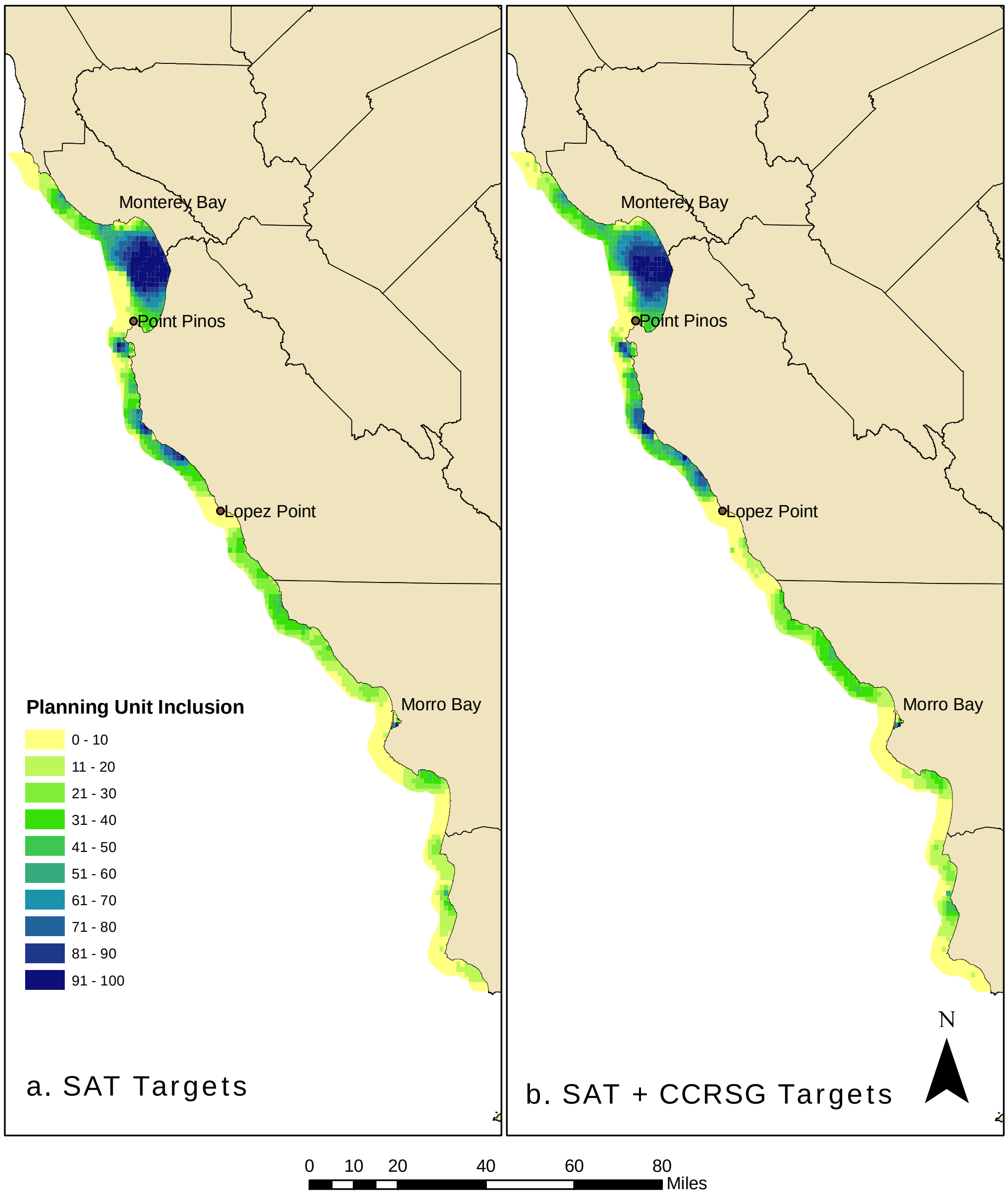

Figure 3.7. Comparison of MARXAN solutions with biophysical targets identified by the (a) SAT and (b) SAT & CCRSG with a BLM of 0.0001 and a conservation target of 30%.

Chapter 4: Socioeconomic Considerations

4.1. Introduction

4.2. Methods

4.2.1. Monitoring Sites, Research Institutions, and Population Centers

4.2.2. Cost: Integrating Recreational and Commercial Fishing

4.2.2.1. Recreational Fishing

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4.4. Results and Discussion

4.4.1. Infrastructure

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4.4.3. Infrastructure and Commercial Fishing

4.4.4. Infrastructure, Recreational Fishing, and Commercial Fishing

4.4.5. Infrastructure, Recreational Fishing, Commercial Fishing, and Parks

4.5. Conclusion to MARXAN Analyses

4.1. Introduction

The implementation of marine protected areas (MPAs) requires that geographic priorities make efficient use of limited resources. This systematic conservation planning is based on clear objectives with specific conservation targets with an explicit and transparent decision making framework (Groves 2003). The primary planning objective of the Marine Life Protection Act (MLPA) is biodiversity conservation. However, the implementation of a network of MPAs also requires the consideration of coastal and marine commercial and recreational uses, research, and study opportunities. The following MARXAN analyses aid in balancing the MLPA Initiative's diverse objectives for the Central Coast.

For the Central Coast Study Region (Central Coast), the CCRSG developed a set of goals and objectives, which were subsequently modified and adopted by the BRTF on September 28, 2005 as the *Adopted Regional Goals and Objectives Package* (Appendix D). While the biophysical targets were identified from the MLPA and Central Coast Regional Profile, the socioeconomic targets were determined using the *Adopted Regional Goals and Objectives* (Appendix E).

The *Goals and Objectiv*es direct the MLPA process to balance the needs of users and conservation goals. Specifically, *Goal 5: Objective 1* states that the process should "minimize negative socio-economic impacts and optimize positive socio-economic impacts for all users, to the extent possible, and if consistent with the Marine Life Protection Act and its goals and guidelines." Also, *Design Consideration 1* states, "in evaluating the siting of MPAs, considerations shall include the needs and interests of all users." In addition, *Goal 3* directs the process to site MPAs so as to "improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbances, and to manage these uses in a manner consistent with protecting biodiversity." Specifically, *Objectives 1 and 3* direct policymakers to place some MPAs near the following: Research institutions, monitoring sites, educational institutions, population centers, and non-consumptive recreational use areas. *Design Consideration 8* supports this goal in stating that the MPAs should "take advantage of existing long-term monitoring studies." *Design Consideration 6* adds that MPAs should be sited "adjacent to terrestrial federal, state, county, or city parks, marine laboratories, or other 'eyes on the water' to facilitate management, enforcement, and monitoring" (Appendix D).

Pursuant to the *Goals and Objectives*, we identified the best available data to quantify these targets for analysis. We used a model (MARXAN) to identify the greatest number of biophysical targets while also achieving (1) inclusion of existing monitoring sites, (2) inclusion of areas near research institutions, population centers (cities), and parks, (3) a minimum potential impact to commercial and recreational consumptive users, and (4) consideration of benefits to non-consumptive recreational users.

4.2. Methods

4.2.1. Monitoring Sites, Research Institutions, and Population Centers

For our second MARXAN analysis, we included the biophysical targets described in Chapter 3 and added monitoring sites, proximity to research institutions and population centers, and adjacency to shoreline parks as targets in our analysis. The combination of these data is henceforward referred to as "infrastructure." All of the infrastructure data used was derived from best available peer-reviewed data provided by the California Marine Geodatabase developed by the MLPA Initiative's GIS team, except for the population centers dataset, which was derived from United States Geological Survey data. Details on source data and data preparation methods are provided in Appendix I.

The original monitoring sites data included the Long-term Monitoring Program and Experiential Training for students (LiMPET), Cooperative Research and Assessment of Nearshore Resources (CRANE), Multi-Agency Rocky Intertidal Network (MARINe), Elkhorn Slough National Estaurine Research Reserve (ESNERR), Central Coast Long-term Environmental Assessment Network (CCLEAN), National

Marine Fisheries Service (NMFS), Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), and California Cooperative Oceanic Fisheries Investigations (CalCOFI) monitoring sites. According to the source data, there are LiMPET, CRANE, MARINe, NMFS, and PISCO monitoring sites on the Central Coast. In order to create a usable dataset, we transformed this complex data into simple data expressing the presence or absence of the Central Coast monitoring sites in each microblock. We assume that at least of some of these monitoring sites will continue in perpetuity.

We adapted the data on research institutions to include the microblocks adjacent to the shoreline of the city in which the institution is located with one exception. For California Polytechnic State University in San Luis Obispo, we selected the microblock adjacent to its Center for Coastal Marine Sciences lab in Avila Beach.

We created a dataset for population centers which identifies microblocks adjacent to shoreline cities and major roads from inland cities. Implicit in our analysis is the assumption that people in cities will go to areas immediately adjacent to cities or major road outlets from inland cities.

Pursuant to the *Goals and Objectives*, the resulting data indicating the presence of monitoring sites, proximity to research institutions and population centers, and adjacency to coastal parks for each microblock were added to the biophysical data as MARXAN targets so that these features would be included in a final MPA network. We applied the same moderate conservation goal (30 percent) to the infrastructure targets and biophysical targets. As discussed in Chapter 3, a medium conservation goal (the proportion of each target conserved in any MARXAN solution) highlights areas where rare targets are found, while also displaying alternatives for protecting more common targets in a variety of locations. The SAT recommended the inclusion of some, but not all monitoring sites inside of MPAs (Gaines 2005). Finally, no criteria were provided to indicate the relative importance of each target, so we chose to use the same proportion conserved for each target. We ran MARXAN with the biophysical and infrastructure targets, with a conservation target of 30 percent for each target, and with a BLM of 0 and 0.0001.

4.2.2. Cost: Integrating Recreational and Commercial Fishing

As discussed in Chapter 3, our first two analyses included only the area of a microblock as the cost of placing it under conservation. This compensates for the uneven size of some of the microblocks and directs the model to meet the conservation goals in the minimum amount of space possible. Until recently, the evaluation of how the placement of MPAs could influence socio-economic factors has mostly been conducted as post-hoc filter of areas (Stewart and Possingham 2005). By integrating recreational and commercial fishing as well as other uses into our analyses, we attempt to better account for these impacts in decision making. For the socioeconomic analysis, we integrated recreational fishing effort and commercial areas of relative importance as well as total area of each microblock into the cost.

This conservative strategy is likely to overestimate the potential costs to recreational and commercial fishermen because we assume that placing areas in MPAs will result in total lost harvest to fishermen. In recent years, significant research has been dedicated to determining whether MPAs will in fact result in lost harvest. Some studies have suggested that fishermen may experience equal catch per unit effort in alternate fishing areas, suggesting that relocating fishing effort may not affect total harvest (Milon 2000). In addition, MPAs could help to replenish fish populations, leading to spillover effects outside reserve boundaries (Halpern 2003; Crowder 2000). If such effects were to occur, it is likely that fishermen could actually benefit from the establishment of MPAs in the long term. Because this debate is on-going, however, and because *Goal 5* of the *Goals and Objectives* directs us to minimize negative social impacts, we assumed there would be some negative socioeconomic impact of MPAs and we incorporated potential losses to fishing as a cost.

4.2.2.1. Recreational Fishing

In order to integrate recreational fishing as a “cost” of placing a microblock under conservation, we used recreational fishing data from two recreational fishing surveys conducted in 2004: The California Recreational Fishing Survey (CRFS) and the Commercial Passenger Fishing Vessel (CPFV) survey. These data were made available on the California Marine Geodatabase for the MLPA process. The data served as an index for recreational fishing “effort,” which is the number of fishing trips made to each microblock over the survey period. The data characterized the effort of each individual fishery for which data existed. While these data identified which recreational fisheries were fishing in each microblock, this data from commercial fisheries did not identify fisheries or individuals due to privacy concerns. To be consistent in our analyses, we did to not integrate the relative value of individual fisheries since we were unable to identify commercial fisheries by name.

In order to incorporate recreational fishing effort into the cost of selecting microblocks in MARXAN, we developed a cost function by adapting an approach taken by Stewart and Possingham (2005). Incorporating fishing data as a cost directs MARXAN to preferentially choose microblocks in areas of lower fishing effort, minimizing potential impacts of MPAs to fishermen, while including the designated proportion of representative habitats and other targets. The cost function is:

$$\text{Cost}(A, R) = 0.2A + 0.8R \quad \text{[Eqn. 1]}$$

where A = Area, R = Recreational Fishing Effort

To calculate R, we summed all of the recreational fishing trips on the Central Coast for each fishery included in the CRFS and CPFV data. We divided the total number of fishing trips to each microblock by this sum, which gave us the proportional fishing effort in each microblock for each recreational fishery. We summed the proportional efforts for each microblock and divided these sums by the largest sum, giving us a normalized proportion of total recreational fishing effort per microblock. Calculating R in this way assigns greater weight to fisheries for which greater proportional effort is being exerted in a particular microblock. Appendix I provides a detailed description of the data and our data preparation.

While recreational fishing effort is the main component of the cost function, we also included area to account for the uneven size of the microblocks – especially on the shoreline and at the boundary of the federal waters – as well as concern that the fishing survey data may have been incomplete for some microblocks, suggesting that some effort is not accounted for in our analysis. Including area as a cost could therefore be considered a proxy for effort that was "missed" during the survey process (Costello 2006). To incorporate this effect of area, but give greater value to fishing, we assigned greater relative importance (0.8) to fishing effort and lesser relative importance (0.2) to area in our cost function (Costello 2006). Using this cost function, we ran MARXAN with 30 percent conservation goals for each biophysical and infrastructure target with no and moderate clustering (BLM 0 and 0.0001).

4.2.2.2. Commercial Fishing

The commercial fishing data was based on surveys conducted during 2005 by Ecotrust, an organization contracted by the MLPA Initiative to provide socioeconomic data and analysis. These data include the relative importance of a given microblock to individual fishermen for 19 commercial fisheries throughout the Central Coast Study Region. Due to the privacy concerns of commercial fishermen, the data provided to us did not identify each fishery by name. Rather, fisheries were assigned random numbers. While the data were not associated with particular fisheries, Appendix I provides a list of the 19 fisheries in the Central Coast. In addition to the Ecotrust data, we included data on kelp bed leases administered by CDFG. As CDFG considers kelp harvest a "fishery," we used both the Ecotrust and kelp data. Our commercial cost function therefore consists of effort for 20 commercial fisheries. The cost function is:

$$\text{Cost}\,(A, C) = 0.2A + 0.8C \quad \text{[Eqn. 2]}$$

where A = Area, C = Relative importance of microblock to commercial fishermen

To calculate C, we summed the total importance of each microblock across all microblocks for each of the 20 fisheries. We divided each fishery's relative importance value for each microblock by this sum, which gave us the proportional importance of each microblock for each commercial fishery. We summed the proportional importance values for each microblock and divided these sums by the largest sum, giving us a normalized value expressing the proportional importance of each microblock to all of the commercial fishermen. Calculating C in this way assigns greater weight to fisheries that are proportionally more important to fishermen in a particular microblock. Appendix I provides a more detailed description of the data and our data preparation.

We used the same weighting scheme in our commercial cost function and our recreational cost function. By weighting both recreational fishing effort and commercial fishing areas of relative importance as 0.8 in each of their respective cost functions, we made the implicit assumption that commercial fishing and recreational fishing (in the previous analysis) have the same relative importance in relationship to area. This assumption is due largely to the limitations of our data, which are discussed below. Using this commercial cost function, we ran MARXAN with 30 percent conservation goals for each biophysical and infrastructure target with no and moderate clustering (BLM 0 and 0.0001).

4.2.2.3. Recreational and Commercial Fishing

For our next analysis, we combined recreational and commercial fishing in our cost function to observe the aggregate impact of all fishing activities on the selection of microblocks in MARXAN. Our cost function is therefore:

$$\text{Cost}(A, R, C) = 0.2A + 0.4R + 0.4C \quad \text{[Eqn. 3]}$$

where A = Area, R = Recreational effort, C = Relative importance of microblock to commercial fishermen

Two implicit assumptions are made in this cost function. Similar to the individual cost functions for recreational and commercial fishing, we assume that recreational and commercial fishing in this cost function have the same relative importance to area. Additionally, we also assume that recreational and commercial fishing should be of equal weight *in relationship to each other* when attempting to minimize impacts to fishermen. We decided upon this weighting scheme for several reasons. The average annual value of the commercial fisheries for the Monterey Bay and Morro Bay port areas for the period from 1999-2004 was $10,739,012 and $4,425,427 respectively (CDFG 2005c). While recreational fishing is also an important component of the highly-lucrative tourism and recreation industry in the Central Coast, estimates of actual values for the recreational fishing industry vary widely. Due to the anonymous nature of our commercial fishing data, the lack of reliable and consistent information about the monetary value of the recreational industry in the Central Coast, and to avoid assigning arbitrary weights to each industry, we assigned equal weight to these two fishing categories.

As discussed previously, because the commercial fishing data was not identified by fishery but by random numbers (Fishery 1, Fishery 2, etc.), we do not know whether the impacts of establishing MPAs affect fisheries of different economic and social importance. Thus, our analysis does not take into account the economic implications of these impacts.

Using the cost function integrating area, recreational fishing effort and commercial fishing areas of relative importance, we ran MARXAN with 30 percent conservation goals for each biophysical and infrastructure target with no and moderate clustering (BLM 0 and 0.0001).

4.2.3. Other Recreational Uses

For our final analysis, parks were included in accordance to *Goal 3*, which directs the process to site MPAs so as to improve recreational opportunities. Furthermore, *Design Consideration 6* adds that MPAs should be sited "adjacent to terrestrial federal, state, county, or city parks, marine laboratories, or other 'eyes on the water' to facilitate management, enforcement, and monitoring." The parks data (Appendix I) were derived from a comprehensive listing of parks at the state and local levels. Using this data, we selected the microblocks immediately adjacent to parks. The data does not rate the parks in terms of use, value, or other criteria. Thus, we assumed in this analysis that different parks are of equal value for recreational use and enforcement. There are two means of directing MARXAN to including microblocks adjacent to shoreline parks in its solutions. One method is to integrate adjacency to parks into the *cost function* so as to "attract" MARXAN to shoreline parks. Depending on the presence of conservation targets and costs in particular microblocks, the selection of microblocks adjacent to shoreline parks may or may not occur. Therefore, we chose to include adjacency to parks as a *conservation target* so as to require that the solution have at least 30 percent of the selected microblocks adjacent to shoreline parks.

With the addition of parks, we ran MARXAN with 30 percent conservation goals for each target with no and moderate clustering (BLM 0 and 0.0001), using the cost function which integrated area, recreational and commercial fishing.

4.3. Limitations

Data availability: The MARXAN output is limited by the lack of comprehensive data on consumptive and non-consumptive recreational activities. As mentioned previously, privacy concerns limited our access to commercial fishing data. Also, reliable data concerning the relative value of commercial versus recreational fishing is not available. Diving, kayaking, and wildlife watching are especially common recreational activities, which would be affected by the placement of MPAs. Consumptive diving could be considered a cost, while non-consumptive diving sites could be an additional conservation target. However, the available diving data did not distinguish between consumptive and non-consumptive diving. In addition, we did not have reliable data on kayaking, wildlife watching, or other non-consumptive activities. Therefore, these features are not considered in our analyses.

Data quality: Although the data were peer-reviewed and approved for use in the MLPA, the data are of various qualities.

Scale of data: Raw data were collected on various scales, causing some of the data to be less precise than other data.

Variability in data: The socioeconomic data is limited by its static nature. The fishing data, in particular, provides only a snapshot of fishing behavior, which can vary widely depending on climate, fish stocks, market conditions, and other factors.

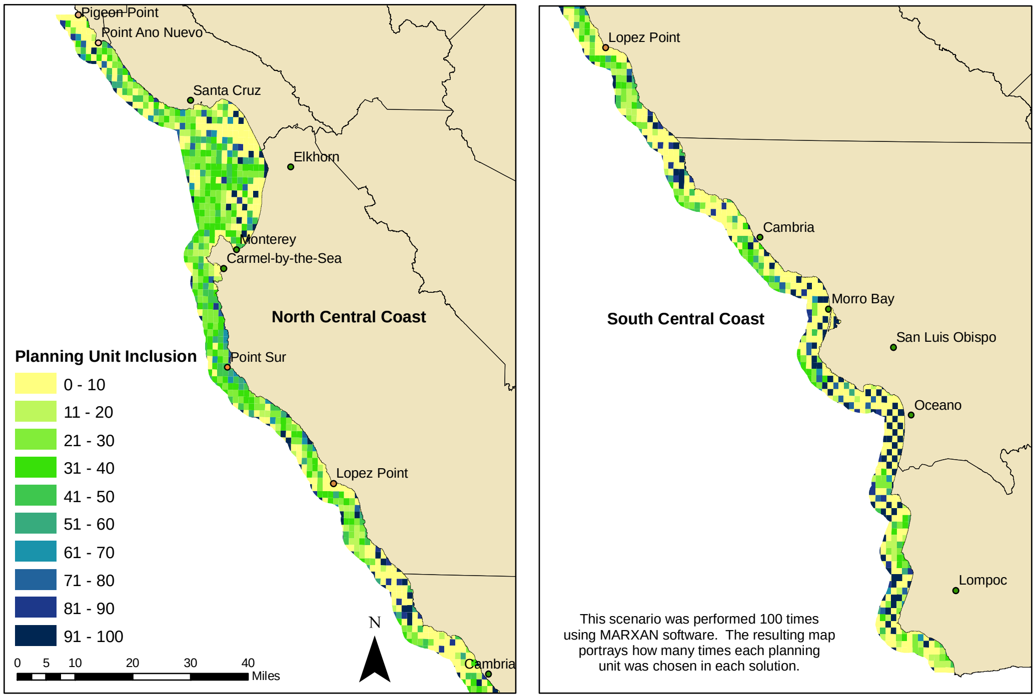
4.4. Results and Discussion

All results are displayed as summed solutions of the 100 runs completed for each scenario. Each run represents a potential solution that satisfies the identified targets. The resulting maps express the number of times each microblock was chosen as a solution out of 100 runs. The darker microblocks (blue) were selected more often as part of a solution than the lighter microblocks (green, yellow).

4.4.1. Infrastructure

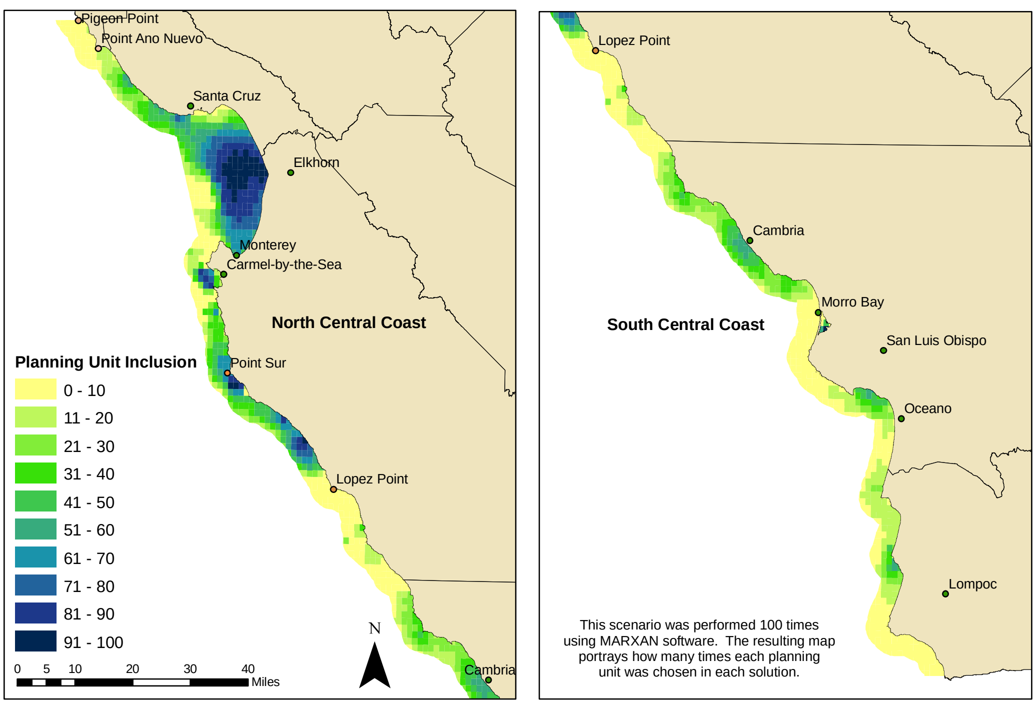
The addition of infrastructure targets (the presence of monitoring sites, proximity to research institutions and population centers, and adjacency to coastal parks targets) to the biophysical targets increased the total number of targets from 49 to 52. Without a clustering factor, this increase in targets did not change regional patterns of the results substantially (Compare Figure H4 to Figure 4.1). However, adding the infrastructure targets led to local shifts in microblock selection. For example, one microblock immediately adjacent to University of California's Big Creek Ecological Reserve and Big Basin Redwoods State Park was selected 51 times under the biophysical targets. With the addition of the infrastructure data, it was selected 71 times. A microblock next to the University of California Santa Cruz's Long Marine Laboratory and its monitoring sites was chosen 28 times without infrastructure targets and 63 times with infrastructure targets.

With the addition of a moderate clustering factor (BLM 0.0001), regional shifts are more evident with the addition of infrastructure and biophysical targets (Compare Figure 4.2 to Figure H5). For example, there was a shift toward the south in the selection of microblocks in Monterey Bay. This was likely due to the large number of research institutions and monitoring sites in that location. In addition, there was a southerly shift in microblock selection at the southern end of the study region, potentially due to the University of California Santa Barbara (UCSB) and Partnership for Interdisciplinary Study of the Coastal Ocean (PISCO) monitoring sites at Jalama and Point Arguello.



52 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0, Block 30

Figure 4.1. Application of MARXAN with the biophysical and infrastructure targets with a BLM of 0 and conservation targets of 30%.



52 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 30

Figure 4.2. Application of MARXAN with the biophysical and infrastructure targets with a BLM of 0.0001 and conservation targets of 30%.

4.4.2. Infrastructure and Recreational Fishing

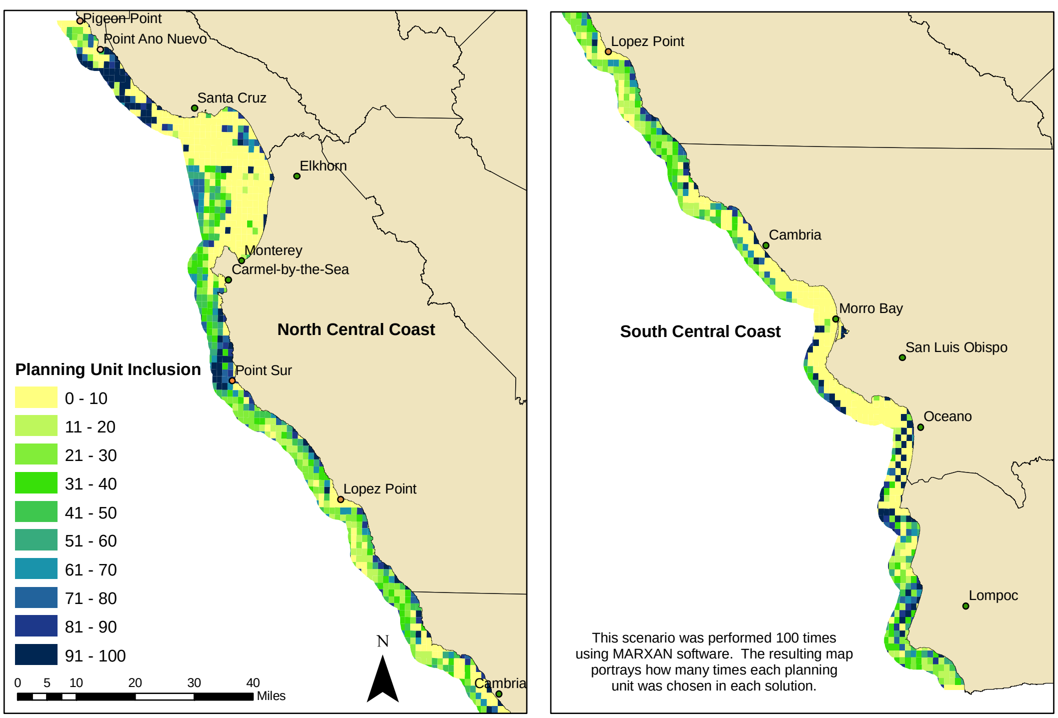
The addition of the recreational fishing data into the cost function resulted in significant clustering of microblocks. Clustering occurred with microblocks chosen often (expressed as dark green or blue in the maps) as well as microblocks chosen very few times throughout the study region (expressed in yellow). With a BLM of 0, distinct clustering of frequently selected microblocks can be seen in the center of Monterey Bay as well as along the northern coast of the bay (Fig. 4.3). South of Monterey Bay, many microblocks immediately adjacent to the coastline also were chosen many times. As you move away from the coast, microblocks were chosen incrementally less times in many areas. A distinct exception to this pattern is the area between Cambria and Oceano, as this area captured a large cluster of microblocks chosen very few times. These clustering patterns suggest that including recreational fishing as a cost resulted in more frequent selection of microblocks in areas where less recreational fishing effort was exerted, and very little selection of microblocks in areas with significant recreational fishing effort. In addition, some microblocks selected a moderate number of times in the analysis including biophysical and infrastructure targets appear to be selected more often when recreational fishing is considered, such as in the area north of Point Sur. One explanation for this is that MARXAN is compensating for the biophysical features that are lost by *not* selecting many of the microblocks that were chosen when only biophysical features and infrastructure were considered. When recreational fishing effort is included as a cost, the program places greater value on the microblocks in which less recreational fishing effort occurs. To verify this, we compared the MARXAN output with a map of the recreational fishing effort per microblock (Fig. 4.5)

When a moderate clustering value (BLM 0.0001) is applied, microblocks are selected along a gradient (from blue to green to yellow) from microblocks chosen often to microblocks chosen rarely (Fig. 4.4). Distinct differences between the BLM 0 and BLM 0.0001 outputs can be observed for example, in Monterey Bay. With a BLM of 0, the bay's microblocks are chosen fewer times than with a BLM of .0001. Also, in the Lopez Point and directly south region in the output with a BLM 0, the microblocks directly surrounding Lopez Point are chosen few times while many of the microblocks south of the point are chosen many times. *All* of the microblocks in this same area are chosen very few times, however, when a BLM of 0.0001 is applied. Another interesting comparison can be made between the output showing biophysical features and infrastructure with a BLM of 0.0001 and the output including recreational fishing at BLM 0.0001. In the former, a large cluster of microblocks chosen often appears along the coast of Monterey Bay, extending into the middle of the bay (Fig. 4.2). In the latter, MARXAN selected microblocks more often in the middle of the bay (Fig. 4.4). The focused therefore appeared to shift from the coast to the waters in the middle of the bay when recreational fishing is incorporated as a cost.

For the purposes of comparison, we quantified the number of times microblocks were chosen 0, 1-20, 80-99, and 100 times when recreational fishing was incorporated as a cost with a BLM of 0 (total number of microblocks is 11,371) in the Table 4.1. These results will be compared with those from commercial fishing in the following section.

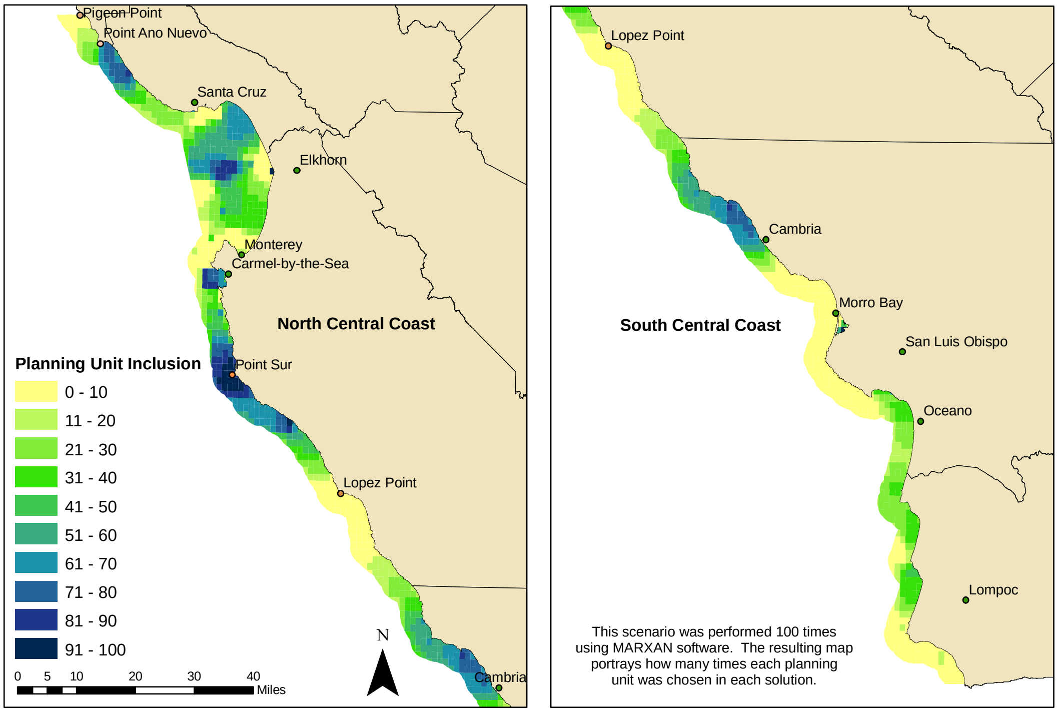
Table 4.1. Comparison of the number of times microblocks were chosen by MARXAN in the area only, commercial fishing, recreational fishing, and recreational and commercial fishing combined analyses with a BLM of 0.

Cost	Number of microblocks chosen 0 times	Number of microblocks chosen 1-20 times	Number of microblocks chosen 80-99 times	Number of microblocks chosen 100 times
Area Only	309	312	149	78
Recreational Fishing	390	299	210	27
Commercial Fishing	622	281	149	138
Recreational and Commercial Fishing	593	295	200	87



52 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0, Block 30

Figure 4.3. Application of MARXAN with the biophysical and infrastructure targets and recreational fishing as cost with a BLM of 0 and conservation targets of 30%.



52 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 30

Figure 4.4. Application of MARXAN with the biophysical and infrastructure targets and recreational fishing as cost with a BLM of 0.0001 and conservation targets of 30%.

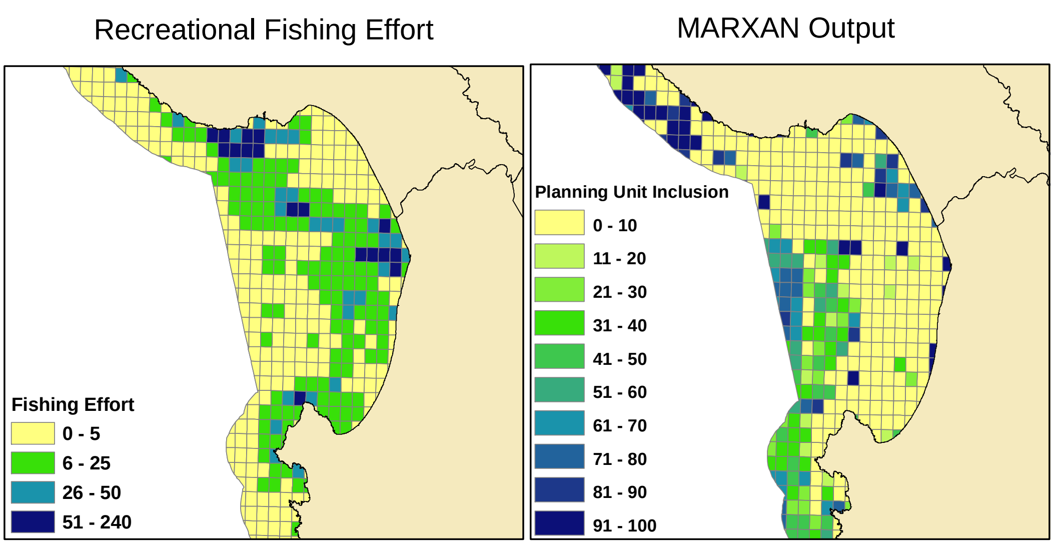
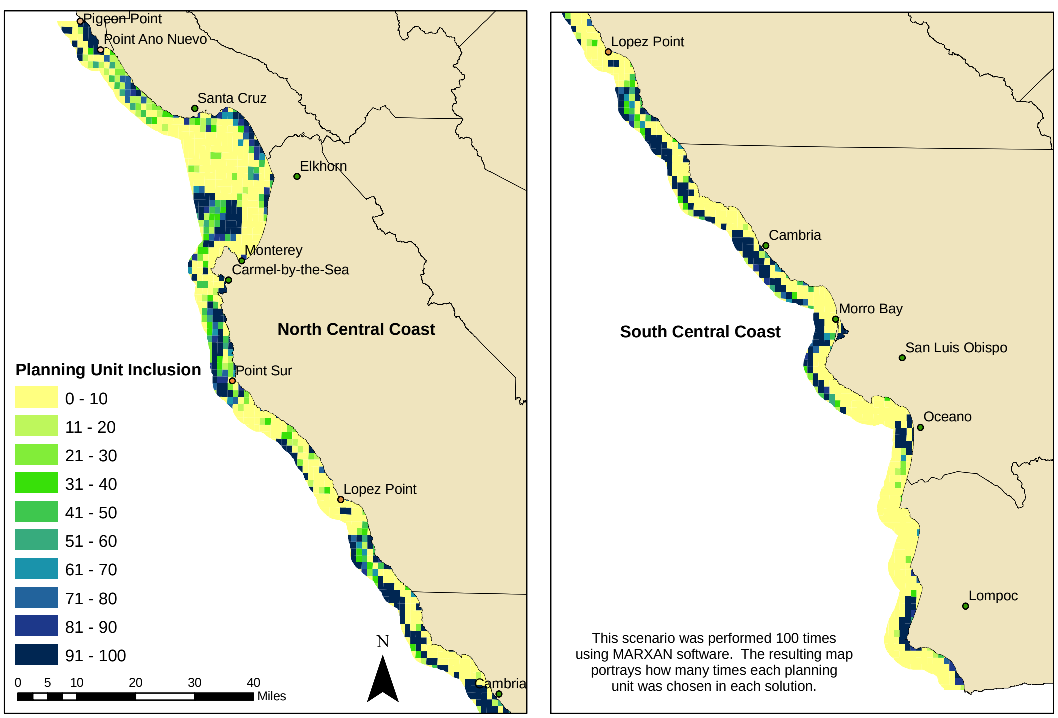


Figure 4.5. Comparison of the recreational fishing effort per microblock with the MARXAN output with microblock area and recreational fisheries as cost.

4.4.3. Infrastructure and Commercial Fishing

When commercial fishing was added as a cost with no clustering factor (BLM 0), more distinct groups of microblocks were selected in comparison to the output with the consideration of recreational fishing value as a cost with a BLM of 0. Some clusters of selected microblocks also were located in different areas from the clusters in the output with the recreational cost function. In Monterey Bay, for example, the output with the commercial cost function shows a cluster of microblocks chosen often in the middle of the bay, but adjacent to edge of the underwater canyon (Fig. 4.6). In contrast, the output with the recreational cost function shows the cluster of microblocks chosen extending over the canyon area (Fig 4.3). This suggests that MARXAN is detracting from areas of significant commercial fishing importance. In addition, another cluster of frequently selected microblocks are located in the northeastern coastline of the bay. While the recreational cost function also produced a cluster in this general location, the microblocks with the commercial cost function are adjacent to the land. This implies that commercial fisheries place less importance upon areas close to land, while a great deal of importance is placed slightly further offshore (indicated by the large cluster of microblocks chosen very few times). To verify this, we compared the MARXAN output with a map of the number of commercial fisheries per microblock (Fig. 4.8).



52 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0, Block 30

Figure 4.6. Application of MARXAN with the biophysical and infrastructure targets and commercial fishing as cost with a BLM of 0 and conservation targets of 30%.

Interestingly, MARXAN selected the microblocks in the northeastern portion of Monterey Bay (shown in Figure 4.8) many times despite the relatively large number of commercial fisheries in this area. One possible explanation for this is that in order for MARXAN to select the designated proportion of biophysical targets (30 percent), some of the nearshore microblocks in the Bay (which contain highly diverse habitat or rare habitats) must be chosen even where a significant number of fisheries are located. Other portions of the northeastern part of the bay were chosen very few times by MARXAN. Assuming that microblocks with a large number of fisheries are of significant importance to commercial fishermen, this pattern of selection exhibits a trade-off between conserving habitat and minimizing impacts to fishermen; some areas with many commercial fisheries will be chosen in order to protect important biophysical targets in the same region, while other areas that are important to commercial fisheries will be left open to fishing.

South of Monterey Bay in the output with the commercial cost function and a BLM of 0 (Fig. 4.6), there are several clusters of microblocks chosen very few times in locations that were chosen many times in the output with the recreational cost function (Fig. 4.3). An example of this is between Point Sur and Lopez Point. In the output with recreational fishing as cost, most microblocks throughout this area were chosen a moderate number of times. In the output with commercial fishing, however, most of the microblocks were chosen very few times with the exception of a short chain of microblocks along the state water line that were chosen many times. This further suggests that commercial and recreational fishing often do not occur in the same areas when observed at a local level. It also implies that commercial fishing occurs in distinct areas, while recreational fishing occurs over larger spatial ranges.

In contrast to the output with BLM 0, cluster locations appear to be in different spatial configurations with the commercial output and a BLM of 0.0001. In many areas where microblocks were chosen very few times in the output with BLM 0, these same microblocks are chosen a moderate number of times when a BLM of 0.0001 is applied. An example of this can be seen in the area south of Lopez Point (Fig. 4.7). Assuming that the microblocks were chosen few times because they have high commercial fishing importance, applying a BLM may be problematic because it may mask the importance of commercial fishing values by choosing the microblocks more often than the output with BLM 0. Another example is observed in microblocks around Cambria. With a BLM of 0, the microblocks away from the coastline of Cambria were chosen often and form a chain down a short section of the state waters (Fig. 4.6). In the output showing BLM 0.0001, the cluster of microblocks chosen often is concentrated directly adjacent to Cambria, including a section of the coastline in which microblocks were chosen few times when a BLM of 0 is applied (Fig. 4.7).

We quantified the number of times microblocks were chosen 0, 1-20, 80-99, and 100 times when commercial fishing was incorporated as a cost with a BLM of 0 and compared this to the results for recreational fishing (Table 4.1).

Using commercial fishing as cost resulted in more microblocks being selected both 0 times and 100 times when compared to the same counts when recreational fishing is used as a cost. Differences in the number of microblocks selected few (1-20) and many (80-99) times were not as significantly different, which also implies that markedly less microblocks were selected a moderate number (21-79) of times. This supports the assumption that commercial fishermen may make more distinct and consistent choices about fishing location than recreational fishermen.

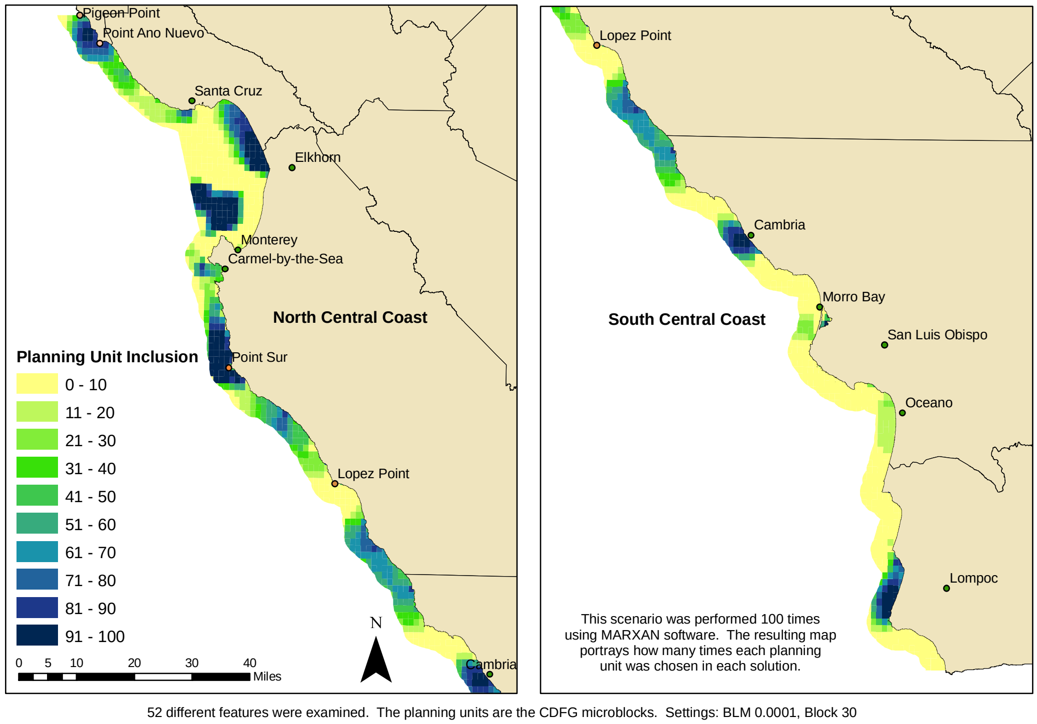


Figure 4.7. Application of MARXAN with the biophysical and infrastructure targets and commercial fishing as cost with a BLM of 0.0001 and conservation targets of 30%.

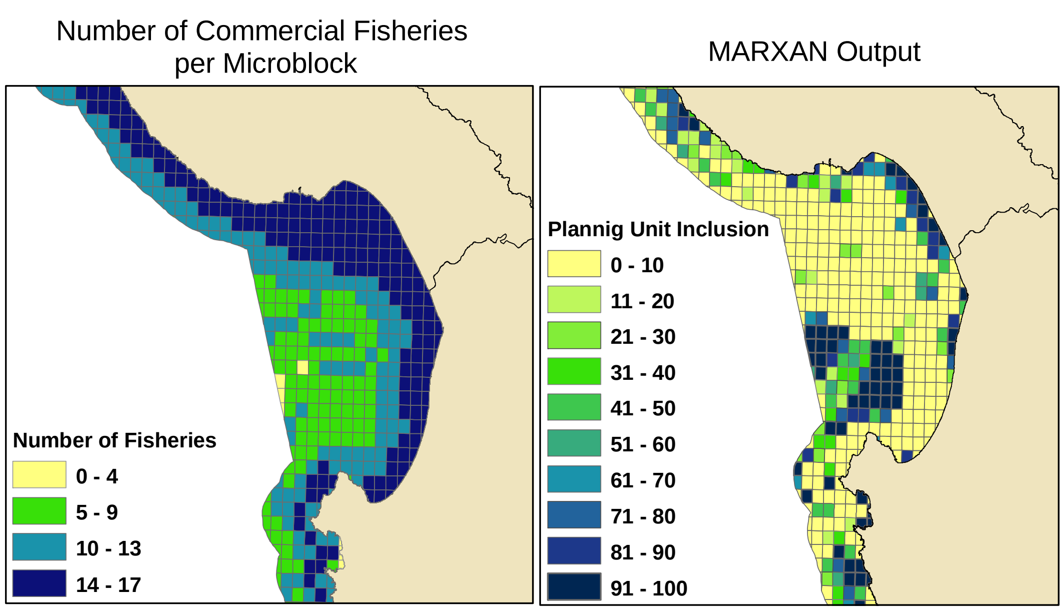


Figure 4.8. Comparison of the number of commercial fisheries per microblock with the MARXAN output with microblock area and commercial fisheries as cost.

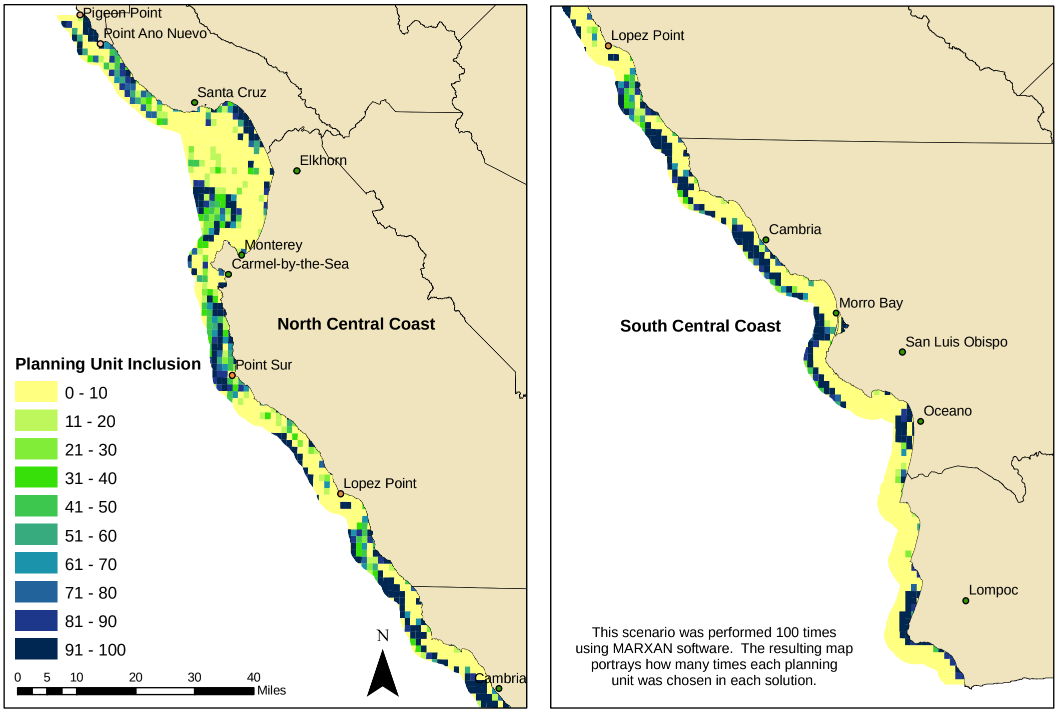
4.4.4. Infrastructure, Recreational Fishing, and Commercial Fishing

With recreational and commercial fishing incorporated together into the cost function at a BLM of 0, the output is clearly a combination the previous two outputs (Fig. 4.9). The spatial configurations of some clusters of microblocks are similar to clusters in the output with recreational fishing as cost, but the combined recreational and commercial output more closely resembles the output with commercial fishing as cost. This is due to many of the same microblocks being selected 81 to 100 times. Some localized shifting occurs of microblocks selected moderately; several microblocks selected never or few times in the center of Monterey Bay with commercial fishing as cost are selected a moderate number of times with commercial and recreational fishing as cost, for example. This is likely related to the fact that more microblocks in the middle of the bay were selected with recreational fishing alone as cost (Fig. 4.3). Combining this effect with commercial fishing caused MARXAN to select at least a portion of these microblocks to minimize impacts to recreational fishermen.

The output showing a BLM of 0.0001 markedly changes the spatial extent and configuration of clusters (Fig 4.10). A clear example of is in the area from Point Sur to Lopez Point. In the output with BLM 0 (Fig. 4.9), the microblocks in this area are relatively scattered. With BLM 0.0001, however, almost all of the microblocks in this area are selected moderately to always. This output also appears similar to the output with commercial fishing alone as cost (Fig. 4.7).

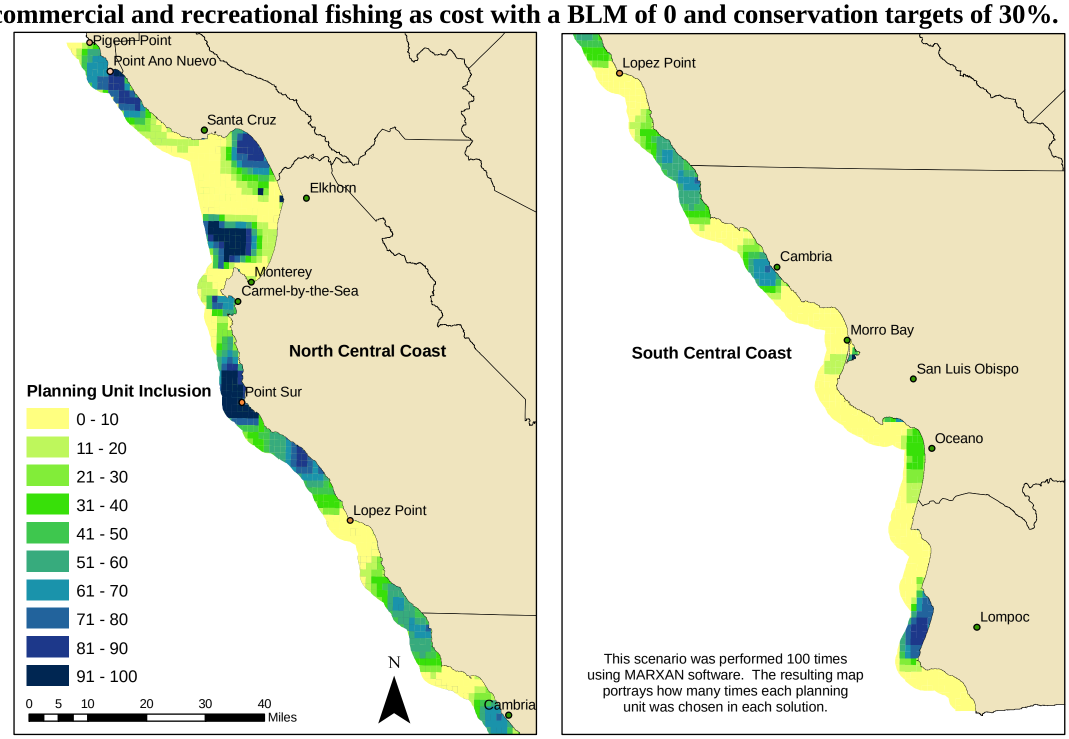
We quantified the number of times microblocks were chosen 0, 1-20, 80-99, and 100 times to compare the outputs of analyses considering recreational, commercial, and the combination of recreational and commercial fishing as costs with a BLM of 0 (Table 4.1).

Using recreational and commercial fishing as costs resulted in more microblocks being selected both 0 times and 100 times when compared to the same counts when recreational fishing alone is used as a cost, but less than when commercial fishing is used as a cost. Differences in the number of microblocks selected few (1-20) and many (80-99) times were not significantly different. These results express the trade-offs required to simultaneously balance different costs in MARXAN.



52 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0, Block 30

Figure 4.9. Application of MARXAN with the biophysical and infrastructure targets and commercial and recreational fishing as cost with a BLM of 0 and conservation targets of 30%.



52 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 30

Figure 4.10. Application of MARXAN with the biophysical and infrastructure targets and commercial and recreational fishing as cost with a BLM of 0.0001 and conservation targets of 30%.

4.4.5. Infrastructure, Recreational Fishing, Commercial Fishing, and Parks

With the addition of microblocks adjacent to parks as a conservation target, all of the best information currently available and accessible was incorporated. This addition only increased the number of targets from 52 to 53. Thus, we did not expect a large shift in the output. With no clustering factor, the addition of microblocks adjacent to parks as a target did not cause variation the microblocks chosen when compared to the analysis with infrastructure, recreational, and commercial fishing (Fig. 4.10). Parks are indicated in green on the maps in Figures 4.11 and 4.12. This was likely because the microblocks adjacent to parks already were selected as optimal solutions due to biophysical and other targets. With moderate clustering (BLM 0.0001), the results of the addition of parks were more obvious. This was especially evident in the Big Sur area, particularly in microblocks adjacent to the Los Padres National Forest in the Andrew Molera and Julia Pfeiffer State Parks area. In this region, more microblocks were chosen 81 to 100 percent on the time. Also, in the Año Nuevo and Big Basin Redwood State Parks region, microblocks previously chosen a moderate amount of times with a BLM of 0 were chosen 81 to 100 percent of the time with a BLM of 0.0001. The microblocks in the northern Monterey Bay chosen often under the previous scenario with BLM 0.0001 (Fig 4.10) were not selected as often with the addition of parks as a conservation target.

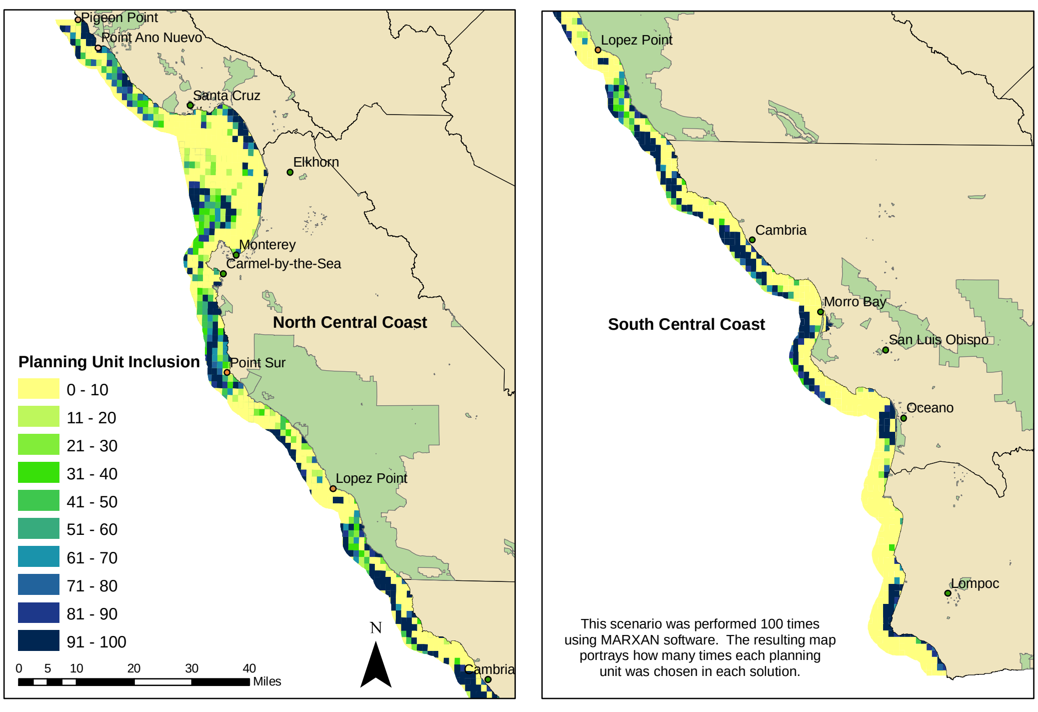
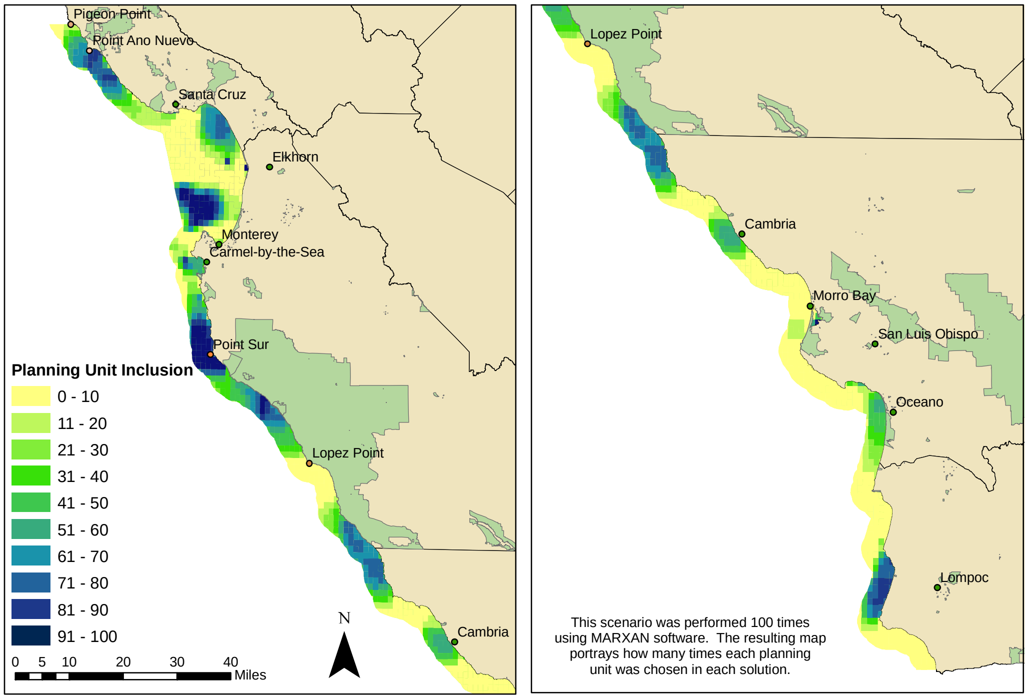


Figure 4.11. Application of MARXAN with the biophysical, infrastructure, and parks targets and commercial and recreational fishing as cost with a BLM of 0 and conservation targets of 30%. Parks are indicated in green.



53 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 30

Figure 4.12. Application of MARXAN with the biophysical, infrastructure, and parks targets and commercial and recreational fishing as cost with a BLM of 0.0001 and conservation targets of 30%. Parks are indicated in green.

4.5. Conclusion to MARXAN Analyses

Conservation planning involves balancing complex scientific, social and economic issues. Often, these aspects are examined in isolation from one another. The use of tools for data integration and synthesis, such as MARXAN, can help ensure a transparent and defensible process and make the most efficient use of valuable resources (Margules 2000). While they are not without their limitations, optimization and modeling tools can provide guidance in identifying areas of high conservation value at the minimum cost. Using the reserve selection software MARXAN, we integrated biophysical and socioeconomic information to identify areas of high conservation value with minimum cost to commercial and recreational fishing. Our seven MARXAN analyses help to balance the complex and controversial aspects of establishing a MPA network. Outputs from each individual scenario could be used to focus on particular objectives, while the last scenario could contribute to understanding interactions among the data. Chapter 6 describes how our modeling outputs are being used in the MLPA's Central Coast process.

Chapter 5: Compliance and Enforcement

5.1. Introduction

5.2. Goals and Policy Basis

5.3. Enforcement Design Evaluation

5.4. Compliance Literature

5.5. Enforcement Tools

5.5.1. Patrol for Detection of Violators

5.5.2. Use of High-Tech Tools

5.5.3. Enforcement Resources

5.5.4. Enforcement Partners

5.5.5. Partnership Agreements

5.6. Education and Outreach

5.6.1. Recent Education and Outreach Efforts

5.6.1.1. Channel Islands National Marine Sanctuary: Creating an Action Plan

5.6.1.2. Great Barrier Reef Marine Park Authority: New Boundary Outreach

5.6.2. Central Coast Education and Outreach

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5.7. Conclusions and Recommendations

5.1. Introduction

If marine protected areas (MPAs) are not enforced, their effectiveness in conserving biological diversity and viable populations is decreased. There always will be some number of violations with MPAs (Sutinen et al. 1990). The Marine Life Protection Act (MLPA) recognizes this and calls for "adequate enforcement" among its goals (MLPA 1999). Due to this mandate and concern of Blue Ribbon Task Force (BRTF) members that the MLPA Initiative process is not directing sufficient attention to enforcement issues, we focus the third portion of our thesis on compliance.

In this chapter, we identify the goals and considerations outlined in the legislation and MLPA Initiative documents related to compliance and enforcement. We present a comprehensive list of design considerations to reduce the enforcement burden for MPAs and evaluate how well the MPA network packages proposed by stakeholders address those considerations. We review the current literature on compliance as it relates to enforcement and the impact of non-compliance on MPA effectiveness. Next, we discuss enforcement tools and introduce an education and outreach partnership as an effective potential tool for the California Department of Fish and Game (CDFG) to encourage compliance. Lastly, we provide several recommendations for enforcement and education/outreach efforts within the Central Coast Study Region (Central Coast).

5.2. Goals and Policy Basis

The Central Coast Regional Stakeholder Group (CCRSG) developed a set of goals and objectives for the Central Coast based on the goals of the MLPA, which were amended and adopted by the BRTF on November 30, 2005 as the *Adopted Regional Goals and Objectives Package* (Appendix D). The fifth goal pertains to enforcement: "To ensure that central California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines." In addition, design considerations 6 and 9 guided our analysis of the stakeholders' package proposals with respect to enforcement. Design consideration 6 states, "To the extent possible, site MPAs adjacent to terrestrial federal, state, county, or city parks, marine laboratories or other 'eyes on the water' to facilitate management, enforcement, and monitoring." Design consideration 9 states, "To the extent possible, design MPA boundaries that facilitate ease of public recognition and ease of enforcement." These design considerations, the MLPA Initiative Framework document, and information from the CDFG and other enforcement agencies provided the basis for the list of design criteria for enforcement that we used to analyze packages of MPAs proposed by stakeholders.

5.3. Enforcement Design Evaluation

There are several widely acknowledged design features of MPAs that facilitate and/or reduce the active enforcement required. These are described in Table 5.1. Perhaps the most important feature is that MPA boundaries be established in an unambiguous manner such that they can be easily explained, charted with a geographical positioning system (GPS), and applied in court (Ekstrom 2005).

Table 5.1. Design criteria that improve compliance for marine protected areas. Adapted from (Randall 2004; Davis and Moretti 2005; McKinney 2003; USCG 2005; and CDFG 2005b).

Design Feature	Rationale	Notes for California's Central Coast
Adjacent to shore	Easy for users and enforcement officials to identify boundaries	Most proposed MPAs are adjacent to shore or connected to shore via another proposed MPA. California State waters only extend 3 nautical miles offshore (except at Monterey Bay), making this feature easy to incorporate into designs.
Close to harbors	Easy to patrol; MPAs that are farther away from harbors may receive less enforcement attention by boat patrol	Currently, the only ports with large CDFG boats are Morro Bay and Monterey (Spear 2005). The biggest commercial harbors (likely candidates for locating additional CDFG vessels) are Santa Cruz, Moss Landing, Monterey Bay, Morro Bay, and Port San Luis.
Boundaries run north-south/east-west OR align with easy-to-identify points on shore	Easy to enforce because it is more obvious whether a vessel is on one side or the other of a lat/long line	The boundary between state and federal waters is curvy, so any MPA that extends to the State boundary will have at least one non-straight boundary, presenting a potential enforcement challenge.
Regularly shaped areas; rectangles are best	Easy to enforce because it is more obvious which side of the boundary a boat is on	
Close to each other	Efficient to patrol more than one MPA on each trip	
Size: The larger, the better	Easy to clearly identify violations; larger MPAs make it more difficult to knowingly violate regulations (e.g. by entering and leaving the MPA quickly)	The smaller proposed MPAs tend to be close to the coast or be intertidal MPAs, so—despite their small size—their location may ease enforcement.
Adjacent to land parks	Park rangers provide "eyes on the water" enforcement	There are 24 state shoreline parks and 1 national forest in the Central Coast Study Region.

5.3.1. Methods

We evaluated the three MPA network packages proposed by the CCRSG on February 9, 2006 (Packages 1, 2, and 3), the network proposed by the Natural Resources

Defense Council and Point Reyes Bird Observatory (Package AC), the existing set of MPAs (Package 0), and the package recommended by MLPA Initiative staff (Package S) for several of the criteria outlined in Table 5.1.

We first summed the number of MPAs, number of MPAs with each conservation designation, and total area of each designation for each network package. We confirmed these with the Science Advisory Team's analysis conducted on February 24, 2006 (Table 5.2) (SAT 2006).

For each of the six networks, we determined whether the boundaries of each constituent MPA followed latitude and longitude lines. Boundaries along the coastline and curved boundaries at the border between state and federal waters were ignored. For other boundaries that were curved or that ran diagonal to lines of latitude and longitude, we suggested changes to improve the MPA's borders for compliance and enforcement purposes. These suggestions are listed for each package in Appendix J, and a summary of the number of MPAs with recommended boundary changes is in Table 5.3. These recommendations are made only with respect to increasing compliance and easing enforcement and made regard to the biophysical or socioeconomic factors that may have initially shaped the boundaries.

We divided the proposed MPAs in the Central Coast into likely vessel enforcement regions, based on their proximity to the five major harbors between Pigeon Point and Point Conception. The MPAs that comprise each enforcement region are listed by harbor in Appendix K. For each package, we noted the total number of MPAs and the number of each conservation designation in Table 5.4. Secondly, the adjacency of land parks has the potential to aid enforcement efforts since shoreline park rangers provide extra "eyes on the water;" as a result, we identified state parks and national forests adjacent to proposed MPAs for each package, as shown in Appendix L. We noted those without a state park or national forest abutting the MPA since those areas may need extra boat patrol or flyover attention. Table 5.5 provides a summary of park adjacency for each patrol region. Lastly, we measured the distance between each harbor and the farthest MPA in its enforcement region, reported in Table 5.6. To find this distance, we used ArcGIS' measuring tool to determine the shortest distance by sea from each harbor to the nearest edge of the farthest MPA.

We made several assumptions in this analysis. We reasoned that MPAs are and will be patrolled by boats and staff based in their nearest harbor. However, for some current MPAs in Package 0, we know this cannot be true since CDFG does not currently maintain boats in all five harbors. We assumed that there will be boats based in four out of the five major Central Coast harbors; we reasoned that Moss Landing will probably not receive a patrol boat because its closest MPAs in all six packages were estuaries (Elkhorn Slough and Morro Cojo Slough) and because Moss Landing's nearest oceanic MPAs are usually equidistant to Monterey. In measuring distance to farthest MPA, we measured to the nearest boundary, a decision that ignores MPA size and how the ease of enforcement varies with MPA size.

5.3.2. Results and Discussion

Table 5.2 shows summary information about the five packages and the *status quo* package. Currently, California has 13 MPAs along the Central Coast. The five network packages each propose between 29 and 30 MPAs. There is wide variety in the total amount of area proposed to be set aside as "no-take" reserves on the Central Coast: the area proposed for State Marine Reserves (SMR) varies from just 155km^2 (Package 1), to almost double that amount—295km^2–for the staff-proposed network (Package S), and up to 524km^2 for Package AC. In all the proposed networks except Package 1, SMRs make up over half of the total network area. This is important because, of the three main conservation designations, a "no-take" reserve is often considered the easiest to enforce because of its lack of exceptions and exemptions (Davis and Moretti 2005).

Table 5.2. Number, size, and conservation level of the five proposed networks (Packages 1, 2, 3, S and AC) and the status quo network of MPAs (Package 0). Area data taken from the Draft analysis of habitat representation in MPA packages 0, 1, 2, 3, S, and AC (SAT, 2006).

NETWORK PACKAGE	0	1	2	3	S	AC
Total # of MPAs	13	29	29	30	30	30
# SMR (no take)	5	21	21	17	18	19
# SMCA (limited fishing)	7	7	7	10	11	8
# SMP (limited recreational fishing)	0	1	1	3	1	3
# Special Closure	1	-	-	-	-	-
Area SMR (mi^2)	7.45	59.99	147.85	107.19	113.91	202.28
Area SMCA (mi^2)	33.50	107.36	63.48	80.80	85.00	99.10
Area SMP (mi^2)	0	4.41	9.84	7.54	5.51	12.33
Area Special Closure	2.20	-	-	-	-	-
SMR (% of study region area)	0.65	5.22	12.86	9.32	9.91	17.59
SMCA (% of study region area)	2.91	9.34	63.48	7.03	7.39	8.62
SMP (% of study region area)	0	0.38	9.84	0.66	0.48	1.07
Special Closure (% of study region area)	0.19	-	-	-	-	-
Total Network Area (mi^2)	111	171.75	221.17	195.53	204.42	313.71
% of study region in MPAs	3.75	14.93	19.23	17.00	17.78	27.28

We recommend the following types of boundary adjustments in our evaluation of the proposed packages: changing diagonal boundaries to run along latitude and longitude lines, extending boundaries to be adjacent to shore, changing common boundaries (separating two MPAs) to run along latitude/longitude lines, and aligning boundaries with clear points on the shore. If these potential changes are taken into consideration, the resulting network will be easier to enforce. Refer to Appendix J for detailed boundary recommendations for each proposed package. Table 5.3 shows the number of MPAs with a recommended boundary change in each package.

Table 5.3. Number of boundary change recommendations for each of the five proposed networks (Packages 1, 2, 3, S and AC).

Package	# of MPAs requiring a boundary change
1	11
2	7
3	10
AC	14
S	13

We recommend boundary adjustments for a few specific MPAs in several of the packages. For example, the MPA proposed for Carmel Bay has a diagonal western boundary in all of the packages except package 2. A potential reason for this design is that the Carmel Bay SMCA is a current MPA and has a diagonal western boundary. Changing the boundary to run north-south would be a simple fix that could improve the enforceability of that MPA. Another example occurs with proposed MPAs near Pt. Buchon: all of the packages suggest diagonal boundaries between the MPAs in that area. A straight boundary between Pt. Buchon MPAs should make enforcement easier.

Table 5.4 shows the number of each designation type and total number of MPAs in each vessel patrol region. The patrol regions that will be most impacted in terms of the number of additional MPAs requiring enforcement will be Monterey and Morro Bay. Currently, six MPAs are located near Monterey, and as many as 12-13 additional MPAs are proposed in the new network. Morro Bay has two nearby MPAs now and, with the new network, could be the closest harbor to 7-10 additional MPAs. Many of the additional proposed MPAs are designated State Marine Conservation Areas (SMCAs) and State Marine Parks (SMPs) which may be more difficult to enforce because of the variety of regulations that allow limited fishing in these types of MPAs, as opposed to State Marine Reserves (SMRs) with a clear “no-take” regulation. As a result, the CDFG may want to place additional resources in these two patrol regions. In contrast, Moss Landing currently has one MPA in the patrol area, and at most will gain one additional MPA to patrol. Both of these MPAs have the SMR designation. Therefore, it is unlikely that a significant increase in enforcement resources will be necessary at Moss Landing.

Table 5.4. Type and number of MPAs in each patrol region.

Harbor / Patrol region	Package 0	Package 1	Package 2	Package 3	Package AC	Package S
Santa Cruz	Special Closure: 1 Total: 1	SMR: 2 SMCA: 1 SMP: 0 Total: 3	SMR: 2 SMCA: 1 SMP: 0 Total: 3	SMR: 2 SMCA: 1 SMP: 1 Total: 4	SMR: 2 SMCA: 2 SMP: 0 Total: 4	SMR: 2 SMCA: 1 SMP: 0 Total: 3
Moss Landing	SMR: 1 SMCA: 0 SMP: 0 Total: 1	SMR: 2 SMCA: 0 SMP: 0 Total: 2	SMR: 2 SMCA: 0 SMP: 0 Total:2	SMR: 2 SMCA: 0 SMP: 0 Total: 2	SMR: 2 SMCA: 0 SMP: 0 Total: 2	SMR: 2 SMCA: 0 SMP: 0 Total: 2
Monterey	SMR: 3 SMCA: 3 SMP: 0 Total: 6	SMR: 6 SMCA: 7 SMP: 0 Total: 13	SMR: 9 SMCA: 4 SMP: 0 Total: 13	SMR: 6 SMCA: 6 SMP: 0 Total: 12	SMR: 7 SMCA: 3 SMP: 2 Total: 12	SMR: 6 SMCA: 7 SMP: 0 Total: 13
Morro Bay	SMR: 0 SMCA: 2 SMP: 0 Total: 2	SMR: 3 SMCA: 3 SMP: 1 SMSMA: 1 Total: 8	SMR: 5 SMCA: 2 SMP: 1 SMSMA: 1 Total: 9	SMR: 4 SMCA: 3 SMP: 2 SMSMA: 1 Total: 10	SMR: 5 SMCA: 1 SMP: 1 Total: 7	SMR: 5 SMCA: 3 SMP: 1 SMSMA: 1 Total: 10
Port San Luis	SMR: 1 SMCA: 2 SMP: 0 Total: 3	SMR: 1 SMCA: 2 SMP: 0 Total: 3	SMR: 2 SMCA: 0 SMP: 0 Total: 2	SMR: 2 SMCA: 0 SMP: 0 Total: 2	SMR: 3 SMCA: 2 SMP: 0 Total: 5	SMR: 2 SMCA: 0 SMP: 0 Total: 2

Shoreline parks can provide enforcement assistance and ease the burden on vessel patrol regions that will need to patrol additional MPAs after the implementation of a new network. Table 5.5 contains information about the number of MPAs with and without adjacent shoreline parks. For Monterey, only 5-8 MPAs would not have assistance from shoreline park enforcement officials, allowing on the water patrols from Monterey to focus on fewer MPAs. In Morro Bay, only 3-5 parks would not have land-based assistance.

Table 5.5. Number of MPAs with and without adjacent shoreline parks in each patrol region. Total number of MPAs without park enforcement in each package is also shown.

Harbor / Patrol region	Enforcement	Package 0	Package 1	Package 2	Package 3	Package AC	Package S
Santa Cruz	**with**	1	2	2	3	2	2
	without	0	1	1	1	2	1
Moss Landing	**with**	1	2	2	2	2	2
	without	0	0	0	0	0	0
Monterey	**with**	5	5	7	5	7	6
	without	1	8	6	7	5	7
Morro Bay	**with**	2	4	5	5	4	5
	without	0	4	4	5	3	5
Port San Luis	**with**	2	0	0	1	1	0
	without	1	3	2	1	4	2
Total	**without**	2	16	13	14	14	15

The distance that patrol boats must travel to reach MPAs can have an impact on the efficiency and effectiveness of enforcement. Table 5.6 shows the distance to the furthest MPA in each patrol region. Enforcement officials based in Morro Bay might need to patrol a much greater area with the implementation of a new network. For example, if the proposed Alder Creek SMCA (Package 1) is included in the new network, enforcement officials will have to travel 74 km to reach its nearest boundary. Travel distances for other patrol regions appear to be similar to what is required for the *status quo* package.

Table 5.6. Distance (km) from the harbor to the furthest MPA in each patrol region.

Harbor / Patrol region	Package 0	Package 1	Package 2	Package 3	Package AC	Package S
Santa Cruz	36.0 (Ano Nuevo Invertebrate Area Special Closure)	36.0 (Ano Nuevo SMR)	27.2 (Ano Nuevo SMR)	27.2 (Ano Nuevo SMR)	32.5 (Ano Nuevo SMCA)	25.3 (Ano Nuevo SMR)
Moss Landing	0.5 (Elkhorn Slough SMR)	0.5 (Elkhorn Slough SMR and Morro Cojo Estuary SMR)	0.5 (Elkhorn Slough SMR and Morro Cojo SMR)	0.8 (Moro Cojo Estuary SMR)	1.5 (Elkhorn Slough SMR)	0.5 (Elkhorn Slough SMR and Morro Coho Slough SMR)
Monterey	81.5 (Big Creek SMR)	81.5 (Big Creek SMR)	84.5 (Big Creek SMR)	71.5 (Expanded Big Creek SMR)	84.0 (Big Creek SMR)	75.1 (Big Creek SMR)
Morro Bay	5.3 (Morro Beach SMCA)	74.0 (Alder Creek SMCA)	47.5 (Piedras Blancas SMR)	52.0 (Piedras Blancas SMCA)	47.5 (Piedreas Blancas SMR)	51.5 (Piedras Blancas SMCA)
Port San Luis	64.3 (Vandenburg SMR)	53.5 (Vandenbrug Danger Zone 4 SMCA)	64.5 (Point Arguello SMR)	59.0 (Vandenburg SMR)	75.0 (Boathouse SMCA)	59.4 (Vandenburg SMR)

Our recommendations for boundary adjustments and our analysis of the vessel patrol regions can be used by the BRTF when making decisions about their preferred MPA network and by the CDFG when allocating enforcement resources prior to the new network's implementation.

5.4. Compliance Literature

Compliance is important in the management of MPAs because noncompliance can negatively impact the effectiveness of MPAs with respect to conservation (Kritzer 2004; Die and Watson 1992). Fishermen who choose not to comply with MPA regulations often fish near the boundaries in order to be able to quickly exit the MPA, creating edge effects that impact the effectiveness of small reserves in particular (Kritzer 2004). Understanding the factors that influence fishermen when making a compliance choice will help managers design effective enforcement programs (Kritzer 2004; Kuperan and Sutinen 1998; Randall 2004). There are several competing perspectives in the literature on fisheries compliance: instrumental, normative, and social (Randall 2004).

The instrumental perspective is based on the assumption that individuals will choose whether or not to comply based only on a balance between expected economic gains, the probability of detection, and the level of penalties associated with a detected and prosecuted violation (Becker 1968; Sutinen et al. 1990; Kuperan and Sutinen 1998; Randall 2004). The probability of detection of noncompliance in fisheries can be very low (Sutinen and Gauvin 1989; Furlong 1991; Kuperan and Sutinen 1998), the judiciary is generally unwilling to assess severe sanctions for fisheries (Kuperan and Sutinen 1998), and potential economic gains from noncompliance can be high (Sutinen et al. 1990). All of these factors indicate that, from an instrumental perspective, noncompliance should be high in fisheries. However, empirical evidence suggests that a large percentage of fishermen (between 50-90%) comply with regulations in most cases (Sutinen et al. 1990).

The normative perspective provides some potential reasons why fishermen might choose to comply regardless of economic incentives to violate. This view points out that individuals make their decision to comply based on internal perceptions of equity, procedural justice, and legitimacy (Randall 2004). For example, if a management agency is not perceived by a fisherman as legitimate, or a particular regulation is viewed as unfair, then that individual may be more likely to violate. The social perspective asserts that individuals make their compliance choice based on personal morality, social pressure, and the behavior of other fishermen (Sutinen et al. 1990; Kuperan and Sutinen 1998). Figure 5.1 is adapted from a model created by Randall (Randall 2004) to conceptualize the compliance decision for use as a tool for enforcement.

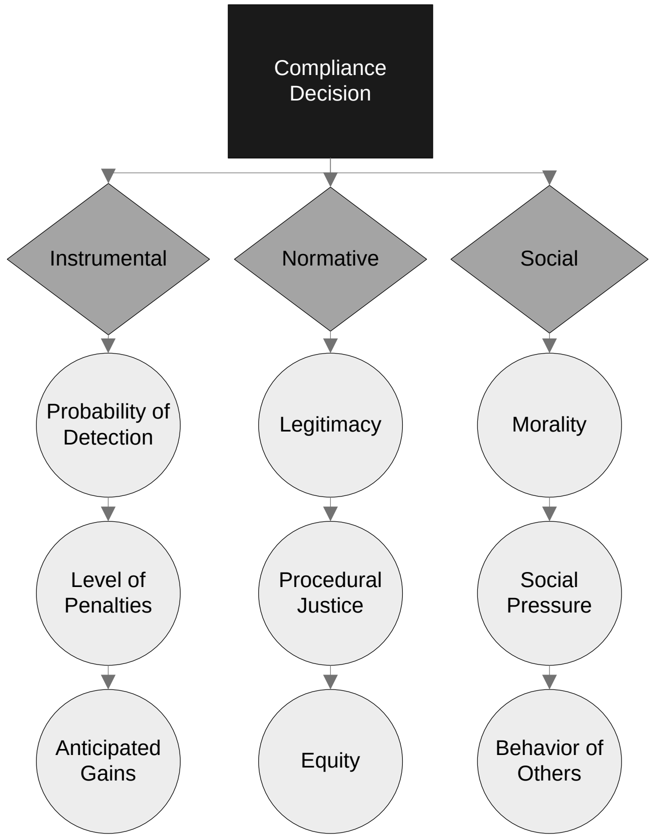

Figure 5.1. The compliance model (adapted from (Randall 2004)).

Traditionally, regulatory enforcement agencies have focused on achieving compliance by detecting and punishing violators (Stahl 1994). This type of enforcement is called deterrence-based enforcement and is rooted in the instrumental compliance perspective (Randall 2004). If the probability of detection and penalties are high, this type of enforcement action might be enough to deter fishermen from violating. However, this is generally not the case in fisheries (Kuperan and Sutinen 1998). As a result, it would be costly to increase enforcement effort to a level that would serve as an effective deterrence tool. With the increasing gap between the scope of the regulations and the difficulty regulatory enforcement agencies face securing additional resources, this deterrence level may be impossible to reach (Stahl 1994).

Compliance-based regulatory enforcement complements the instrumental view with both normative and social compliance perspectives (Randall 2004). Enforcement from this perspective relies on education and cooperation in order to provide fishermen with the resources and motivation to comply with regulations before a violation might occur (Randall 2004; Stahl 1994). A balanced mix of deterrence and compliance based efforts can provide an effective method for achieving higher levels of compliance than traditional enforcement alone (Stahl 1994).

5.5. Enforcement Tools

There are two potential components of a traditional enforcement program to increase compliance using deterrence methods: (1) physical patrol for detection and apprehension of violators and (2) the use of technologically advanced surveillance tools. The appropriate combination of these methods will depend on the location and size of each MPA in a network, as well as whether a given MPA is "no-take" or allows certain fisheries and other uses.

5.5.1. Patrol for Detection of Violators

Interviews with a wide range of fishermen have suggested that the perceived probability of detection affects the number of violations more than any other factor (Furlong 1991). Not surprisingly then, high visibility and on-the-water presence is a major contributor to deterrence (Randall 2004; Davis and Moretti 2005).

The CDFG currently uses patrol boats, small skiffs, and aircraft to detect violations. They conduct joint patrols, by both boat and aircraft, with the United States Coast Guard (USCG) and cooperate with local city and county law enforcement agencies (Warrington 2005). The CDFG plans to continue and possibly increase these practices. Due to expensive and difficult maintenance, the use of buoys to mark boundaries may only be considered for near-shore MPAs in shallow water such as those in southern Monterey Bay (Reilly 2006).

5.5.2. Use of High-Tech Tools

Technologically advanced surveillance tools include satellite real-time imagery, radar alarm boundaries (buoy based or shore based), seabed hydrophone arrays (*i.e.* sensors on the bottom of the ocean that detect vessels and are linked to a surface buoy that radios back to shore), and vessel monitoring systems (VMS). Vessel monitoring systems would increase inspector capacity by decreasing search time (NOAA 2003). The disadvantage of VMS is its high cost, between $1800 and $5800 per boat (2005), which will fall either on individual fishermen or the resource-strapped CDFG. Due to its high cost, VMS may be considered as a requirement only for certain "high-risk" fishery vessels or only for documented MPA violators. As suggested by a Florida fisherman, the penalty levied on prosecuted violators might include purchase of VMS in lieu of or in addition to a fine (Brown et al. 2003). Currently, the Pacific Fishery Management Council is considering a policy that would require VMS for several fisheries; monitoring state MPAs will become easier for the CDFG if such a policy is implemented (Reilly 2006).

While it cannot replace good inspectors, on-board technology has the potential to streamline inspections, to allow on-the-spot database searches of past violations, and to help focus patrol effort on high-violation areas (Randall 2004).

5.5.3. Enforcement Resources

Twenty-two wardens and five support personnel run CDFG's fleet of seven large patrol boats (54-65 feet). Between 30 and 40 additional wardens staff the CDFG's eight medium-size patrol boats (24-30 feet) and 15 smaller patrol skiffs. This total fleet of 30 boats is stationed throughout the state—not just on the Central Coast (Spear 2005). Between Pigeon Point and Point Conception, CDFG boats are currently based only at Morro Bay and Monterey ports (Warrington 2005). The duties of these wardens cover a broad range, from handling marine water pollution incidents and enforcing fishing regulations to homeland security.

The CDFG also operates a small fleet of single- and twin-engine fixed wing aircraft that assist both marine and land-based wardens in spotting and investigating violations. No planes are completely dedicated to ocean patrol (Reilly 2006).

Because of the wardens' already extensive duties, representatives of the CDFG are adamant that the Department will require additional enforcement staff, and possibly more watercraft, to patrol any new MPAs. Since 2001, USCG has shifted attention away from helping to enforce current California MPAs such as the Channel Islands National Marine Sanctuary and toward homeland security issues (Davis and Moretti 2005). USCG attention to marine environment protection and fisheries enforcement has been slow to return to pre-September 11, 2001 levels (Randall 2004). This shift could mean that the USCG will have fewer resources available to help the CDFG with the enforcement of the new network. As with the rezoning and the Enhanced Enforcement Program of the Great Barrier Reef in Australia (GBRMPA 2006), new funding and resources will need to be either invested in high tech surveillance tools or directed to patrol MPAs of highest violation risk. Undoubtedly, the CDFG should be allocated additional resources, in the form of boats and staff, to patrol the new protected areas.

5.5.4. Enforcement Partners

Just as federal and state agencies enter into joint enforcement agreements to enforce federal marine protection and fisheries law (NOAA 2005; Randall 2004), they also may formally partner to enforce state law. While the lead enforcement agency for the new California MPAs will be the state's Department of Fish and Game, other state and federal agencies will need to cooperate with and assist the CDFG to maximize effectiveness. The National Oceanic and Atmospheric Administration (NOAA) Fisheries Enforcement Division, the United States Coast Guard (USCG), and California State Parks may each play a major role in enforcing the new MPAs.

Marine environmental protection and fisheries enforcement are major functions of the U.S. Coast Guard (2004). The USCG is authorized to enforce the nationwide system of National Marine Sanctuaries; the agency contributes both aircraft surveillance flight hours and boat patrol hours to this effort and works closely with Sanctuary officials (Davis and Moretti 2005). Since September 11, 2001, significant USCG resources have been shifted away from fisheries and marine protection to homeland security. Perhaps due in part to this shift, economics and compliance theory are being applied to USCG strategy in hopes of increasing enforcement effectiveness. Suggestions from within the agency include training better inspectors, investment in new technology, and changes in allocation of enforcement resources (Randall 2004). The USCG has experience partnering with NOAA's Office of Law Enforcement to create their, "Guidance for Effective Fisheries Enforcement" (USCG 2005).

The National Ocean Service and the National Marine Fisheries Service, both within NOAA, also have experience with interagency partnerships for enforcement; they are enforcement partners for the National Marine Sanctuary Program. For the California State MPAs, it should be decided whether these specific agencies should be involved in a partnership or whether their parent agency, NOAA, should take the lead.

Because there are several State Parks along California's central coast, it would be advantageous for the CDFG to include the State Parks system in any interagency agreement on enforcement. Indeed, proximity to State Parks is recognized as a design consideration in the MLPA Initiative Master Plan Framework (CDFG 2005b). State parks and national forests that are adjacent to proposed MPAs between Pigeon Point and Point Conception are listed in Appendix L. Park rangers and other staff may take part in MPA enforcement trainings run by the CDFG, park brochures and maps may be amended to show the neighboring MPA, and park literature may include an "enforcement hotline" phone number to report possible violations (especially for intertidal MPAs).

5.5.5. Partnership Agreements

A Memorandum of Agreement (MOA) for enforcement codifies an interagency enforcement partnership. Such memoranda have been used, for example, to formalize partnerships between the NOAA National Ocean Service, NOAA National Marine Fisheries Service, the National Park Service, and the U.S. Fish and Wildlife Service in the enforcement of National Marine Sanctuaries (e.g. Enforcement Action Plan (NOAA 2005). We recommend a MOA be created for the new MPAs on the central coast as the first step in a larger strategy, as suggested by CDFG staff, to develop (1) an interagency agreement, (2) standard operating procedures, and (3) a standardized training program (Spear 2005).

An interagency MOA would estimate the resources that each agency is able to contribute for new MPA enforcement. First, agency staff would need to determine surveillance practices and patrols that are already in place and an inventory of aircraft, boats, staff, and surveillance data that are available or routinely collected.

A second part of a MOA would describe how enforcement responsibility—both high tech surveillance and patrolling—will be divided between the federal and state agencies. For intertidal areas, for instance, land-based enforcement may be the most cost-effective and—depending on the location of the MPA—this might fall to the State Parks or to the Coast Guard. The agreement should specify which agency(s) is responsible for land-based enforcement.

The MOA should describe how the agencies plan to integrate and share their data systems. An agreement would describe how agencies will communicate with each other and how violations will be tracked for all agencies to access. We recommend a cross-agency tracking system that would keep a database of offenders, vessels, and penalties levied.

When interviewed about their enforcement program, managers of the Florida Keys National Marine Sanctuary highly recommended regular meetings between enforcement staff, education specialists, and sanctuary officers (Davis and Moretti 2005). A schedule or plan for such meetings, and for regular evaluations and updates of the MOA, should be included in the MOA document.

5.6. Education and Outreach

Traditional enforcement efforts involving detecting and adjudicating violators are costly and resource intensive (Stahl 1994). It is difficult or impossible to achieve full compliance using traditional enforcement tools alone (Stahl 1994). Compliance-based regulatory enforcement, which includes educational outreach and cooperative efforts, can reduce dependence on traditional enforcement tools (Randall 2004) while preventing violations, thus increasing the potential benefits of MPAs (Kritzer 2004). Many agencies have shifted toward a balance between traditional enforcement tools and the use of compliance based tools, and recent efforts by the Channel Islands National Marine Sanctuary and the Great Barrier Reef Marine Park Authority provide potential models for how to utilize education and outreach to increase compliance.

5.6.1. Recent Education and Outreach Efforts

The Channel Islands National Marine Sanctuary (CINMS) and Great Barrier Reef Marine Park Authority (GBRMPA) MPA networks provide two recent examples of the use of educational outreach as a means to increase compliance and complement a traditional enforcement effort.

5.6.1.1. Channel Islands National Marine Sanctuary (CINMS): Creating an Action Plan

The goal of the CINMS's education and outreach programs is "to promote understanding, support and participation in the protection and conservation of marine resources." (CINMS 2006). Outreach and educational programs target teachers, students, resource user groups, and the general public. CINMS implemented the recommendations from working groups of the Sanctuary Advisory Council, including the Marine Reserves Working Group (MRWG) and the Sanctuary Education Team (SET), to create an education and outreach action plan. The MRWG included representatives from many resource user groups, and the SET was comprised of representatives from the following resource user and interest groups: diving, marine education, conservation, media, recreational boating, recreational fishing, research, tourism, and yachting. One role of the MRWG was to provide implementation recommendations regarding marine reserves in CINMS, and one part of those recommendations included education recommendations. The MRWG recommended that the Sanctuary create an interagency education team to develop an education plan, provide additional educational training to staff, integrate education about marine reserves into existing programs, and create an interagency website (Jostes and Eng 2001). The SET recommendations included the use of their "materials and products matrix." This matrix ranks outreach materials and distribution methods for the major resource user groups in the area (Appendix M). The SET also recommended the use of a "strategies table" which lists numerous outreach events and programs, identifies partners and funding sources, and estimates costs (SET 2002). The "materials and products matrix" was used by education and outreach employees as a tool for prioritizing efforts to efficiently educate MPA user groups. Sanctuary education and outreach employees also created several MPA outreach products in an effort to address MRWG and SET recommendations including brochures, newsletters, a GIS curriculum, a digital lab, websites, and outreach events (Hastings 2006). The CDFG could gain many insights about education and outreach from this program considering the proximity of the Channel Islands to the central coast region and the similarity of user groups that are targeted for education and outreach. We recommend that the CDFG partner with education and outreach specialists from the National Marine Sanctuary Program to develop an effective outreach and education action plan.

5.6.1.2. Great Barrier Reef Marine Park Authority (GBRMPA): New Boundary Outreach

The GBRMPA zoning process provides another example of the extensive use of education and outreach in order to increase compliance and awareness. To ensure that users of the Marine Park (GBRMP) are informed of zone boundaries, managers made maps and brochures explaining the new rules, which are available free of charge at 200 community access points along the coast of Queensland. Shortly after the new rules went into effect in July of 2004, GBRMP staff members were dispatched to coastal communities to answer questions. These "question and answer" sessions were advertised on the GBRMP website, television, in newspapers, and on the radio. Managers made zoning materials available at public libraries, on the website, and through requests from a toll-free number. Marine park users can access the coordinates of zone boundaries through an interactive page on the GBRMP webpage, by looking at printed materials, and by calling the GBRMPA toll-free number. The GBRMPA also supplied zoning boundary information to electronic chart companies and GPS manufacturers so they could be released with new products. Early violators were issued warning citations along with education information; efforts like these can help to ensure fewer violations in the future (GBRMPA 2004).

We recommend that the CDFG engage in similar efforts to disseminate information about the new MPA network in the study region. Since Geographic Information System layers of the new MPAs will be available from the CDFG website upon network establishment, software companies will almost certainly add the information to the onboard software they produce, as Furuno and C-MAP software companies did shortly after the implementation of the Channel Island National Marine Sanctuary (Reilly 2006).

5.6.2. Central Coast Education and Outreach

When designing an education and outreach plan, the CDFG will need to consider how to reach all of the central coast study area user groups. We have compiled a list of user groups along with many potential products to use in education and outreach as well as options for distributing the products (Table 5.7).

Table 5.7. Central Coast education and outreach: partners, products, and distribution methods.

Central Coast Marine Resource User Groups
Commercial Fishermen Resident, Seasonal, Transient
Recreational Fishermen Private boaters, charter operators, charter passengers, spear fishermen, shore fishermen, kayak fishermen, kelp harvesters, consumptive scuba divers/snorkelers
Recreational Users Non-consumptive scuba divers, wildlife viewing operators and passengers, non-consumptive kayakers, surfers, boaters
Researchers
General Public
Products
Printed Materials Newsletters, brochures, maps, charts, flyers, newspapers, magazines, fact sheets
Digital Materials Newsletters, brochures, maps, charts, flyers, fact sheets, web pages, computer software
In-Person Contact Workshop curriculum, special event plans
Distribution Methods
Direct Mail
Email
Toll-free information phone number
Postings
Signage
Websites
Television
Radio
Video/ DVD
Compact Disc
Printed Media Newspapers, magazines, newsletters
Workshops
Special Events

5.6.2.1. Partnership Options

We recommend that the CDFG partner with user group organizations in order to provide compliance-based regulatory enforcement. One option for partnership involves representatives from the various user groups advising the CDFG on how to best educate users about the MPA network as part of an education advisory board. The CDFG also could directly contact user group organizations to provide educational outreach in the form of press releases, printed materials, workshops, or special events. This type of partnership could reduce the costs of education and outreach for the CDFG because partner organizations might have access to outside funding sources and in some cases information might be relayed directly to users through existing communication channels such as newsletters at little or no additional cost to the user group organization.

The CDFG also could partner with user group organizations to create a volunteer on-the-water educational presence. There are several examples of this type of partnership across the country. In 1995, NOAA's Office of Law Enforcement adopted the Community Oriented Policing and Problem Solving (COPPS) program nationwide (NOAA Fisheries 2006). This program includes partnerships with resource stakeholders, a "fix-it-ticket" program that allows for small violations to be corrected without penalty, a 24-hour violation reporting hotline, and education and outreach events (NOAA Fisheries 2006). Another example is the Soundwatch program in the San Juan Islands National Wildlife Refuge and Wilderness Areas, a partnership between the U.S. Fish and Wildlife Service and the Whale Museum (Osborne et al. 2001). Soundwatch volunteers from the Whale Museum are involved in patrols that contact boaters near the refuge areas, maintain signage, and participate in wildlife monitoring (Osborne et al. 2001). In Alabama, the Coastwatch program trains volunteers to detect fisheries violations and provides them with 24-hour hotline access to enforcement officers (Brown et al. 2003). We recommend that the CDFG utilize volunteer groups to increase on-the-water presence in a cost effective way.

5.6.2.2. Central Coast Potential Partners

In order to aid the CDFG in establishing a network of outreach and education partners for the central coast study region, we conducted a search for potential partners. We chose potential partners based on their compatible mission statements, user group members, or access to user groups. We contacted potential partners to gauge their interest in working with the CDFG on education and outreach. We contacted several different groups: commercial fishermen's organizations, recreational fishermen's organizations, harbormasters, state parks, and non-governmental organizations (NGOs). Harbormasters were included because marinas have been found to be areas where rumors and misinformation can be spread, (Davis and Moretti 2005) indicating a need for accurate information availability. We contacted most potential partners via email in order to encourage rapid response. For groups without email addresses, we sent our letter by post. We asked for a response indicating the organization's level of interest in working with the CDFG on education and outreach as well as what types of communication methods the organization currently uses with members and/or user groups, as follows:

Question #1.

If the California Department of Fish & Game (CDFG) were to establish a partner program to circulate information about the location and protection level of California's marine protected areas, would your organization be willing to participate? Please indicate your probable level of interest:

__ Not interested in being an outreach partner
__ May be interested; need more information
__ Willing to provide information to members one time
__ Willing to periodically update members with new information from the CDFG
__ Willing to work with CDFG to hold an outreach event with members
__ Willing to partner with CDFG in any way possible to educate members

Question #2.

What is your primary communication method with your members?

__ Newsletter
__ Email Listserve
__ Direct mail
__ In-person
__ Other ________________________________

Our response rate was 22/44. The vast majority of response was positive—only one organization checked "not interested in being an outreach partner," and only three organizations checked "may be interested; need more information." All the others indicated they were willing to help disseminate information to assist the CDFG's efforts. Harbormasters and environmental NGOs were the most responsive, indicating that they would be willing to publicize information from the CDFG to harbor users and their members, respectively. Appendix N shows potential partner contact information, mission statement, and response to our inquiry. Although we did not contact research institutions, such organizations usually have an educational mandate that makes them likely partners in an outreach effort.

5.7 Conclusions and Recommendations

Designing for compliance can have a significant effect on the success of MPA networks. Our evaluation of compliance factors for the proposed networks and the *status quo* package has spotlighted MPAs that could be easily modified to increase compliance and ease enforcement. We conclude that the design of MPA boundaries is the factor that can most easily be adjusted on the current MPA network proposals to increase compliance and ease enforcement along the California central coast; there are many examples where boundaries could be made straight instead of curved and where boundaries could be adjusted to run along latitude and longitude lines. Adjusting boundaries to be straight and to run east/west and north/south may be the most valuable way to increase compliance.

In addition, there are several demonstrated ways to maximize compliance and ease the enforcement burden in MPAs. Our literature review, information about successes and failures from other MPAs in the United States and Australia, and communication with user groups and NGOs lead us to make the following recommendations for the new network of MPAs in California:

- **More boats and staff** will be required to patrol the Central Coast (5.5.3). Additional resources should be allocated to Morro Bay and Monterey because of the number of additional MPAs they will need to patrol. Boats and staff stationed in Santa Cruz and San Luis would also allow the efficient patrolling of the new network.
- An **interagency MOA**, between the CDFG, USCG, State Parks, NOAA, and any other agency with a suitable mandate, should be established before the network goes into effect (5.5.5). Regular meetings of MOA participants should be held including MPA officers, wardens, other enforcement staff, and education specialists from the involved agencies.
- CDFG should invest in a **cross-agency computer tracking system** that on-the-water patrol boats can access remotely (5.5.5).
- CDFG should partner with education and outreach specialists from the National Marine Sanctuary Program to create an **education and outreach action plan** (5.6.1.1).
- CDFG should make extensive efforts to disseminate information about the rules and regulations that apply to the new network prior to and immediately after implementation (5.6.1.2).
- CDFG should utilize **volunteer groups** to increase the on-the-water presence in a cost effective way (5.6.2.1).
- To efficiently circulate information on the location, designation, and scientific basis of the MPAs, the CDFG should establish an **outreach partnership program** with fishing industry organizations, non-governmental organizations, and other government agencies (5.6.2.2). Conservation groups and user groups with an interest in the success of this MPA network can efficiently broadcast the information to their members and others, at minimal cost to the CDFG.

Chapter 6: Applications, Conclusions, and Recommendations

6.1. Application to the Marine Life Protection Act

6.1.1. Species Likely to Benefit

6.1.2. MARXAN Analyses

6.1.3. Compliance and Enforcement Analyses

6.2. Conclusions and Recommendations

6.1. Application to MLPA

The overarching goal of our project was to integrate biological, physical, and socioeconomic data with policy to help the Blue Ribbon Task Force (BRTF) establish a network of Marine Protected Areas (MPAs) in accordance with the Marine Life Protection Act (MLPA) Initiative. We conducted our analyses to be consistent with the MLPA and the *Adopted Regional Goals and Objectives Package* of the Central Coast Regional Stakeholder Group (CCRSG) so that our work could inform the process. In this chapter, we provide an overview of the contribution of our work to the MLPA Initiative, and our final conclusions and recommendations for future work.

6.1.1. Species Likely to Benefit

The Science Advisory Team (SAT) used our research on species likely to benefit from a network of MPAs in the Central Coast Study Region (Appendix C) to compose an official list of species likely to benefit for the Initiative (CDFG 2005c). The most useful contribution of our research to this list was the detailed information that we provided on species ranges, distributions, habitat preferences, and life history characteristics (e.g. larval types). Our addition of mammals and birds to the species list may have influenced the inclusion of a *Special Status Species* section in the Central Coast Regional Profile (Appendix B).

6.1.2. MARXAN Analyses

Throughout the duration of our project, we met with the MLPA staff and members of the SAT to discuss our analyses and ensure that our approach was consistent with the MLPA Initiative. Our analyses provided the SAT, BRTF, and MLPA staff with the only tool in the MLPA Initiative that integrated both biophysical and socioeconomic features. Maps depicting our MARXAN output aided the SAT in evaluating stakeholder proposed packages of MPAs. The MLPA staff reviewed the results of our MARXAN analysis before developing a staff preferred alternative network of MPAs (Gleason 2006). For example, our MARXAN output was used to verify some assumptions the staff had about particular biodiversity hotspots. Our analyses will be submitted to the BRTF and the California Department of Fish and Game (CDFG) to assist them in determining which network proposal package(s) will be considered for implementation.

6.1.3 Compliance and Enforcement Analyses

Our work on enforcement, education, and outreach has the potential to aid the revision of proposals and the implementation of the resulting network. MLPA staff used portions of our analysis of the stakeholder packages. We provided a list of potential outreach partners with their contact information, mission statement, user group, and level of interest in outreach partnership with the CDFG. The identification and use of partner organizations has the potential to make the CDFG's education and outreach efforts less costly and more effective. Our compliance analyses and recommendations will be submitted to the BRTF and CDFG to assist them in determining which network proposal package(s) will be considered for implementation.

6.2. Conclusions and Recommendations

While our analyses and research were valuable during the evaluation phase of network proposal packages, their incorporation would have been more useful in the design phase of the MPA networks. The MLPA Initiative was guided by a rigorous timeline and was intended to be completed within a short period of time. As a result, the process of developing and evaluating networks of MPAs required the SAT, CCRSG, BRTF, and MLPA staff to complete their tasks quickly and with the best available information. Our MARXAN and compliance analyses also were limited by the Initiative's timeline. A complete package of results from our MARXAN analyses was not available until after the design of the MPA networks was completed. This was due, in part, to 1) the difficulty in obtaining confidential fishing data from the CDFG and 2) hesitation by the CDFG and MLPA staff to use MARXAN in the process. Furthermore, our research on compliance and enforcement was not available until the final stages of the Initiative. This was partially due to the lack of priority given to compliance and enforcement considerations early in the MLPA Initiative and changes to the stakeholder packages late in the process. As a result, we were unable to clearly define what type of analyses would be useful to the MLPA Initiative early in the process, and needed to quickly adjust our analyses to accommodate changes later in the process.

Our MARXAN analyses would have been useful for the stakeholders to consider while designing MPA network proposals consistent with the MLPA and CCRSG's Adopted Regional Goals and Objectives Package because it provided a way to evaluate the trade-off between conservation of biophysical features and important socioeconomic considerations. Due to the confidentiality of the commercial fishing data, the data were not available to all stakeholders for the design of MPA network proposals. We gained access to a modified set of summary data by working under supervision of CDFG staff and with a modified data set that did not reveal any fishery identities. We demonstrated the ability of MARXAN to consider commercial fishing data without revealing descriptive information about fishing grounds. Stakeholders could use the results of our analysis to minimize the impact of their proposed MPAs on fisheries. Therefore, we recommend that a MARXAN analysis be completed for use by the stakeholders in designing MPA network proposals for Northern and Southern California. Additionally, in order to alleviate the CDFG's and MLPA staff's concerns of using MARXAN to aid in the design of MPAs, we recommend modification of MARXAN for use in the design and evaluation of MPAs specific to California. These modifications are currently being considered and should include the ability to incorporate multiple types of zones (e.g. marine reserve, marine park, marine conservation area, multiple use zones), multiple costs of MPAs (e.g. fishing, enforcement, spatial), and ecological connectivity between of a network of MPAs. Additionally, modifications should be designed such that stakeholders may provide meaningful contributions to the analyses.

Furthermore, several design factors would help user groups recognize MPA boundaries and aid law enforcement officials in identifying violations. We recommend that enforcement considerations be prioritized while designing MPA network proposals for Northern and Southern California. In addition, our research on compliance and enforcement should be considered by the CDFG during the implementation phase of the MLPA in order to increase the effectiveness of the network of MPAs. Based on our literature review, we conclude that the CDFG should invest in both enforcement and education to achieve optimal compliance with the new regulations. Our review of the literature on MPAs also has indicated that (1) more boats, staff, and volunteers will be required for on-the-water patrol, (2) an interagency memorandum of agreement between CDFG, NOAA, USCG, State Parks, and any other relevant government agency should be developed and approved prior to the establishment of a network of state MPAs, and (3) a cross-agency computer tracking system for violations should be implemented. Moreover, to maximize limited resources for education and outreach, CDFG should connect and partner with organizations and user groups that have a vested interest in the success of the new MPA network. If CDFG cultivates a network of partner organizations in California, the Department can disseminate information about the new MPAs inexpensively and efficiently to a significant fraction of user groups and the public at large.

References

Agency, California Resources. 2001. California Wetlands Information System. URL: http://ceres.ca.gov/wetlands/geo_info/so_cal/species_list.html Accessed on July 5, 2005.

Airame, S. 2005. Channel Islands National Marine Sanctuary: Advancing the Science and Policy of Marine Protected Areas. Pages 91-124 *in* A. Sholz and D. Wright, editors. Place Matters: Geospatial Tools for Marine Science, Conservation, and Management in the Pacific Northwest. Oregon State University Press, Corvallis.

Airame, S., J. E. Dugan, K. D. Lafferty, H. Leslie, D. A. McArdle, and R. R. Warner. 2003. Applying ecological criteria to marine reserve design: A case study from the California Channel Islands. Ecological Applications **13**:S170-S184.

Aquarium, Monterey Bay. 1999-2006. Monterey Bay Aquarium Online Field Guide. URL: http://www.mbayaq.org/cr/cr_seafoodwatch/content Accessed on July 5, 2005.

Ardron, J., J. Lash, and D. Haggarty. 2002. Modelling a Network of Marine Protected Areas for the Central Coast of BC. Living Oceans Society, Sointula.

Association, Farallones Marine Sanctuary. 2005. Sand Crabs Along California Beaches. URL: http://www.farallones.org/sandcrabs/ Accessed on July 5, 2005.

Ball, I. R., and H. P. Possingham. 2000. MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual.

Becker, G. S. 1968. Crime and Punishment - Economic Approach. Journal of Political Economy **76**:169-217.

Branch, C. V. B.-D. Central Valley Bay-Delta Branch Estuarine Monitoring Project, Dungeness crabs. CDFG. URL: http://www.delta.dfg.ca.gov/baydelta/monitoring/cmag.asp Accessed on July 5, 2005.

Brown, D., J. Weaver, D. McKinney, and G. Freselli. 2003. Enforcement/Compliance Roundtable Discussion Summary: Madison-Swanson and Steamboat Lumps Marine Protected Areas. *in* Enforcement/Compliance Roundtable Discussion. NOAA, Panama City Beach, FL.

CDFG. Marine Protected Areas and Potential Benefits to Selected Species (California Halibut). URL: http://www.dfg.ca.gov/mrd/mlpa/response/halibut.pdf Accessed on July 5, 2005.

CDFG. 2003. California Marine Sportfish Database. State of California. URL: http://www.dfg.ca.gov/hcpb/species/species.shtml Accessed on July 5, 2005.

CDFG. 2005a. California's Plants and Animals. URL: http://www.dfg.ca.gov/mrd/status/status2001.html Accessed on July 5, 2005.

CDFG. 2005b. California Marine Life Protection Act Initiative Draft Master Plan Framework: A Recommendation to the California Fish and Game Commission by the California Department of Fish and Game.

CDFG. 2005c. California Marine Life Protection Act Initiative Regional Profile of the Central Coast Study Region.

CDFG. 2005d. Pinnacle Structures of the Central California Seafloor Metadata. Accessed through the California Marine Geodatabase. University of California, Santa Barbara.

CDFG. December 2001. California's Living Marine Resources: A Status Report. URL: http://www.dfg.ca.gov/mrd/status/status2001.html Accessed on July 5, 2005.

CDFG. December 2004. Annual Status of the Fisheries Report Through 2003. URL: http://www.dfg.ca.gov/mrd/status/ Accessed on July 5, 2005.

AFSC. Guide to Rockfishes. National Marine Fisheries Service - NOAA Fisheries. URL: http://www.afsc.noaa.gov/groundfish/RockfishGuide/Rockfish_Pages Accessed on July 5, 2005.

AFSC. 2005a. Kodiak Laboratory Aquarium. Center, A. F. S. 2005b. Resource Assessment and Conservation Engineering Invertebrate Photos by Species. URL: http://www.afsc.noaa.gov/race/media/photo_gallery/invert_by_species.htm Accessed on July 5, 2005.

CINMS, C. I. N. M. S. 2006. Marine Reserves.

Commission, Pacific States Marine Fisheries. 1996. Pacific Littleneck Clam. URL: http://www.psmfc.org/habitat/edu_pacclam_fact.html Accessed on July 5, 2005.

Costello, C. 2006. *Personal Communication. with* A. Chan, C. Klein, and N. Gardner.

Council, P. F. M. 2/10/2006. Groundfish Current Season Management.

Cowles, D. 2002. Key to Invertebrates Found On or Near Rosario. URL: http://www.rosario.wwc.edu/inverts/ Accessed on July 5, 2005.

Crowder, L. L., SJ; Figueira, WF; Priddy, J. 2000. Source-sink population dynamics and the problem of siting marine reserves. Bulletin of Marine Science **66**:799-820.

D'Vincent, S., H. Geoffrey Moser, Elbert S. Ahlstrom. 1980 (Vol XXI). Description of the Larvae and Early Juveniles of the Pacific Butterfish *Peprilus Simillimus* (Family Stromateidae). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Center, La Jolla, CA.

Davis, B. C., and G. S. Moretti. 2005. Enforcing U.S. Marine Protected Areas: Synthesis Report.

Denny, C. M., and R. C. Babcock. 2004. Do partial marine reserves protect reef fish assemblages? Biological Conservation **116**:119-129.

Department of Biological Science, C. S. U., Fullerton. 1997. Classification of Southern California Sea Urchins. URL: http://biology.fullerton.edu/courses/biol_317/web/Murray/Fall97/sea_urchin.html Accessed on July 5, 2005.

Die, D. J., and R. A. Watson. 1992. Dissipation of spatial closure benefits as a result of non-compliance. Mathematics and Computers in Simulation **33**:451-456.

Ecotrust. 2005. Oceanmap Fisheries Lists. Fisheries Use and Value Project.

Ekstrom, J. 2005. Approaches to Implementation of Regulations in MPA Networks Supplementary to MLPA Master-Plan Framework, September 2005, California Resources Agency.

eNature. 2005. Field Guides. National Wildlife Federation. URL: http://www.enature.com/fieldguides/ Accessed on July 5, 2005.

NatureServe Explorer. 3/12/1996, 5/12/1994. *Balaenoptera physalus,* Fin Whale. URL: http://www.natureserve.org/explorer/servlet/NatureServe?searchName=Balaenoptera+physalus Accessed on July 5, 2005.

Furlong, W. J. 1991. The Deterrent Effect of Regulatory Enforcement in the Fishery. Land Economics **67**:116-129.

Gaines, S. 2005. *Personal Communication. with* N. Gardner.

GBRMPA. 2004. Frequently Asked Questions about the rezoning. Great Barrier Reef Marine Park Authority.

GBRMPA. 2006. Day-to-Day Management: Surveillance and Enforcement.

Gell, F. R., and C. M. Roberts. 2003. Benefits beyond boundaries: the fishery effects of marine reserves. Trends in Ecology & Evolution **18**:448-455.

Gleason, M. 2006. *Personal Communication*. *with* C. Klein.

Groves, C. R. 2003. Drafting a Conservation Blueprint: A Practitioner's Guide to Planning for Biodiversity. Island Press, Washington DC.

Halpern, B. S. 2003. The impact of marine reserves: Do reserves work and does reserve size matter? Ecological Applications **13**:S117-S137.

Hastings, S. 2006. Unpublished internal document (education and action plan). Channel Islands National Marine Sanctuary.

IUCN. 2003. Recommendations of the Vth IUCN World Parks Congress. IUCN (The World Conservation Union), Gland, Switzerland.

Jostes, J. C., and M. Eng. 2001. Facilitator's Report Regarding the Channel Islands National Marine Sanctuary Marine Reserves Working Group. Channel Islands National Marine Sanctuary, Sanctuary Advisory Council.

Leslie, H., M. Ruckelshaus, I. R. Ball, S. Andelman, and H. P. Possingham. 2003. Using siting algorithms in the design of marine reserve networks. Ecological Applications **13**:S185-S198.

Kritzer, J. P. 2004. Effects of noncompliance on the success of alternative designs of marine protected-area networks for conservation and fisheries management. Conservation Biology **18**:1021-1031.

Kuperan, K., and J. G. Sutinen. 1998. Blue water crime: Deterrence, legitimacy, and compliance in fisheries. Law & Society Review **32**:309-337.

Margules, C. R. a. R. L. P. 2000. Systematic Conservation Planning. Nature **405**:243-253.

McKinney, D. 2003. Enforcement/Compliance Roundtable Discussion Summary: Madison-Swanson and Steamboat Lumps Marine Protected Areas. Panama City Beach, FL.

Milon, J. W. 2000. Pastures, fences, tragedies and marine reserves. Bulletin of Marine Science **66**:901-916.

MLPA. 1999. California Marine Life Protection Act. Chapter 10.5, Fish and Game Code 2850-2863.

Museum, San Diego Natural History. 2005. Balaenoptera Physalus. URL: http://www.sdnhm.org/fieldguide/mammals/bala-phy.html Accessed on July 5, 2005.

NMFS. 2002. Black Abalone - Species of Concern.URL: http://www.nmfs.noaa.gov/pr/species/concern/profiles/black_abalone.pdf Accessed on July 5, 2005.

NOAA. 2003. Socioeconomic Research and Monitoring Recommendations for Marine Protected Areas in the Channel Islands National Marine Sanctuary. report from CINMS monitoring workshop, held in Santa Barbara, CA, in March 2003 National Oceanic and Atmospheric Administration (NOAA), National Oceans Service. NOAA Fisheries. 2006. Office for Law Enforcement Home Page. Special Projects, Silver Spring, MD.

NOAA Fisheries. 2005. Office of Protective Resources. Species Information. URL: http://www.nmfs.noaa.gov/pr/species/ Accessed on July 5, 2005.

NOAA Fisheries. 2006. Office for Law Enforcement Home Page.

OBIS - SEAMAP. 2005. Species Profiles - Balaenoptera physalus. URL: http://seamap.env.duke.edu/species/tsn/180527 Accessed on July 5, 2005.

Osborne, R. W., K. L. Koski, and R. E. Tallmon. 2001. Voluntary Marine Protected Areas and Adaptive Management in the San Juan Islands. Puget Sound Research.

Randall, J. K. 2004. Improving compliance in US federal fisheries: An enforcement agency perspective. Ocean Development and International Law **35**:287-317.

Reilly, P. 2006. Email. *Personal Communication. with* A. Cundiff.

Roberts, C. M., S. Andelman, G. Branch, R. H. Bustamante, J. C. Castilla, J. Dugan, B. S. Halpern, K. D. Lafferty, H. Leslie, J. Lubchenco, D. McArdle, H. P. Possingham, M. Ruckelshaus, and R. R. Warner. 2003a. Ecological criteria for evaluating candidate sites for marine reserves. Ecological Applications **13**:S199-S214.

Roberts, C. M., G. Branch, R. H. Bustamante, J. C. Castilla, J. Dugan, B. S. Halpern, K. D. Lafferty, H. Leslie, J. Lubchenco, D. McArdle, M. Ruckelshaus, and R. R. Warner. 2003b. Application of ecological criteria in selecting marine reserves and developing reserve networks. Ecological Applications **13**:S215-S228.

SAT. 2006. Science Advisory Team Draft Analysis of Habitat Representation in MPA Packages 0, 1, 2, 3, S, AC.

Scott, V. 2000. Bivalve Seashells of Western North America. URL: http://www.sbnature.org/estore/pdf/0936494301.pdf Accessed on July 5, 2005.

Seafood Network Information Center, UC Davis. 10/19/2005. Abalone. URL: http://seafood.ucdavis.edu/pubs/abalone.htm Accessed on July 5, 2005.

Service, Fish and Wildlife. 1989a. Brown Rock Crab, Red Rock Crab and Yellow Crab. 82, Lafayette, La. URL: http://www.nwrc.usgs.gov/wdb/pub/0105.pdf Accessed on July 5, 2005.

Service, Fish and Wildlife. 1989b. Pacific Geoduck Clam. Lafayette. URL: http://www.nwrc.usgs.gov/wdb/pub/0125.pdf Accessed on July 5, 2005.

Service, Fish and Wildlife. 1989c. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates: Pismo Clam. URL: http://www.nwrc.usgs.gov/wdb/pub/0194.pdf Accessed on July 5, 2005.

Service, Fish and Wildlife. 2002. Endangered Species Information. URL: http://www.fws.gov/endangered/wildlife.html#Species Accessed on July 5, 2005.

SET. 2002. Recommendations on marine reserves education strategies [SET Matrix] from the Sanctuary Education Team to Channel Islands National Marine Sanctuary, Sanctuary Advisory Council, 13 November.

Society, American Cetacean. 2005a. American Cetacean Society Fact Sheet, Right Whale. URL: http://www.acsonline.org/factpack/RightWhale.htm Accessed on July 5, 2005.

Society, Seattle Audubon. 2005b. Bird Web - Learn About the Birds of Washington state. URL: http://www.birdweb.org/birdweb/species.asp?id=28 Accessed on July 5,2005.

Spear, F. 2005. Enforcement, Education, and Outreach Action Plan. *in*. California Marine Life Protection Act Initiative Framework. Department of Fish and Game.

Stahl, M. M. 1994. Promoting voluntary compliance: a valuable supplement to environmental enforcement. Pages 551-557 *in* Third International Conference on Environmental Enforcement.

Starr, R. M., M. H. Carr, J. Caselle, J. A. Estes, C. Syms, D. A. VenTresca, and M. M. Yoklavich. 2002. A Review of the Ecological Effectiveness of Subtidal Marine Reserves in Central California--Part II: Summary of Existing Marine Reserves in Central California and their Potential Benefits. A report to the Sanctuary Monterey Bay National Marine Sanctuary, Monterey.

Stewart, R. R., and H. P. Possingham. 2005. Efficiency, costs and trade-offs in marine reserve system design. Environmental Modeling & Assessment **10**:203-213.

Sutinen, J. G., and J. R. Gauvin. 1989. An Econometric Study of Regulatory Enforcement and Compliance in the Commercial Inshore Lobster Fishery of Massachusetts. Kluwer Academic Publishers, Boston.

Sutinen, J. G., A. Rieser, and J. R. Gauvin. 1990. Measuring and Explaining Noncompliance in Federally Managed Fisheries. Ocean Development and International Law **21**:335-372.

University, Oregon State. 1997. Oregon Developmental Species - Spot Prawn. URL: http://hmsc.oregonstate.edu/odfw/devfish/sp/prawn.html Accessed on July 5, 2005.

USCG. 2004. Ocean Guardian: Coast Guard Fisheries Enforcement Plan.

USCG. 2005. Enforcement Considerations for NOAA Fisheries and N. Pacific Fishery Management Council Staff.

Wang, J. C. S. January 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Water, California: A Guide to the Early Life Histories. *in*. California Department of Water Resources, California Department of Fish and Game, U. S. Bureau of Reclamation and U. S. Fish and Wildlife Service.

Warrington, T. 2005. Assistant Chief, California Dept. of Fish and Game Marine/Special Operations Unit. *Personal Communication. with* L. Kircher.

Wildlife, Oregon Department of Fish and. 1/28/2005. Developmental Fisheries List. URL: http://hmsc.oregonstate.edu/odfw/devfish/ Accessed on July 5, 2005.

Appendix A: Current and proposed networks of marine protected areas.

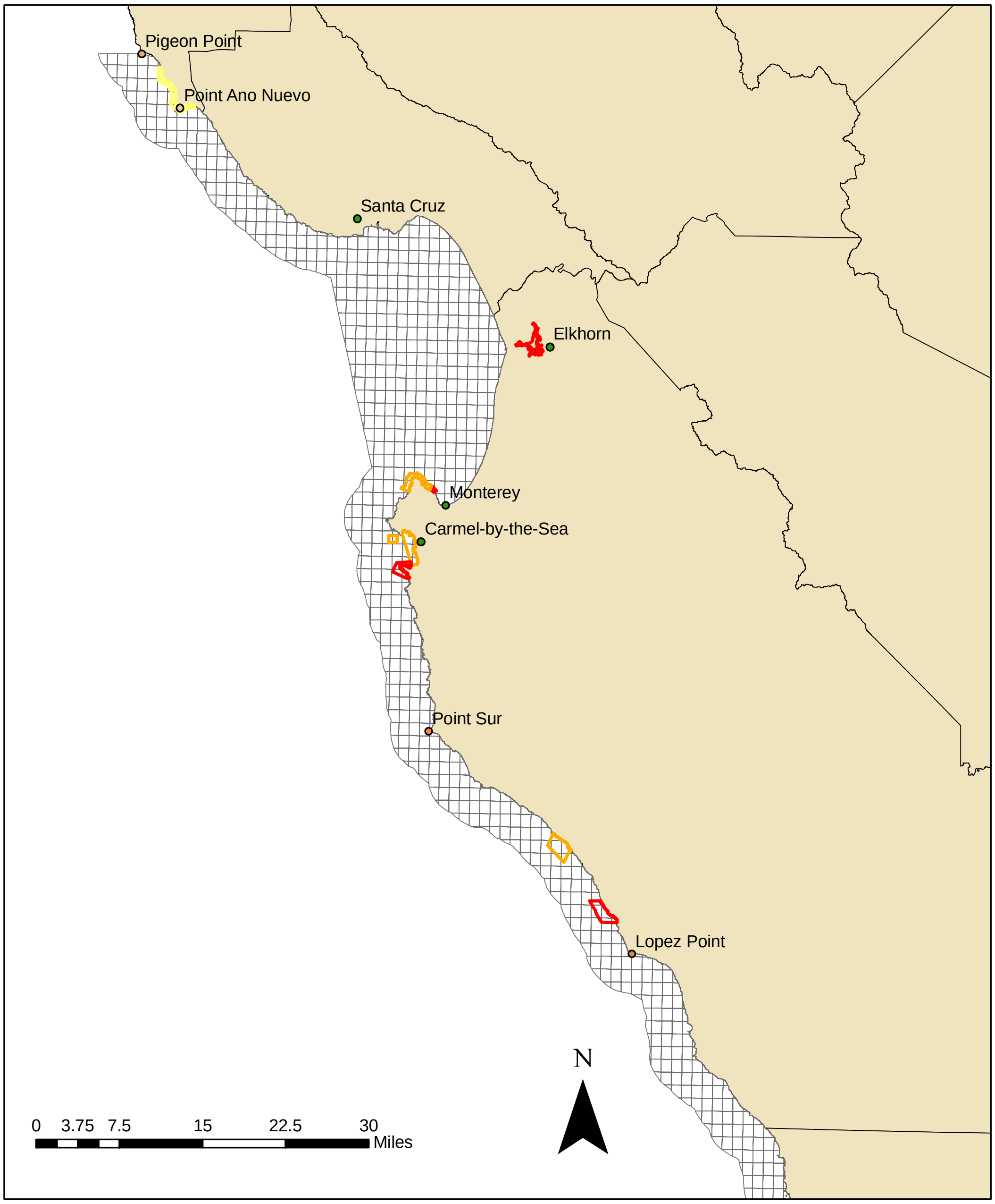

Figure A1. Package 0 (North) - Current marine protected areas. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas. Yellow borders = Special Closure.

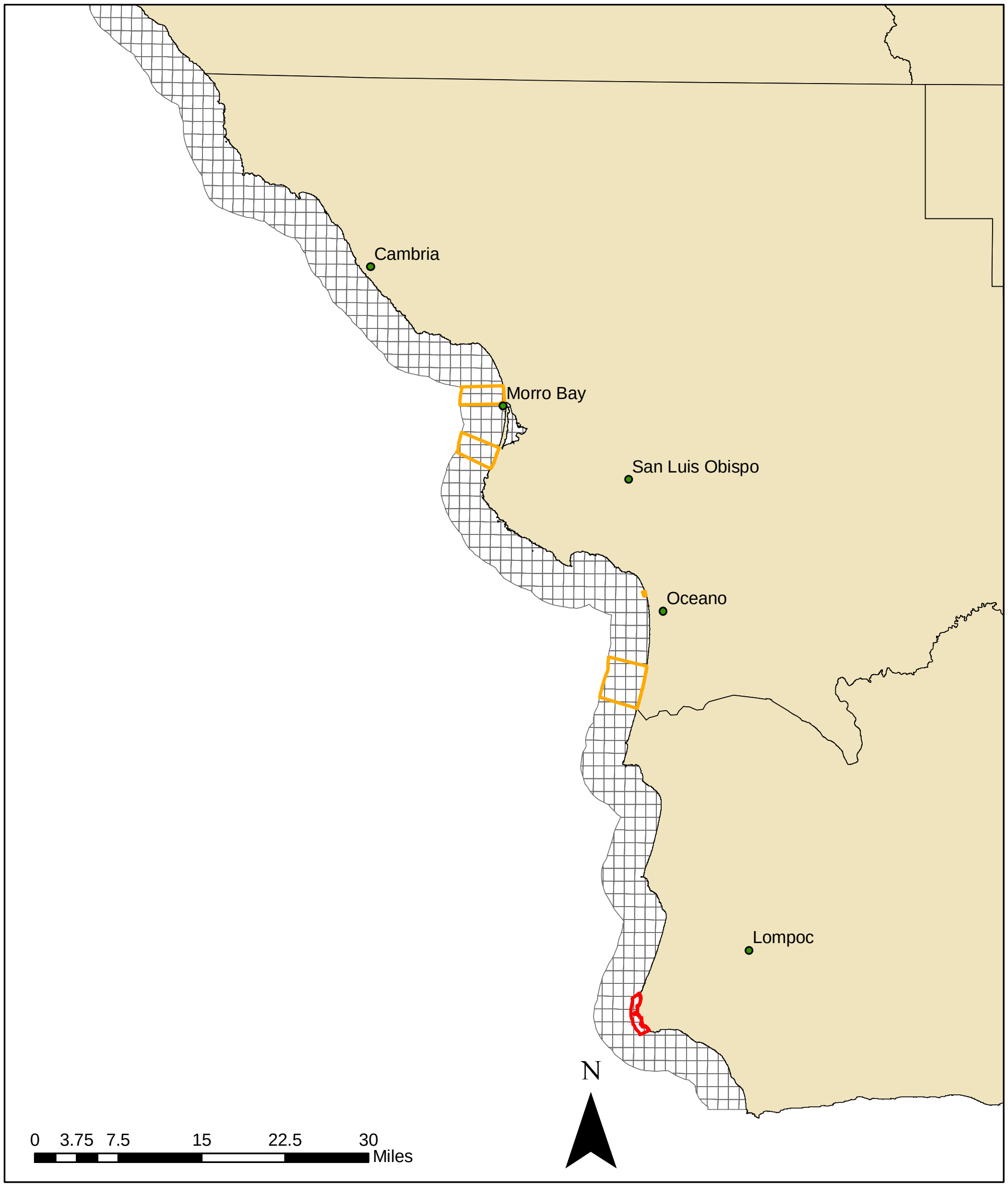

Figure A2. Package 0 (South) - Current marine protected areas. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas. Yellow borders = Special Closure.

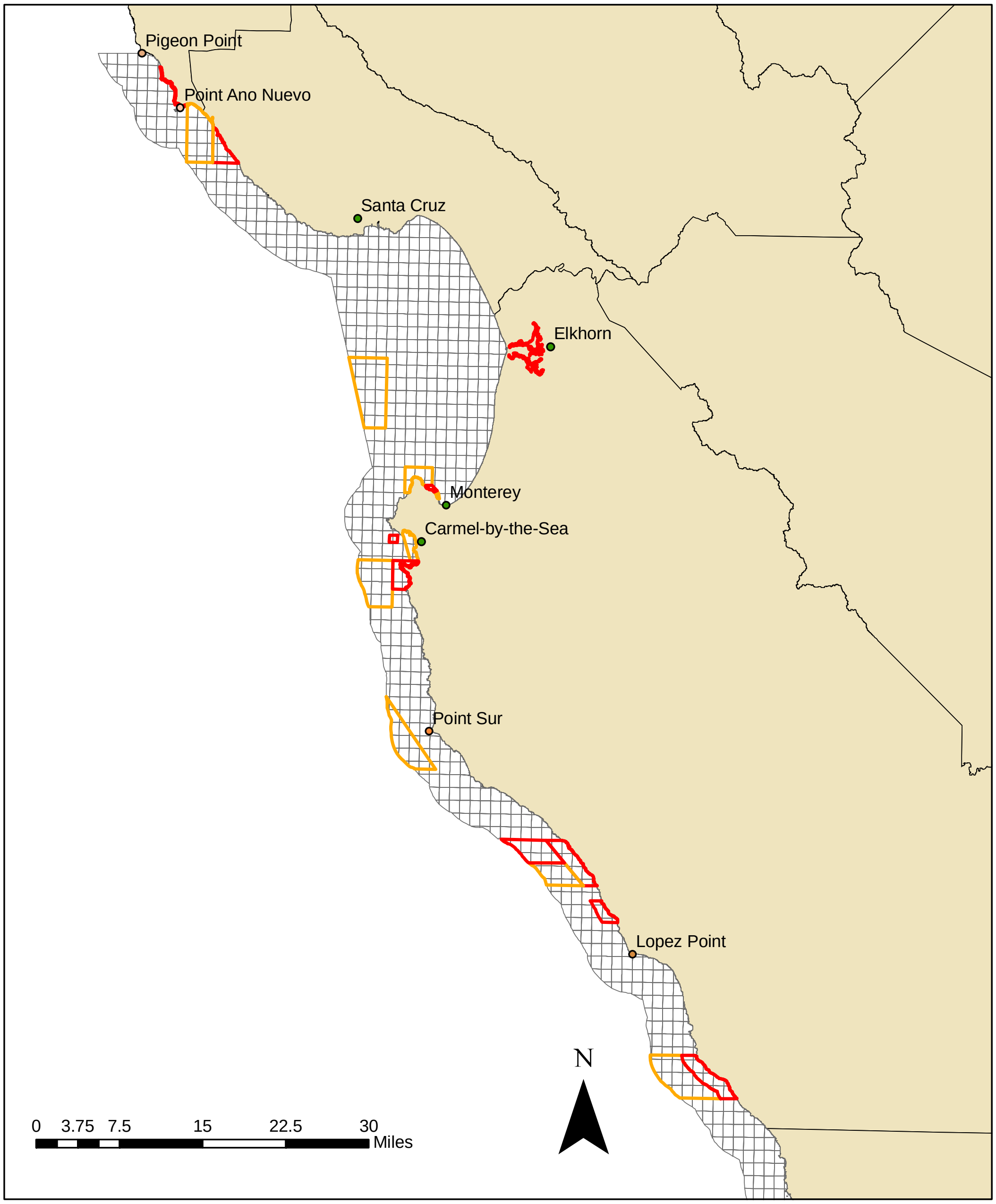

Figure A3. Package 1(North) proposed by the Central Coast Regional Stakeholder Group on February 9, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

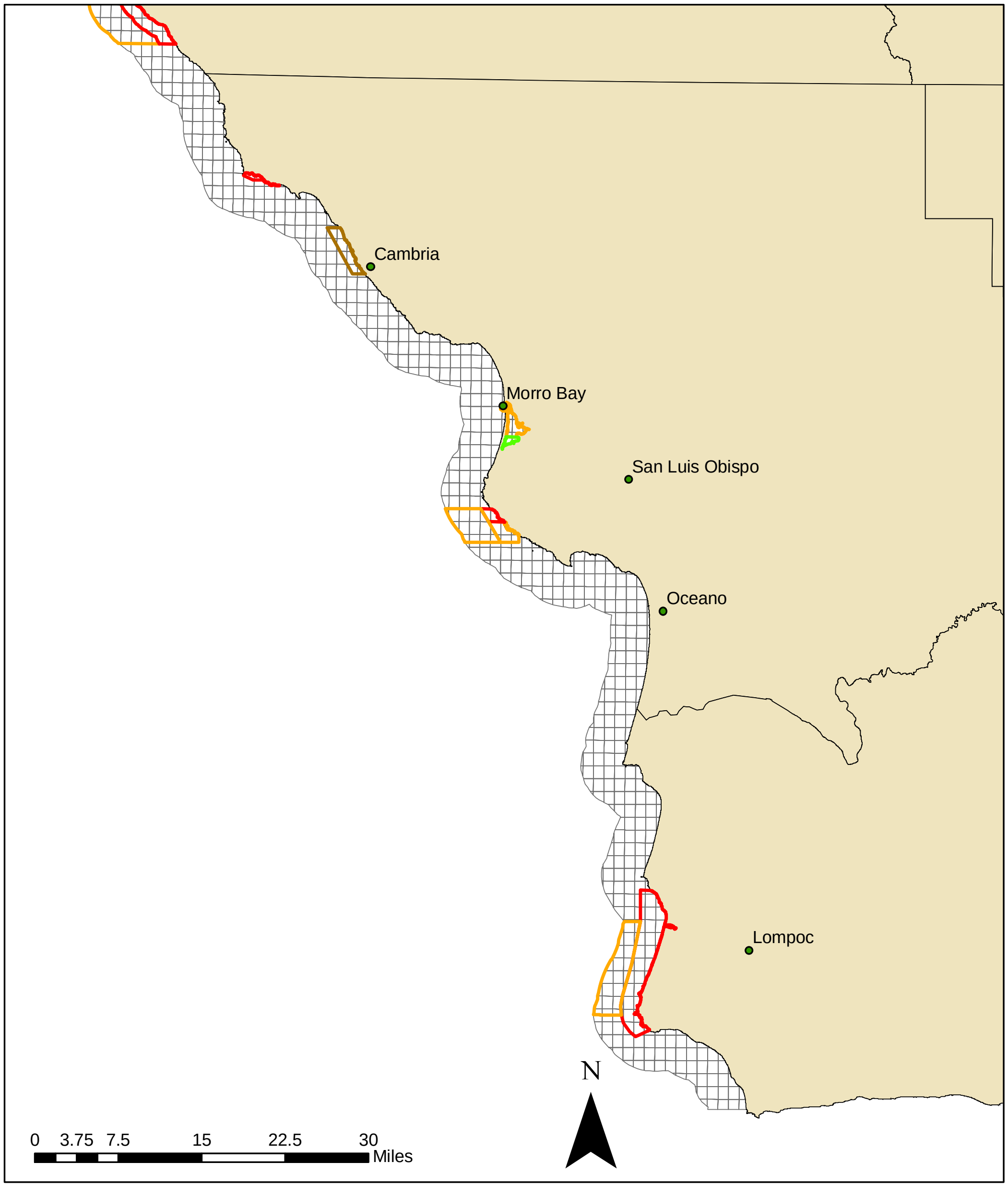

Figure A4. Package 1 (South) proposed by the Central Coast Regional Stakeholder Group on February 9, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

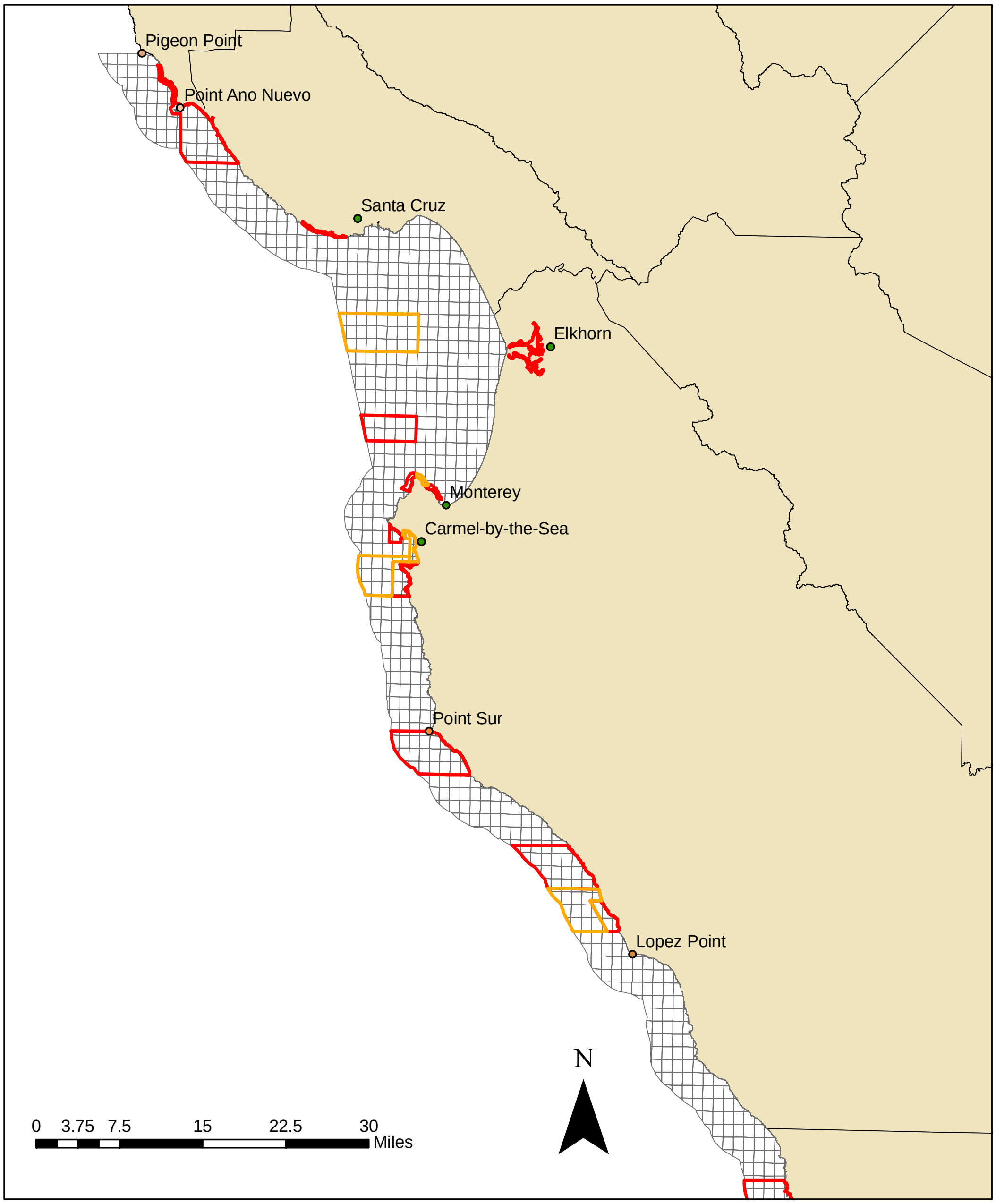

Figure A5. Package 2 (North) proposed by the Central Coast Regional Stakeholder Group on February 9, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

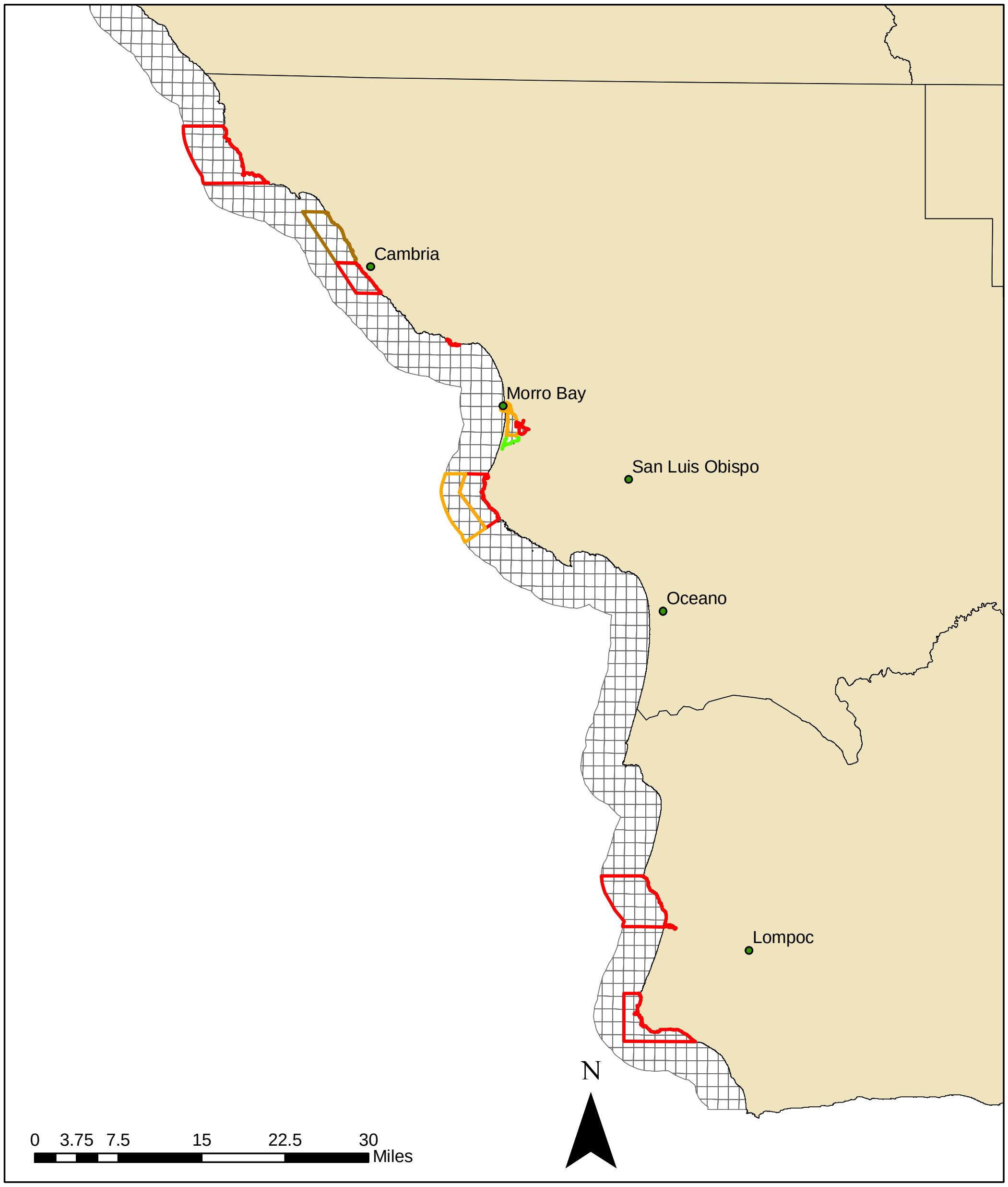

Figure A6. Package 2 (South) proposed by the Central Coast Regional Stakeholder Group on February 9, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

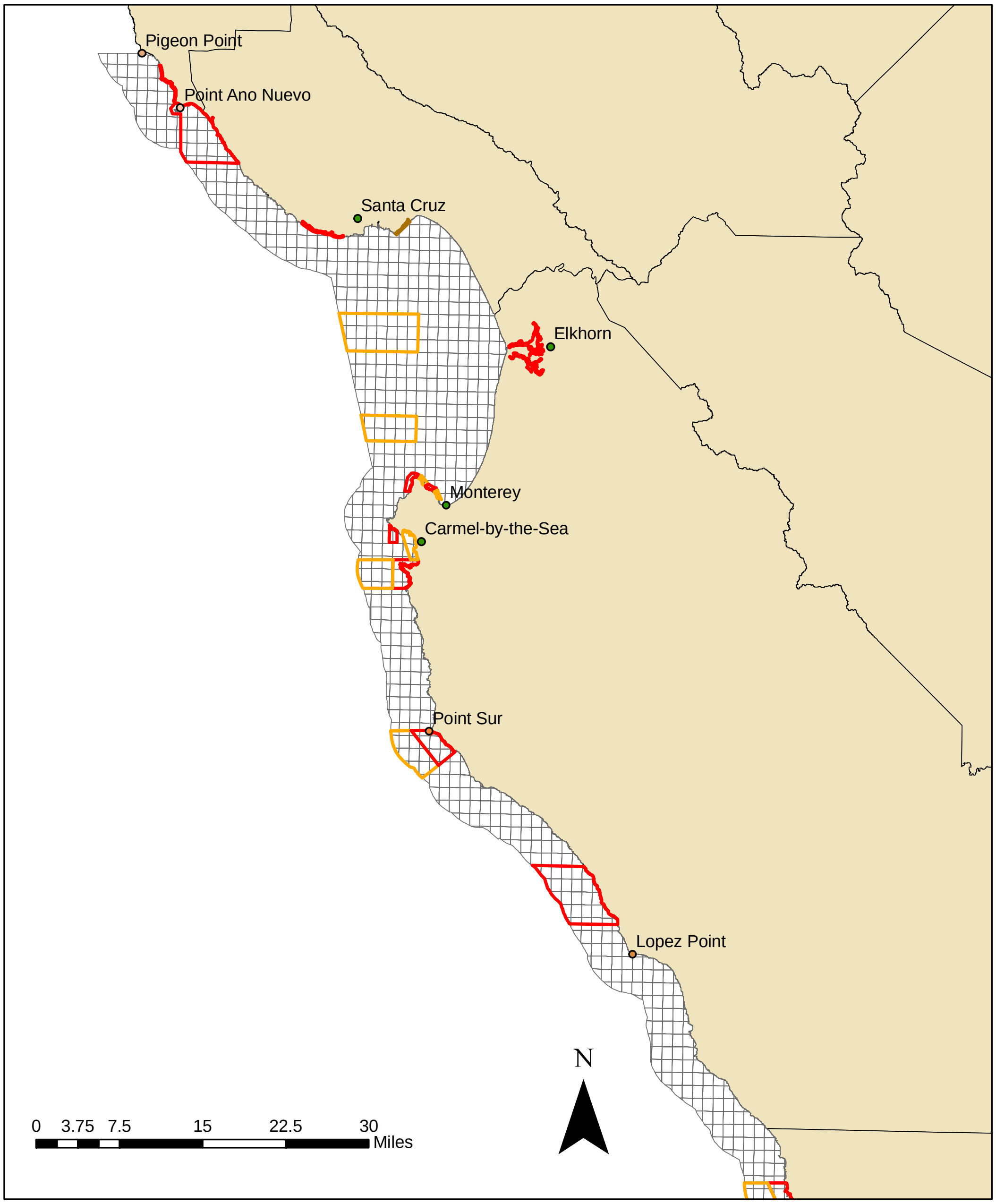

Figure A7. Package 3 (North) proposed by the Central Coast Regional Stakeholder Group on February 9, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

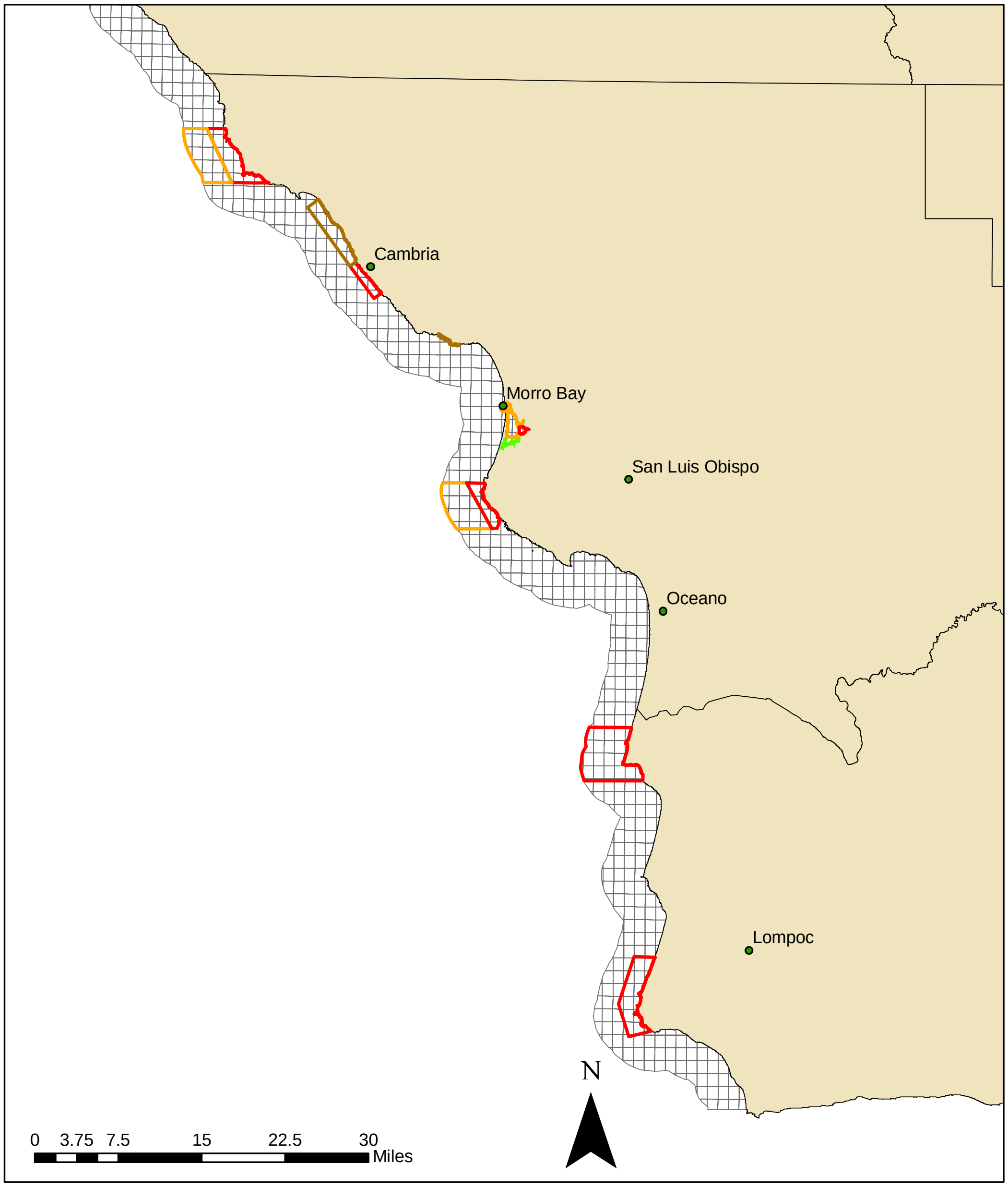

Figure A8. Package 3 (South) proposed by the Central Coast Regional Stakeholder Group on February 9, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

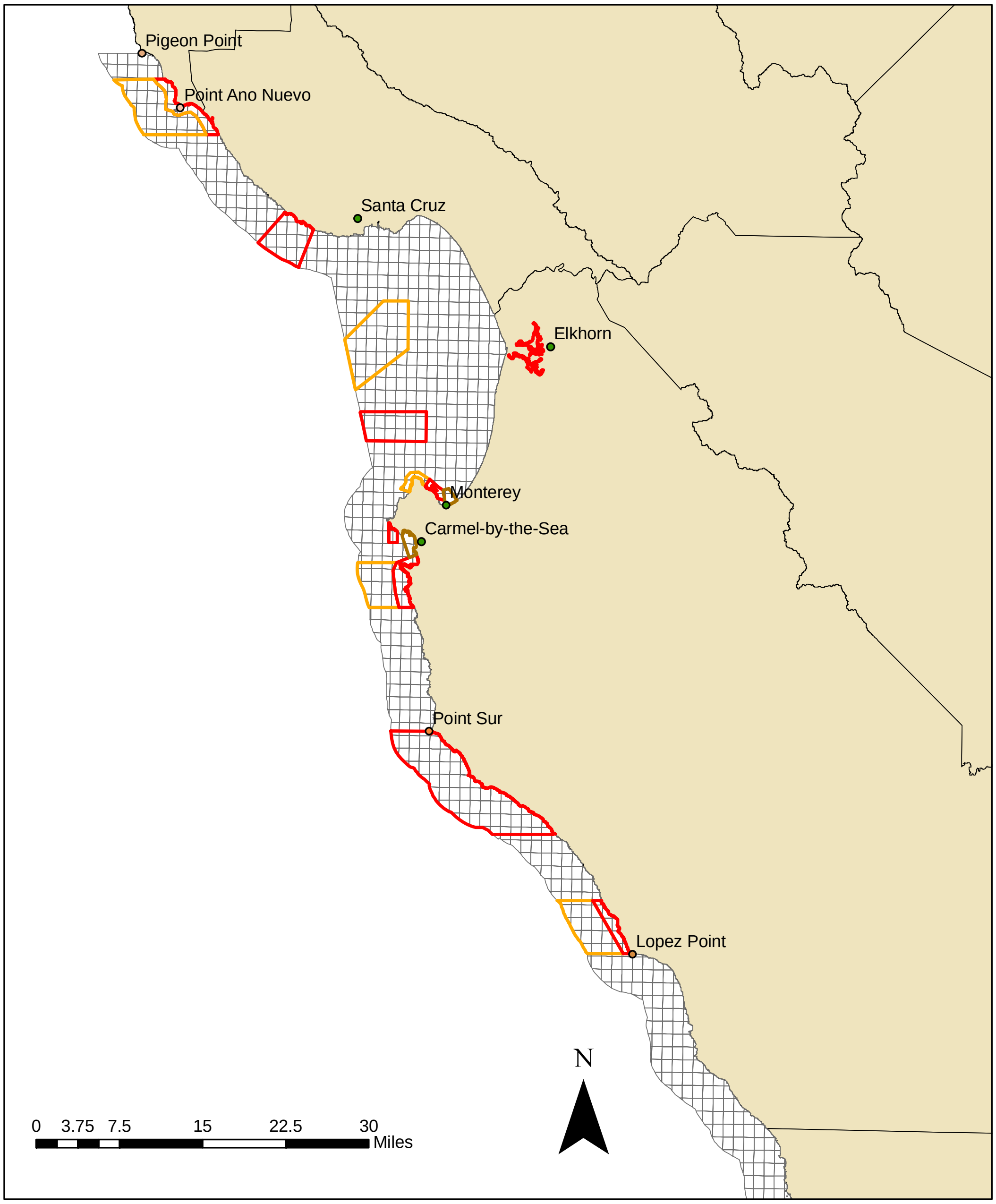

Figure A9. Package AC (North) proposed by the Natural Resources Defense Council and Point Reyes Bird Observatory on January 23, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

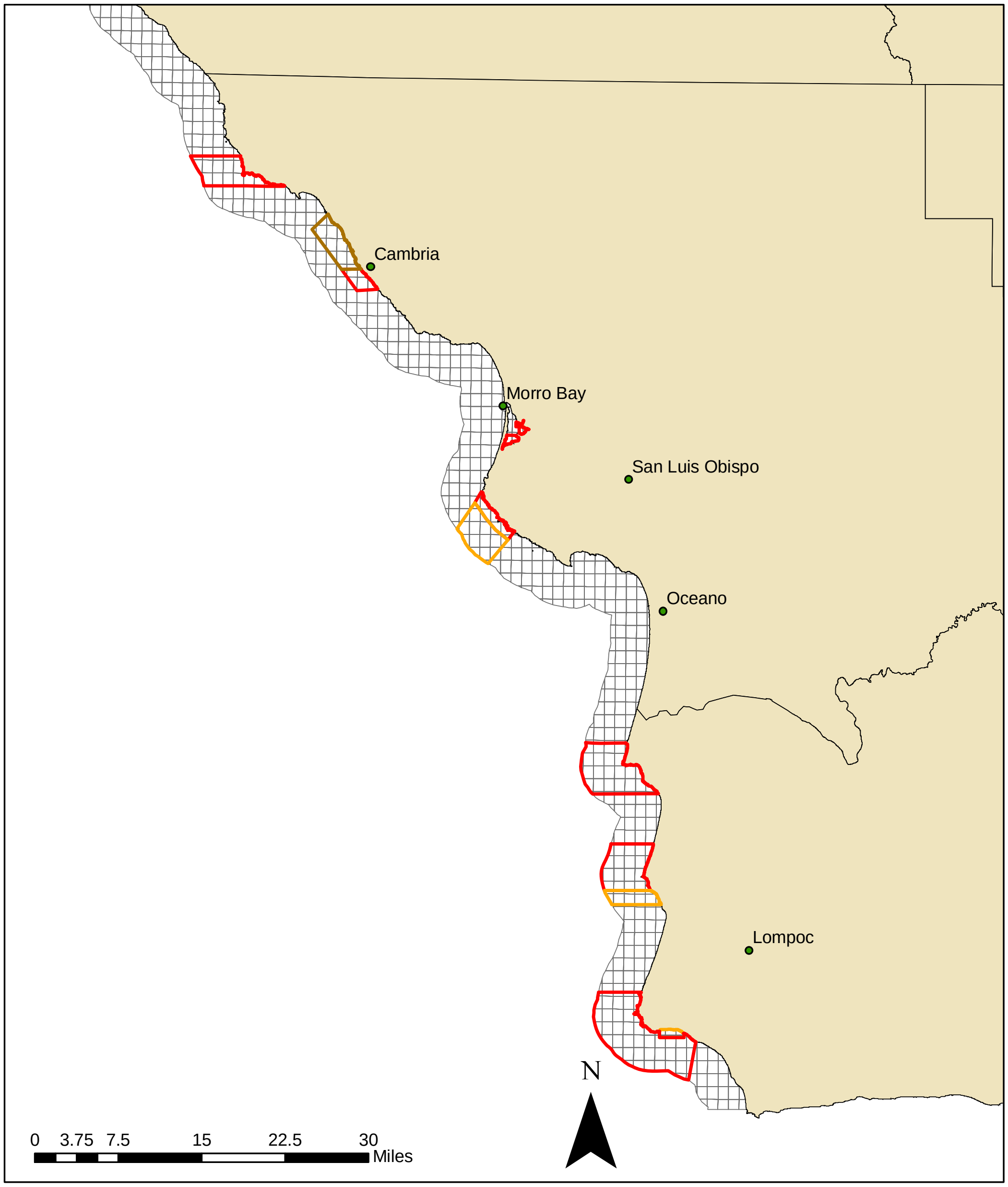

Figure A10. Package AC (South) proposed by the Natural Resources Defense Council and Point Reyes Bird Observatory on January 23, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

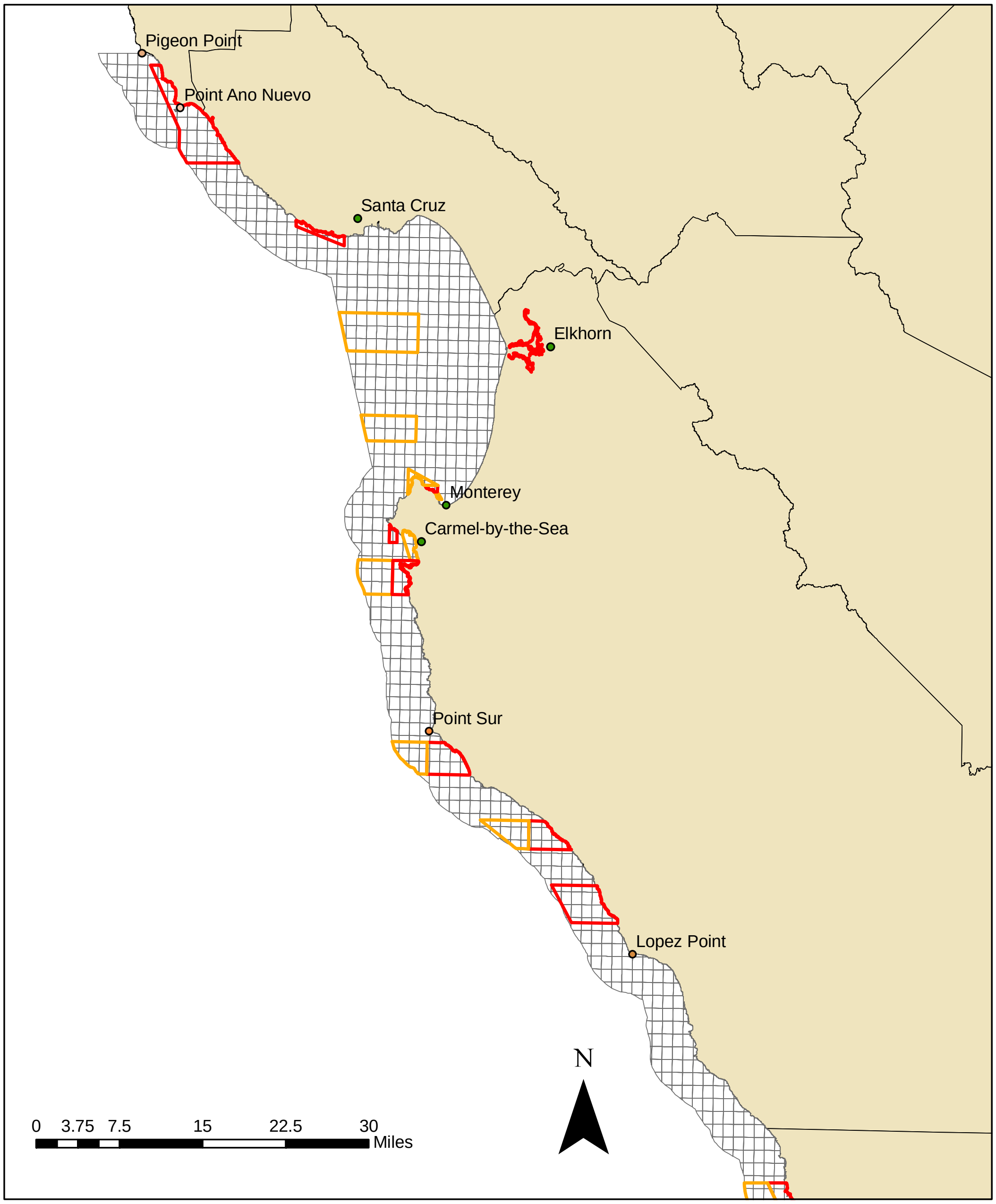

Figure A11. Package S (North) submitted by the Marine Life Protection Act Initiative Staff on February 28, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

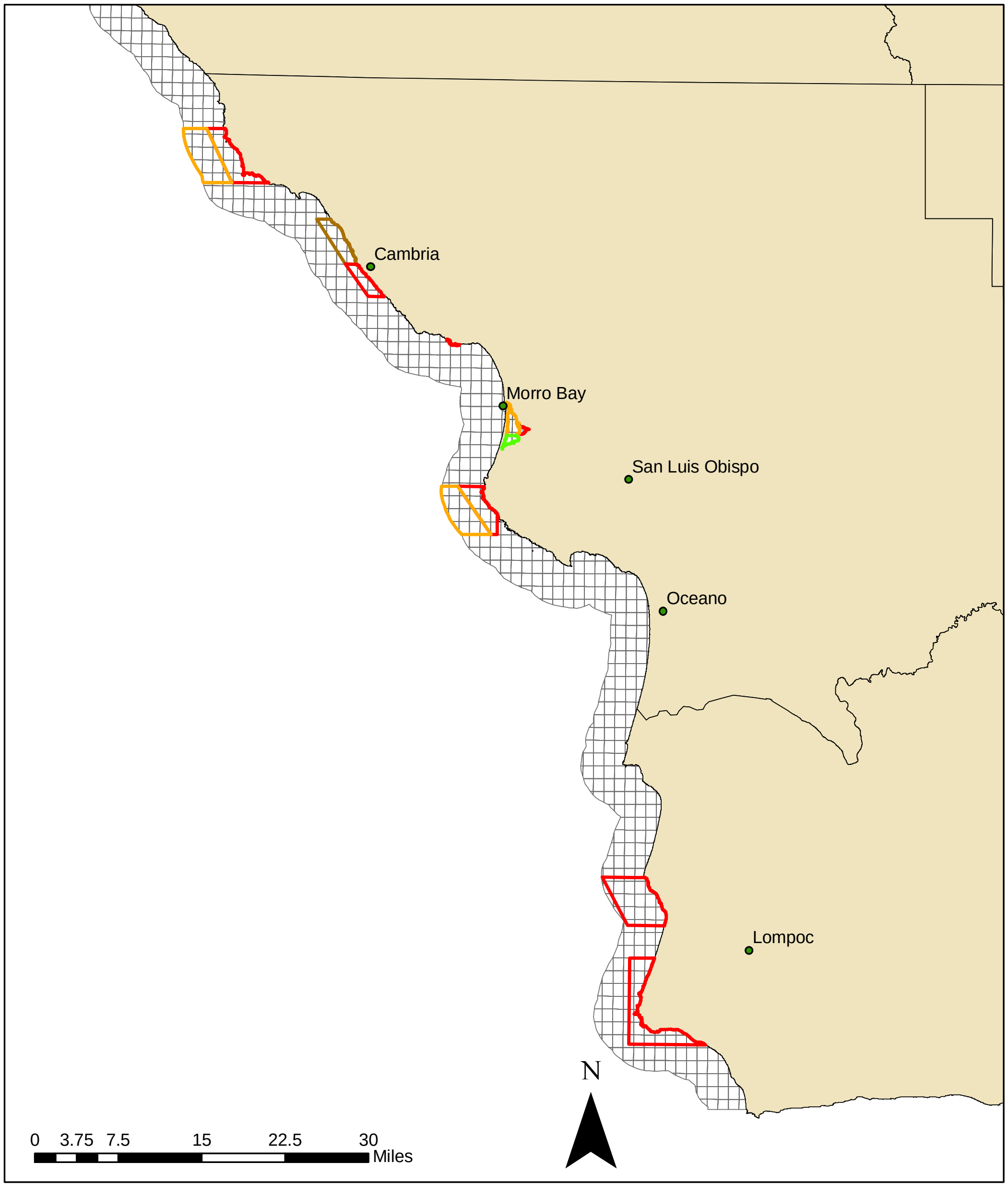

Figure A12. Package S (South) submitted by the Marine Life Protection Act Initiative Staff on February 28, 2006. Red borders = State Marine Reserves, Orange borders = State Marine Conservation Areas, Brown borders = State Marine Parks, Green borders = State Marine Recreational Management Areas.

Appendix B: *Species of Special Status* list compiled by NOAA staff representing species expected to occur in the Monterey Bay National Marine Sanctuary. The list is shown as it appears in the MLPA's Central Coast Regional Profile Appendix II (c) (CDFG 2005c).

Table B1. Mammals with special status

Common Name	*Scientific Name*	ESA	CESA
Blue whale	*Balaenoptera musculus*	E (06-02-70)	
Fin whale	*Balaenoptera physalus*	E (06-02-70)	
Humpback whale	*Megaptera novaeangliae*	E (06-02-70)	
North Pacific right whale	*Eubalaena japonica*	E (06-02-70)	
Gray whale	*Eschrichtius robustus*	Delist (06-15-94)	
Sei whale	*Balaenoptera borealis*	E (06-02-70)	
Sperm whale	*Physeter macrocephalus*	E (06-02-70)	
Killer Whale	*Orcinus orca*	PT (12-22-04); SC (NMFS)	
Steller sea lion (Eastern stock)	*Eumetopias jubatus*	T (04-05-90)	
Guadelupe fur seal	*Arctocephalus townsendi*	T (12-16-85)	T (06-27-71)
Southern sea otter	*Enhydra lutris nereis*	T (01-14-77)	

Table B2. Birds with special status

Common Name	*Scientific Name*	ESA	CESA
Common loon	*Gavia immer*		SSC
Short-tailed Albatross	*Phoebastria albatrus*	E (08-30-00)	SSC
Black-footed albatross	*Phoebastria nigripes*	SC (FWS)	
Ashy storm-petrel	*Oceanodroma homochroa*	SC (FWS)	SSC (SP)
Fork-tailed storm-petrel	*Oceanodroma furcata*		SSC (FP)
Black storm-petrel	*Oceanodroma melania*		SSC (TP)
California brown pelican	*Pelecanus occidentalis californicus*	E (10-13-70)	E (06-27-71)

Common Name	*Scientific Name*	ESA	CESA
American white pelican	*Pelecanus erythrorhynchos*		SSC (FP)
American bittern	*Botaurus lentiginosus*	SC (FWS)	
Least bittern	*Ixobrychius exilis*		SSC (TP)
White-faced ibis	*Plegadis chihi*	SC (FWS)	
Harlequin duck	*Histrionicus histrionicus*	SC (FWS)	SSC (FP)
California clapper rail	*Rallus longirostris obsoletus*	E (10-13-70)	E (06-27-71)
California black rail	*Laterallus jamaicensis coturniculus*	SC (FWS)	T (06-27-71)
Western snowy plover	*Charadrius alexandrinus nivosus*	T (04-05-93)	SSC
Black oystercatcher	*Haematopus bachmani*	SC (FWS)	
Whimbrel	*Numenius phaeopus*	SC (FWS)	
Long-billed curlew	*Numenius americanus*	SC (FWS)	
Marbled godwit	*Limosa fedoa*	SC (FWS)	
Black turnstone	*Arenaria melanocephala*	SC (FWS)	
Red knot	*Calidris canutus*	SC (FWS)	
Elegant tern	*Sterna elegans*	SC (FWS)	SSC (TP)
California least tern	*Sterna antillarum browni*	E (10-13-70)	E (06-27-71)
Marbled murrelet	*Brachyramphus marmoratus marmoratus*	T (09-30-92)	E (03-12-92)
Xantus's murrelet	*Synthliboramphus hypoleucus*	SC / Candidate (FWS)	T (12-22-04)
Cassin's auklet	*Ptychoramphus aleuticus*	SC (FWS)	SSC (SP)
Rhinoceros auklet	*Cerorhinca monocerata*		SSC (TP)
Tufted Puffin	*Fratercula cirrhata*		SSC (FP)

Table B3. Reptile with special status

Common Name	*Scientific Name*	ESA	CESA
Leatherback sea turtle	*Dermochelys coriacea*	**E (06-02-70)**	

Table B4. Fish with special status

Common Name	*Scientific Name*	ESA	CESA
Chinook salmon (spring run) Sac Rv and tributaries	*Oncorhynchus tshawytscha*	PT (06-14-04); T (11-15-99)	T (02-05-99)
Chinook salmon (fall/late fall run) Sacramento river	*Oncorhynchus tshawytscha*	Candidate; SC (NMFS)	SSC
Chinook salmon (winter run) Sacramento River	*Oncorhynchus tshawytscha*	PT (06-14-04); E (02-03-94)	E (09-22-89)
Coho salmon (central CA coast ESU)	*Oncorhynchus kisutch*	PE (06-14-04); T (12-02-96)	E (12-31-95)
Steelhead (central CA coast ESU) Russian Rv to Soquel Creek	*Oncorhynchus mykissirideus*	PT (06-14-04): T (10-17-97)	
Steelhead (south/cen CA coast ESU) Pajaro Rv to Santa Maria Rv	*Oncorhynchus mykisirideuss*	PT (06-14-04): T (10-17-97)	
Tidewater goby	*Eucyclogobius newberryi*	E (02-04-94)	SSC (QE)
Pacific lamprey	*Lampetra tridentata*	SC (FWS)	
White sturgeon	*Acipenser transmontanus*	E (09-06-94)	
Green sturgeon	*Acipenser medirostris*	Candidate; SC (NMFS)	SSC (QT)
Cowcod	*Sebastes levis*	SC (NMFS)	
Bocaccio	*Sebastes paucispinis*	SC (NMFS)	
Eulachon	*Thaleichthys pacificus*		SSC (WL)

Table B5. Invertebrates with special status

Common Name	*Scientific Name*	ESA	CESA
Black abalone	*Haliotis cracherodii*	SC (NMFS)	
Pinto abalone	*Haliotis kamtschatkana*	SC (NMFS)	

Index of the listing codes used in the tables above

FEDERAL LISTING CODES

ESA: Endangered Species Act of 1973 Listing Codes

E	Federally listed as Endangered
T	Federally listed as Threatened
PE	Proposed for federal listing as Endangered
PT	Proposed for federal listing as Threatened
PD	Proposed for federal de-listing
Candidate	Candidate for federal listing as endangered or threatened
SC	Species of Concern

STATE LISTING CODES

CESA: California Endangered Species Act Listing Codes

E	State-listed as Endangered
T	State-listed as Threatened
CE	Candidate for state listing as Endangered
CT	Candidate for state listing as Threatened
SSC	Species of Special Concern
	QE Qualify as Endangered (fish list)
	QT Qualify as Threatened (fish list)
	WL Watch List (fish list)
	FP First Priority (bird list)
	SP Second Priority (bird list)
	TP Third Priority (bird list)

Appendix C: List species likely to benefit from a network of marine protected areas in the Central Coast Study Region. The list includes life history characteristics, habitat and depth zone boundaries, and species status of fishes, mammals, birds, invertebrates, and algae.

KEY

1 = adult, 2 = larva and/or juvenile, 3 = both, 4 = life stage not indicated, B = benthic, D = deepest canyons, E = epibenthic, I = intertidal, J = juvenile, NA = not available, P = planktonic, Pe = pelagic, S = shallow, SS = shallow subtidal, Unk = unknown, MBTA = Migratory Bird Treaty Act, ESA = Endangered Species Act, MLMA = Marine Life Mammal Act, MMPA = Marine Mammal Protection Act, SC = Federally listed Species of Concern

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Fish																												
(Pacific pompano)	*Peprilus*	*simillimus*	Unk	British Columbia	Bahia Magdalena, Baja California	30	300	P																		3		

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Cabezon	*Scorpaenichthys*	*marmoratus*	[i]	Sitka, Alaska	Point Abreojoa, Baja California	0	250	P		2		3	3														2	
Croaker, white	*Genyonemus*	*lineatus*	Unk	Vancouver Island, British Columbia	Bahia Magdalena, Baja California	0	420	P,E	3	1					3													
Eel, wolf-	*Anarrhichthys*	*ocellatus*	Unk	Kodiak Island, Alaska	Imperial Beach, San Diego County, CA	I	600	P				1	1													2		
Flounder, starry	*Platichthys*	*stellatus*	[ii]	Arctic Alaska and the Sea of Japan	Santa Barbara, CA	S	900	P	3						2		1											

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Greenling, kelp	*Hexagrammos*	*decagrammus*	Unk	Aleutian Islands, Alaska	La Jolla, CA	0	150	P				3	3															
Greenling, rock	*Hexagrammos*	*lagocephalus*	Unk	Bering Sea, AK	Pt. Conception, CA	S	-	P				3	3															
Grunion, California	*Leuresthes*	*tenuis*	Unk	San Francisco, CA	Magdalena Bay, Baja California	0	60	P							3													
Guitarfish, shovelnose	*Rhinobatos*	*productus*	Unk	San Francisco, CA	Gulf of California	0	50	B	3						3													
Hagfish, Pacific	*Eptatretus*	*stoutii*	Unk	Southeastern Alaska	Southern CA	30	2600	J						3														

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Halibut, California	*Paralichthys*	*californicus*	700,000 halibut for Central CA	Quillayute River, BC	Magdalena Bay, Baja California	0	300	P	3						3													
Jacksmelt	*Atherinopsis*	*californiensis*	Common	Yaquina, Oregon	Santa Maria Bay, Baja California	S		P			3	3		3														
Lingcod	*Ophiodon*	*elongatus*	[iii]	Kodiak Island, Alaska	Point San Carlos, Baja California	0	1400	P				3	3															
Lizardfish, California	*Synodus*	*lucioceps*	Unk	San Francisco, California	Guaymus, Mexico	5	750	P						3														
Midshipman, plainfin	*Porichthys*	*notatus*	Unk	Sitka, Alaska	Gulf of California	0	1000	P						3														

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Opaleye	*Girella*	*nigricans*	Unk	San Francisco, California	Cape San Lucas, Baja California	0	95	P		2		1	1															
Pricklebacks, monkeyface	*Cebidichthys*	*violaceus*	Unk	Southern Oregon	San Quintin Bay, Baja California	0	80	P		2		1	1															
Prickleback, rock	*Xiphister*	*mucosus*	Unk	Port San Juan, AK	Pt. Arguello Boat Station, CA	0	60	Pe		2		1	1															
Queenfish	*Seriphus*	*politus*	Unk	Yaquina Bay, Oregon	Uncle Sam Bank, Baja California	0	180	P	1					2	3													
Ray, bat	*Myliobatis*	*californica*	Unk	Oregon	Gulf of California	0	150	J	3			1	1		3													

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, aurora	*Sebastes*	*aurora*	Unk	Amphitrite Pt, Vancouver Island	Cedros Island, Baja California	600	1800	P						3					1									
Rockfish, bank[iv]	*Sebastes*	*rufus*	Unk	Washington	Baja California	102	810	P																				
Rockfish, black	*Sebastes*	*melanops*	[v]	Amchitka Island, AK	Paradise Cove, CA	0	1200	P				1	1	2														
Rockfish, black/yellow	*Sebastes*	*chrysomelas*	Unk	Eureka, CA	Isla San Natividad, central Baja California	0	120	P				1	3															
Rockfish, blackgill	*Sebastes*	*melanostomumela nostomus*	Unk	Washington	Baja California	720	1800	P						3			1		1			1			1			

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, blue	*Sebastes*	*mystinus*	Healthy	Bering Sea, AK	Punta Baja, Baja California	0	300	P				3	3	2														
Bocaccio[vi]	*Sebastes*	*paucispinus*	SC	Kruzof Island and Kodiak Island, AK	Punta Blanca, Baja California	0	1050	P						2					3									
Rockfish, brown	*Sebastes*	*auriculatus*	vulnerable	Southeastern Alaska	Hipolito Bay, central Baja California	0	420	P							3					3								
Rockfish, calico	*Sebastes*	*dalli*	Unk	San Francisco, CA	Sebastian Viscaino Bay, Baja California	60	840	P						3					1									
Rockfish, canary	*Sebastes*	*pinniger*	[vii]	Cape San Bartolome, AK	Cape Colnett, Baja California	0	900	P						2					1									

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Chilipepper	*Sebastes*	*goodei*	Unk	Vancouver Island, British Columbia	Magdalena Bay, Baja California	0	1080	P						2					1									
Rockfish, China	*Sebastes*	*nebulosus*	Unk	Kachemak Bay, AK	Redondo Beach and San Miguel Island, CA	36	420	P				1	3															
Rockfish, copper	*Sebastes*	*caurinus*	Severely declined	Gulf of Alaska	central Baja California	0	600	P				1	3	2														
Cowcod	*Sebastes*	*levis*	SC	Usal, CA	Ranger Bank and Guadalupe Island, Baja California	68	1200	P						2					3						1			
Rockfish, darkblotched	*Sebastes*	*crameri*	Unk	Bering Sea, AK	Southern CA	240	1800	P						3					1									

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, flag	*Sebastes*	*rubrivinctus*	Unk	Central Ca	Baja California	100	600	P					3												1			
Rockfish, gopher	*Sebastes*	*carnatus*	Above precautionary threshold	Eureka, CA	San Roque, central Baja California	0	180	P				1	3															
Rockfish, grass	*Sebastes*	*rastrelliger*	Unk	Yaquina Bay, Oregon	Bahia Playa Maria, central Baja California	0	150	P				1	3															
Rockfish, greenblotched	*Sebastes*	*rosenblatti*	Unk	Central Ca	Baja California	200	1300	P						3					1						1			
Rockfish, greenspotted	*Sebastes*	*chlorostictus*	Unk	Copalis Head, WA	Cedros Island, Baja California	160	660	P						2					1						1			

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, greenstriped	*Sebastes*	*elongatus*	Unk	Montague Island, AK	Cedros Island, Baja California	200	1320	P						3						1								
Rockfish, halfbanded	*Sebastes*	*semicinctus*	Unk	Oregon	Baja California	192	1320	P						3						1								
Rockfish, kelp	*Sebastes*	*atrovirens*	Highly exploitable	Timber Cove, northern CA	Punta San Pablo, central Baja California	0	150	P				3	2															
Rockfish, Olive	*Sebastes*	*serranoides*	Declined in abundance	Southern Oregon	Islas San Benitos, central Baja California	0	480	P				3	1	2														
Pacific ocean perch	*Sebastes*	*alutus*	[viii]	Bering Sea, AK	Baja California	180	2100	P											3									

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, pink	*Sebastes*	*eos*	Unk	Oregon	Baja California	250	1200	P						2					1						1			
Rockfish, pinkrose	*Sebastes*	*simulator*	Unk	Northern CA	Baja California	325	960	P						2					1						1			
Rockfish, quillback	*Sebastes*	*maliger*	Unk	Gulf of Alaska	San Miguel Island, CA	75	900	P					3															
Rockfish, redbanded	*Sebastes*	*babcocki*	Unk	Bering Sea, AK	Southern CA	300	1560	P						3					1									
Rockfish, redstripe	*Sebastes*	*proriger*	Unk	Bering Sea, AK	Baja California	300	1200	P											3									

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, rosethorn	*Sebastes*	*helvomaculatus*	Unk	Gulf of Alaska	Baja California	390	1800	P						2					3						1			
Rockfish, rosy	*Sebastes*	*rosaceus*	Unk	Cobb Seamount, WA	Baja California	50	420	P						2					3									
Rockfish, sharpchin	*Sebastes*	*zacentrus*	Unk	Aleutian Islands, Alaska	Southern CA	300	1050	P											3									
Rockfish, shortbelly	*Sebastes*	*jordani*	Unk	British Columbia	Baja California	0	930	P											3									
Rockfish, speckled	*Sebastes*	*ovalis*	Unk	Washington	Baja California	100	1200	P											3									

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, splitnose	*Sebastes*	*diploproa*	Unk	Gulf of Alaska	Baja California	700	1560	P						2					1						1			
Rockfish, squarespot	*Sebastes*	*hopkinsi*	Unk	Oregon	Baja California	60	600	P											3									
Rockfish, starry	*Sebastes*	*constellatus*	Unk	San Francisco, CA	Thetis Bank, Baja California	80	900	P											3									
Rockfish, stripetail	*Sebastes*	*saxicola*	Unk	Gulf of Alaska	Baja California	192	1320	P						3					1									
Rockfish, swordspine	*Sebastes*	*ensifer*	Unk	Central CA	Baja California	250	1420	P						2					1						1			

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Rockfish, tiger	*Sebastes*	*nigrocinctus*	Unk	Gulf of Alaska	Southern CA	200	900	P											3									
Rockfish, treefish	*Sebastes*	*serriceps*	Unk	San Francisco, CA	Cedros Island, Baja California	0	150	P				1	3															
Rockfish, vermilion[ix]	*Sebastes*	*miniatus*	[x]	Vancouver Island, British Columbia	San Benito Islands, Baja California	0	900	P				1	1	2					2						1			
Rockfish, widow[xi]	*Sebastes*	*entomelas*	[xii]	Kodiak Island, Alaska	Todos Santos Bay, Baja California	0	1200	P											3									

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Rockfish, yelloweye	*Sebastes*	*ruberrimus*	[xiii]	Aleutian Islands, Alaska	Baja California	150	1200	P					2						1						1			
Rockfish, yellowtail	*Sebastes*	*flavidus*	Unk	Kodiak Island, Alaska	San Diego, CA	0	1800	P											1									
Sanddab, Pacific	*Citharichthys*	*sordidus*	Unk	Bering Sea, AK	Cape San Lucas, Baja California	30	1800	P						3														
Seabass, white[xiv]	*Genyonemus*	*lineatus*		Vancouver Island, British Columbia	Magdalena Bay, Baja California	0	400	P	2			3	1	2														
Shark, brown smoothhound	*Mustelus*	*henlei*		Huboldt Bay, CA	Gulf of California	0	360	J	3	1				1														

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Shark, gray smoothhound	*Mustelus*	*californicus*		Cape Mendocino, CA	Mazatlan, Mexico	0	150	J	3					1														
Shark, horn	*Heterodontus*	*francisci*	Declined in abundance	Central CA	Baja California	0	492	J				3	3															
Shark, Pacific angel[xv]	*Squatina*	*californica*	Recovering, limits on catch	southern Alaska	Baja California	3	600	J						3														
Shark, leopard	*Triakis*	*semifasciata*	Unk	Oregon	Mazatlan, Mexico	0	300	J	3			3			3													
Sheephead, California	*Semicossyphus*	*pulcher*	Unk	Monterey Bay, CA	Gulf of California	0	180	P				3	3															

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Skate, big	*Raja*	*binoculata*	Unk	Bering Sea, AK	Bahia de San Quintin, Baja California	10	360	J					1	3														
Skate, California	*Raja*	*inornata*	Unk	Strait of Juan de Fuca, BC	Baja California	60	2200	J						3														
Skate, longnose	*Raja*	*rhina*	Unk	Southeastern Alaska	Central Baja California	180	2040	J						3														
Smelt, night	*Spirinchus*	*starksi*	Unk	Shelikof Bay, AK	Point Arguello, Ca	0	420	P						2	1													
Smelt, surf	*Hypomesus*	*pretiosus*	Unk	Prince William Sound, Gulf of Alaska	Long Beach, CA	S	-	P						2	1													

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Smelt, whitebait	*Allosmerus*	*elongatus*	Unk	Strait of Juan de Fuca, BC	San Francisco Bay, Ca	0	180	P	1					2	1													
Sole, Dover	*Microstomus*	*pacificus*	Unk	Bering Sea, AK	San Cristobal Bay, Baja California	60	3000	P								3												
Sole, English	*Pleuronectes*	*vetulus*	Unk	Bering Sea, AK	San Cristobal Bay, Baja California	60	1000	P						1	2	2												
Sole, petrale	*Eopsetta*	*jordani*	Unk	Gulf of Alaska	Cedros Island, Baja California	60	1500	P							3	3				3	3							
Sole, rex	*Errex*	*zachirus*	Unk	Bering Sea and Aleutian Islands, AK	San Cristobal Bay, Baja California	60	2100	P							3	3	3											

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Sole, rock	*Pleuronectes*	*bilineatus*	Unk	Bering Strait	Tanner Bank, southern Ca	50	1200	P							3	3	3											
Sole, sand	*Psettichthys*	*melanostictus*	Unk	Bering Sea and Aleutian Islands, AK	Redondo Beach, CA	5	312	P	2						3													
Sole, slender	*Lyopsetta*	*exilis*	Unk	Alsek Canyon, southeastern Alaska	Isla Cedros, central Baja California	250	1700	P							3	3	3											
Surfperch, barred	*Amphistichus*	*argenteus*	Unk	Bodega Bay, CA	Plaza Maria Bay, Baja California	0	240	NA		3																		
Surfperch, black	*Embiotoca*	*jacksoni*	Unk	Northern CA	Baja California	0	130	NA				3	3															

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Surfperch, calico	*Amphistichus*	*koelzi*	Unk	Cape Flattery, WA	Baja California	0	30	NA		3																		
Surfperch, pile	*Rhacochilus*	*vacca*	Unk	Alaska	Baja California	0	240	NA				3	3	3														
Surfperch, rainbow	*Hypsurus*	*caryi*	Unk	Cape Mendocino, CA	northern Baja California	0	130	NA				3	3															
Surfperch, redtail	*Amphistichus*	*rhodoterus*	Unk	Vancouver Island, British Columbia	Monterey Bay, CA	0	60	NA		3																		
Surfperch, rubberlip	*Rhacochilus*	*toxotes*	Unk	Russian Gulsh State Beach, CA	Thurloe Head, Baja California	0	150	NA				3	3	3														

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Surfperch, shiner	*Cymatogaster*	*aggregata*	Unk	Port Wrangell, AK	San Quintin Bay, Baja California	0	480	NA	3			3	3	3														
Surfperch, striped	*Embiotoca*	*lateralis*	Unk	Alaska	Baja California	0	55	NA				3	3															
Surfperch, walleye	*Hyperprosopon*	*argenteum*	Unk	Vancouver Island, British Columbia	Point San Rosarito, Baja California	0	60	NA		3																		
Surfperch, white	*Acipenser*	*transmontanus*	Unk	Gulf of Alaska	Ensenada, Baja California	0	140	NA				3	3	3														
Thornyhead, longspine	*Sebastolobus*	*altivelis*	Unk	Bering Sea and Aleutian Islands, AK	Baja California	1090	5000	P									3	2				3	2					

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Thornyhead, shortspine[xvi]	*Sebastolobus*	*alascanus*	Unk	Bering Sea and Aleutian Islands, AK	Cedros Island, Baja California	84	5000 +	P									3	2				3	2					
Tomcod, Pacific	*Microgadus*	*proximus*	Unk	Unalaska Island, AK	Point Sal, CA	0	720	P						1														
Topsmelt	*Atherinops*	*affinis*	Unk	Vancouver Island, British Columbia	Gulf of California	S	-	P		3	3	3		3														
Turbot, C-O	*Pleuronichthys*	*coenosus*	Unk	Alaska	Baja California	S	966	P					3		3	3												
Turbot, curlfin	*Pleuronichthys*	*decurrens*	Unk	Alaska	Baja California	25	1146	P						3	3													

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Whitefish, ocean[xvii]	*Caulolatilus*	*princeps*	Unk	British Columbia and Southeast Alaska	Peru and Chile	0	300	P						3					3									
Mammals																												
Whale, Right[xviii]	*Eubalaena*	*japonica*	ESA, MMPA	Alaska	Baja California, Mexico	NA	NA	NA																				
Whale, Blue	*Balaenoptera*	*musculus*	ESA, MMPA	British Columbia	Baja California, Mexico and the Costa Rican dome	NA	NA	NA							3	3	3			3	3	3				3		
Whale, Finback[xix]	*Balaenoptera*	*physalus*	ESA, MMPA	Bering Sea	Cabo San Lucas, Baja California, Mexico	NA	NA	NA																				

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Whale, Humpback[xx]	*Megaptera*	*novaeangliae*	ESA, MMPA	Washington	Central America	NA	NA	NA							3	3	3			3	3	3						
Sea Lion, Steller[xxi]	*Eumetopias*	*jubatus*	ESA, MMPA	Aleutian Islands/Gulf of Alaska	Ano Nuevo Island	NA	NA	NA							3	3	3			3	3	3				3		
Sea Otter, Southern[xxii]	*Enhydra*	*lutris nereis*	ESA, MMPA	Pigeon Point	Point Conception	20	100	NA	3			3	3	3												3		
Seal, Northern Pacific Fur[xxiii]	*Callorhinus*	*ursinus*	MLMA	Mid-latitudes off western N. America	Mid-latitudes off western N. America			NA							3	3	3			3	3	3				3		

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Birds																												
Petrel, Fork Tailed Storm[xxiv]	*Oceanodroma*	*furcata*	MBTA	S. Alaska	N. CA	NA	NA	NA							4	4										4		
Pelican, Brown[xxv]	*Pelecanus*	*occidentalis*	MBTA, ESA	British Columbia	Chile	NA	NA	NA																				
Puffin, Tufted[xxvi]	*Fratercula*	*cirrhata*	MBTA	Alaska	California	NA	NA	NA																		4		
Murrelet, Marbled[xxvii]	*Brachyramphus*	*marmoratus*	MBTA, ESA	Alaska	California	NA	NA	NA																				

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Murrelet, Xantus's	*Synthliboramphus*	*hypoleucus*	MBTA	Washington	Baja California, Mexico	NA	NA	NA																				
Shearwater, Sooty[xxviii]	*Puffinus*	*griseus*	MBTA	North Pacific	North Pacific	NA	NA	NA																				
Gull, Western[xxix]	*Larus*	*occidentalis*	MBTA	Washington	Baja California, Mexico	NA	NA	NA	4																			
Mure, Common[xxx]	*Uria*	*aalge*	MBTA	Arctic costs	S. CA	NA	NA	NA																				

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Auklet, Cassin's	*Ptychoramphus*	*aleuticus*	MBTA	Alaska	Mexico	NA	NA	NA								4					4					4		
Phalarope, Red-necked[xxxi]	*Phalaropus*	*lobatus*	MBTA	Alaska	migrates along Pacific Coast	NA	NA	NA																			4	
Phalarope, Red[xxxii]	*Phalaropus*	*fulicarius*	MBTA	Alaska	irregular along Pacific Coast	NA	NA	NA																			4	

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Invertebrates																												
Crab, box	*Lopholithodes*	*foraminatus*	NA	Kodiak Island, Alaska	San Diego, California	I	600	P		3			3	3					3						3			
Crab, brown rock	*Cancer*	*antennarius*	NA	Sequim, Washington	Baja California, Mexico	I	>100	P		4		3	3	4														
Crab, Dungeness	*Cancer*	*magister*	NA	Aleutian Islands	Point Conception	I	230	P	2	4	3			3														
Crab, red rock	*Cancer*	*productus*	NA	Kodiak Island, Alaska	San Deigo, California	I	>91	P	3	4			3	4											3			

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Crab, sand	*Emerita*	*analoga*	NA	Alaska	Baja California, Mexico	I	SS	P		3				3														
Prawn, spot	*Pandalus*	*platyceros*	NA	Alaska	Baja California, Mexico	Il	488	P		4			3	2											3			
Shrimp, ghost and mud shrimp (several species)	*(family Callianassidae)*		NA	All regions (in CA)		I		P		4				3														
Shrimp, ocean	*Pandalus*	*jordani*	NA	Oregon Border	Point Arguello	45	366	P						3														

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Urchin, purple[xxiii]	*Strongylocentrotus*	*purpuratus*	NA	Vancouver Island	Baja California, Mexico	0	92	P				3	3															
Urchin, red	*Strongylocentrotus*	*franciscanus*	NA	Gulf of Alaska	Baja California, Mexico	I	153	P		4		3	3															
Abalone, black	*Haliotis*	*cracherodii*	SC	Mendocino County, CA	Baja California, Mexico	I	6	P		4		3	3, 2															
Abalone, flat	*Haliotis*	*walallensis*	SC	British Columbia	San Deigo, California	6	21	P				3	3, 2															

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Abalone, pinto	*Haliotis*	*kamtschatkana*	SC	Sitka, Alaska	Monterey, CA	I	21	P		4		3	3, 2															
Abalone, red[xxxiv]	*Haliotis*	*rufescens*	SC	Sunset Bay, OR	Baja California, Mexico	I	30	P		4		3	3, 2															
Clam, California jackknife	*Tagelus*	*californianus*	NA	South, mainland, and islands		I		P	3	4				3														
Clam, chione (several species)	*(Family Veneridae)*		NA	South, mainland, and islands		I	50	P	3	4				3														

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Clam, littleneck [xxxv]	*Protothaca*	*staminea*	NA	Aleutian Islands	Baja California, Mexico	I		P	3	4				3														
Clam, gaper (several	*Tresus*	*capax & nuttallii*	NA	Kodiak Island, Alaska	San Francisco, CA	I	46	P	3	3	3			3														
Clam, geoduck	*Panopea*	*abrupta*	NA	Alaska	Baja California, Mexico	I	110	P	4	4				3														
Clam, Manila	*Tapes*	*philippinarum*	NA	All regions (in CA)		I		P	3	4				3														
Clam, Pismo	*Tivela*	*stultorum*	NA	Monterey Bay, CA	Baja California, Mexico	I	25	P		4				3														

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Clam, razor	*Siliqua*	*patula*	NA	Alaska	San Luis Obispo, CA	I	SS	P		4				3														
Clam, softshell	*Mya*	*arenaria*	NA	Alaska	Elkhorn Slough, CA	I		P	4	4				4														
Clam, Washington [xxxvi]	*Saxidomus*	*nuttalli, giganteus*	NA	Humboldt Bay, CA	Baja California, Mexico	I	30	P	3	3				3														
Cockles	*(Family: Cardiidae)*		NA	All regions (in CA)		I	201	P	3	4				3														
Limpets			NA	All regions (in CA)		I	30	P		4			3															

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Mussels[xxxvii]			NA	All regions (in CA)		I	40	P		4			3															
Octopus			NA	All regions (in CA)		I	200	P		4		3	3	3														
Scallop, rock[xxxviii]	*Crassadoma*	*gigantea*	NA	Sitka, Alaska	Magdalena Bay, Baja California, Mexico	I	30	P		4			3															
Sea hare (two species)	*Aplysia*	*californica, vaccaria*	NA	Northern CA	Baja California, Mexico	0	18	P				3		3					3									

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Sea stars (many species)	(*Family Asterinidae*)		NA	All regions (in CA)		*Intertidal*	D	P		4			3	3					3									
Snail, moon	*Polinices*	*lewisii*	NA	All regions (in CA)		0	152	P						3														
Snail, turban (several species)	*(Family Trochidae)*		NA	All regions (in CA)		I	76	P		4		3	3, 2															
Worms (polychaetes)	*(Class Polychaeta)*		NA	All regions (in CA)		I	D	P		4			3	3														

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Algae																												
Gelidium sp. (many species)	*Gelidium*	*sp.*	NA	All regions (in CA)		I	30	NA					3															
Gracilaria sp.	*Gracilaria*	*sp.*	NA	All regions (in CA)		I	15	NA						3														
Porphyra sp.	*Porphyra*	*sp.*	NA	All regions (in CA)		I	30	NA					3															
Sea palm[xxxix]	*Eisenia*	*arborea*	NA	British Columbia	Baja California, Mexico	I	-	NA					3															
Kelp, giant	*Macrocystis*	*pyrifera*	NA	Santa Cruz	Turtle Bay, Mexico	6	37	NA					3	3					3									

Common Name	Genus	Specific epithet	Status	N Range Endpoint	S Range Endpoint	Shallow depth (m)	Deepest depth (m)	Larval type	Estuaries	Intertidal , Shallow Subtidal	Seagrass	Kelp Forest	Rocky Reef	Soft Bottom Undefined	Soft Bottom (30-100 m)	Soft Bottom (100-200 m)	Soft Bottom (200-3000 m)	Soft Bottom (>3000 m)	Hard Bottom Undefined	Hard Bottom (30-100 m)	Hard Bottom (100-200 m)	Hard Bottom (200-3000 m)	Hard Bottom (>3000 m)	Underwater pinnacles	Submarine canyon	Pelagic	Upwelling areas	Freshwater plume
Kelp, bull	*Nereocystis*	*luetkeana*	NA	Alaska	Southern CA	3	18	NA					3						3									

Sources:

Fish - CDFG 2004, CDFG 2003**,** CDFG 2001**,** Aquarium 1999-2006**,** eNature 2005**,** Wang 1986**,** D'Vincent 1980**,** Wildlife 2005**,** CDFG 2005a**,** AFSC 2005b**,** P. F. M. Council (Council) 2006

Inverts, Kelp, Mammals - CDFG 2001, Aquarium 1999-2006, eNature 2005, Oregon Department of Fish and Wildlife (Wildlife) 2005, Seafood Network Information Center 2005, Society 2005a, NatureServe Explorer 1996 &1994, California Resources Agency 2001, Fish and Wildlife Service (Service) 2002, Farallones Marine Sanctuary Association 2005, CDFG 2005a, NMFS 2002, Fish and Wildlife Service (Service) 1989a, Fish and Wildlife Service (Service) 1989b, Fish and Wildlife Service (Service) 1989c, Scott 2000, AFSC 2005a, Pacific States Marine Fisheries Commission (Commission) 1996, AFSC 2005b, Museum 2005, Department of Biological Science 1997, NOAA Fisheries 2005, OBIS - SEAMAP 2005, University (Oregon State) 1997, Cowles 2002, Seattle Audubon Society (Society) 2005b

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[i] Northern CA substock: 40.1% depleted; southern CA substock: 28.3% depleted.

[ii] Both northern and southern stocks are well above the precautionary threshold (62% virgin spawning biomass).

[iii] Current estimate of female spawning biomass is 13 percent of the un-fished level.

[iv] Adults live in midwater over hard bottom drop offs, juveniles live in midwater.

[v] Infrequently observed south of Eureka area.

[vi] Adults are found midwater over hard bottom.

[vii] Estimates of 1999 spawning population sizes were 6-23 percent of historically unfished levels. In 1999, the canary rockfish resource off the entire U.S. West Coast was declared overfished.

[viii] Spawning stock biomass in 2003 was near 25% of the unfished biomass but well under the recovered status, set at 40%.

[ix] Adults found in wide depth range.

[x] Only lower bound model for S. CA indicates adundance to be in the precautionary zone (30% in 2005).

[xi] Adults and juveniles found midwater over hard bottom.

[xii] The stock was recently declared over fished by the Pacific Fishery Management Council because spawning potential was reduced to below 25 percent of the unfished condition. In response, a rebuilding plan for the stock will be implemented in 2002.

[xiii] Current yelloweye stock biomass is about 7% of unexploited biomass (the average stock size if there was no fishing) in northern California, and 13% of unexploited biomass in Oregon; declared overfished in 2002.

[xiv] Additionally, juveniles can be found in piers and jetties and adults can be found in offshore banks and open ocean.

[xv] Adults are also found in sand channels between reefs.

[xvi] Unknown juvenile habitat preference.

[xvii] Adults found midwater over hard and soft bottom.

[xviii] Gulf of Alaska, Go to colder waters for feeding and warmer (coastal) waters for breeding and calving.

[xix] Both pelagic and coastal habitats are stated to be this species' main habitat.

[xx] Most numerous pelagic baleen whale sighted in Central Coast Biogeographic Assessment; more frequently sighted off central California from March through November, with peaks in the summer and fall.

[xxi] Ano Nuevo is southernmost rookery; females and pups are found at the rookeries year-round, but adult bulls are only at the rookery during the breeding season.

[xxii] 3 - rarely venture much more than about 1 1/2 miles (3km) offshore.

[xxiii] Rookeries located on Pribilof Islands (Bering Sea), San Miguel Island (S. CA), and south Farallon Island.

[xxiv] Storm-petrels flutter low over offshore waves, sometimes in flocks, where they pluck food from the water's surface. They also feed while swimming.

[xxv] Found over waters within several miles of shore; mean depth where they occur is 266 ± 21 m; frequent shallow marine areas such as bays, offshore islands, spits, breakwaters, and open sandy beaches.

[xxvi] 4 - Breed in coastal habitats.

[xxvii] Forage in water < 30 m deep.

[xxviii] Most abundant marine bird in CA during upwelling season. Continental shelf and upper slope; mean depth where they occur is 380 +/- 10 m .

[xxix] Found in coastal areas and offshore.

[xxx] Second most abundant marine bird in central CA; outside of the breeding season, Common Murres are almost always seen in the water; can dive more than 150 feet below the water's surface. Shelf and upper slope; mean depth is 110± 5 m; found in coastal areas and offshore.

[xxxi] In open ocean, also gather at convergence zones for food; sometimes migrate over coastal marshes.

[xxxii] In open ocean, also gather at convergence zones for food; sometimes migrate over coastal marshes; usually occur farther offshore than Red-necked Phalaropes.

[xxxiii] 2 - Under canopy of adults

[xxxiv] 2 -Under canopy of red urchins

[xxxv] 3 - Open coast

[xxxvi] 3 - Bays, lagoons

[xxxvii] 3 - Pilings

[xxxviii] 3 - Pier pilings, rock jetties

[xxxix] Exposed rocky reefs

Appendix D: *Adopted Regional Goals and Objectives Package* of the California Marine Life Protection Act Initiative Central Coast Project.

Amended by the MLPA Blue Ribbon Task Force on November 30, 2005. Accessed from http://www.dfg.ca.gov/mrd/mlpa/draftdocuments.html on March 10, 2006.

Provisional Regional Objectives

Goal 1. To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems.

1. Protect areas of high species diversity and maintain species diversity and abundance, consistent with natural fluctuations, of populations in representative habitats.
2. Protect areas with diverse habitat types in close proximity to each other.
3. Protect natural size and age structure and genetic diversity of populations in representative habitats.
4. Protect natural trophic structure and food webs in representative habitats.
5. Protect ecosystem structure, function, integrity and ecological processes to facilitate recovery of natural communities from disturbances both natural and human induced.

Goal 2. To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.

1. Help protect or rebuild populations of rare, threatened, endangered, depleted, or overfished species, where identified, and the habitats and ecosystem functions upon which they rely.
2. Protect larval sources and restore reproductive capacity of species most likely to benefit from MPAs through retention of large, mature individuals.
3. Protect selected species and the habitats on which they depend while allowing the harvest of migratory, highly mobile, or other species where appropriate through the use of state marine conservation areas and state marine parks.

Goal 3. To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbances, and to manage these uses in a manner consistent with protecting biodiversity.

1. Ensure some MPAs are close to population centers and research and education institutions and include areas of traditional non-consumptive recreational use and are accessible for recreational, educational, and study opportunities.
2. To enhance the likelihood of scientifically valid studies, replicate appropriate MPA designations, habitats or control areas (including areas open to fishing) to the extent possible.

3. Develop collaborative scientific monitoring and research projects evaluating MPAs that link with fisheries management information needs, classroom science curricula, volunteer dive programs, and fishermen of all ages, and identify participants.
4. Protect or enhance recreational experience by ensuring natural size and age structure of marine populations.

Goal 4. To protect marine natural heritage, including protection of representative and unique marine life habitats in central California waters, for their intrinsic value.

1. Include within MPAs the following habitat types: estuaries, heads of submarine canyons, and pinnacles.
2. Protect, and replicate to the extent possible, representatives of all marine habitats identified in the MLPA or the Master Plan Framework across a range of depths.

Goal 5. To ensure that central California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.

1. Minimize negative socio-economic impacts and optimize positive socio-economic impacts for all users, to the extent possible, and if consistent with the Marine Life Protection Act and its goals and guidelines.
2. For all MPAs in the region, develop objectives, a long-term monitoring plan that includes standardized biological and socioeconomic monitoring protocols, and a strategy for MPA evaluation, and ensure that each MPA objective is linked to one or more regional objectives.
3. To the extent possible, effectively use scientific guidelines in the Master Plan Framework.

Goal 6. To ensure that the central coast's MPAs are designed and managed, to the extent possible, as a component of a statewide network.

1. Develop a process for regional review and evaluation of implementation effectiveness that includes stakeholder involvement to determine if regional MPAs are an effective component of a statewide network.
2. Develop a mechanism to coordinate with future MLPA regional stakeholder groups in other regions to ensure that the statewide MPA network meets the goals of the MLPA.

Design and Implementation Considerations

Design Considerations

1. In evaluating the siting of MPAs, considerations shall include the needs and interests of all users.
2. Recognize relevant portions of existing state and federal fishery management areas and regulations, to the extent possible, when designing new MPAs or modifying existing ones.
3. To the extent possible, site MPAs to prevent fishing effort shifts that would result in serial depletion.
4. When crafting MPA proposals, include considerations for design found in the Nearshore Fishery Management Plan and the draft Abalone Recovery and Management Plan.
5. In developing MPA proposals, consider how existing state and federal programs address the goals and objectives of the MLPA and the central coast region as well as how these proposals may coordinate with other programs.
6. To the extent possible, site MPAs adjacent to terrestrial federal, state, county, or city parks, marine laboratories, or other "eyes on the water" to facilitate management, enforcement, and monitoring.
7. To the extent possible, site MPAs to facilitate use of volunteers to assist in monitoring and management.
8. To the extent possible, site MPAs to take advantage of existing long-term monitoring studies.
9. To the extent possible, design MPA boundaries that facilitate ease of public recognition and ease of enforcement.

Implementation Considerations

1. Improve public outreach related to MPAs through the use of docents, improved signage, and production of an educational brochure for central coast MPAs.
2. When appropriate, phase the implementation of central coast MPAs to ensure their effective management, monitoring, and enforcement.
3. Ensure adequate funding for monitoring, management, and enforcement is available for implementing new MPAs.
4. Develop regional management and enforcement measures, including cooperative enforcement agreements, adaptive management, and jurisdictional maps, which can be effectively used, adopted statewide, and periodically reviewed.

Appendix E: Application of conservation targets and socioeconomic considerations to the *Adopted Regional Goals and Objectives Package* of the California Marine Life Protection Act Initiative. A check indicates that the target/data contributes to meeting the specific goal, objective, or design consideration. The *Regional Goals and Objectives Package* is provided in Appendix D.

Table E1. How the *Goals and Objectives* correspond to the biophysical targets in MARXAN.

BiophysicalGoals / Objectives as Identified in Appendix D: Targets	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**3.1**	**3.1**	**3.3**	**3.4**	**4.1**	**4.2**	**5.1**	**5.2**	**5.3**	**6.1**	**6.2**
Rocky reef (granite – Pt. Pinos to Pt. Sur)	✓			✓	✓	✓								✓		✓	✓		
Rocky reef (sandstone and shale – Monterey Bay to Pigeon Point)	✓			✓	✓	✓								✓		✓	✓		
Rocky reef (Franciscan Complex – Pt. Sur to Pt. Conception)	✓			✓	✓	✓								✓		✓	✓		
Sandy or soft ocean bottoms	✓			✓	✓	✓								✓		✓	✓		
Underwater pinnacles	✓			✓	✓	✓							✓	✓		✓	✓		
Kelp forest (Bull)	✓			✓	✓	✓								✓		✓	✓		
Kelp forest (Giant)	✓			✓	✓	✓								✓		✓	✓		
Submarine canyons	✓			✓	✓	✓							✓	✓		✓	✓		
Eelgrass beds	✓			✓	✓	✓	✓							✓		✓	✓		
Surfgrass beds	✓			✓	✓	✓	✓							✓		✓	✓		
Large estuaries (Elkhorn Slough and Morro Bay) with eelgrass beds, tidal flats, and coastal marsh	✓			✓	✓	✓	✓						✓				✓		
Small estuaries with presence of coho or steelhead populations	✓			✓	✓	✓	✓						✓	✓			✓		

BiophysicalGoals / Objectives as Identified in Appendix D: Targets	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**3.1**	**3.1**	**3.3**	**3.4**	**4.1**	**4.2**	**5.1**	**5.2**	**5.3**	**6.1**	**6.2**
Submarine canyon heads and large submarine canyons	✓			✓	✓	✓							✓	✓			✓		
Persistent kelp beds	✓			✓	✓	✓								✓			✓		
Areas of high bathymetric complexity	✓	✓		✓	✓														
Shallow and deep pinnacles	✓			✓	✓	✓							✓	✓					
Rocky substrata in all depth zones	✓			✓	✓									✓					
Shelf-slope break (100-200m)	✓			✓	✓														
Rocky intertidal shores	✓			✓	✓	✓								✓					
Seabird colonies	✓			✓	✓	✓													
Areas of high fish diversity and density (top 20th percentile)	✓			✓	✓		✓	✓											
Areas of high seabird diversity and/or density (top 20th percentile)	✓			✓	✓														
Marine mammal rookeries	✓			✓	✓	✓													
Marine mammal haulouts	✓			✓	✓	✓													
Sea otters	✓			✓	✓	✓													

Table E2. How the *Goals and Objective* correspond to the socioeconomic considerations used in MARXAN.

Socioeconomic Goals/Objectives: Considerations	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**3.3**	**3.4**	**4.1**	**4.2**	**5.1**	**5.2**	**5.3**	**6.1**	**6.2**
INFRASTRUCTURE:																			
Population centers									✓						✓		✓		
Marine research institutions									✓								✓		
Monitoring sites										✓	✓					✓	✓		
Parks									✓						✓		✓		
FISHING:																			
Commercial fishing areas of relative importance															✓		✓		
Recreational fishing effort															✓		✓		

Table E3. How the *Design Considerations* correspond to the socioeconomic considerations used in MARXAN.

Socioeconomic Design Considerations: Considerations	1	2	3	4	5	6	7	8	9
INFRASTRUCTURE:									
Population centers	✓			✓		✓	✓		
Marine research institutions	✓			✓		✓		✓	
Monitoring sites	✓								
Parks	✓					✓	✓		
FISHING:									
Commercial fishing areas of relative importance	✓								
Recreational fishing effort	✓								

Appendix F: Parameters used in MARXAN's input parameter file.

The following is a list of the parameters set in the input parameter file in MARXAN. The input file contains all of the main parameter definitions that control the way in which MARXAN works. The titles of the sections and names of the parameters are listed as seen in Inedit.exe, the windows program used to create the input file.

<u>Problem</u>

Repeat Runs: 100

Boundary Modifier: Various values ranging from 0 to 1.

Input File Type: New Freeform Style

<u>Run Options</u>

Simulated Annealing, Summed Irreplaceability, Heuristic, and Normal Iterative Improvement.

<u>Annealing</u>

Number of Iterations: 5,000,000

Temperature Decreases: 10,000

Activated Adaptive Annealing

<u>Input</u>

Five files were used in each of the scenarios: Species, Planning Unit, Planning unit Versus Species, Block Definitions, and Boundary Length

<u>Output</u>

Screen Output: General Progress

Species missing if proportion of target lower than 0.95.

<u>Cost Threshold</u>

Cost Threshold: Not enabled

<u>Miscellaneous</u>

Starting Prop: 0

Specified Random Seed: -1

Appendix G: Overview of the biophysical data used in MARXAN and data analysis procedures conducted in ArcGIS for use in MARXAN.

We used the California Department of Fish and Game's (CDFG) microblocks in state waters as the planning units for this project. The study area includes 1381 microblocks. We chose the microblocks as the planning units for this study because they were the standard analysis units used in the MLPA Initiative. The microblocks are typically one nautical mile square, but their shape and size vary on the coast and at the border with federal waters. Using ArcGIS, the CDFG's microblocks were clipped to the study region and the biophysical data were divided into microblocks for use in MARXAN. An overview of the analysis is presented in this appendix.

The biophysical data layers were available as either a feature class or raster. Data in the form of a feature class was a point, line, or polygon. Table G1 lists the format of the biophysical data used in this project. All data was obtained from the California Marine Geodatabase developed by the MLPA Initiative's GIS group.

Table G1. Format and source of the data layers used in this project.

Data	Format	Source
Submarine Canyons	**Feature - Polygon**	Moss Landing Marine Laboratories
Kelp Forests Union ('89, '99, '02)	**Feature - Polygon**	ECOSCAN Resources/CDFG
Persistent Kelp Forest	**Feature - Polygon**	ECOSCAN Resources/CDFG
Eelgrass Beds	**Feature - Polygon**	TNC, Humbolt Bay Atlantas, CDFG, NOAA
Shelf-Slope Break	**Feature - Polygon**	Pacific States Marine Fisheries Commission
Sea Otter Density	**Feature - Polygon**	Long Marine Laboratory
Estuaries	**Feature - Polygon**	TNC
Fish Diversity and Density	**Feature - Polygon**	NOAA
Fine Scale Substrate	**Feature - Polygon**	USGS, California State University, Monterey Bay
Seabird Diversity and Density	**Feature - Polygon**	NOAA
Coarse Scale Substrate	**Feature - Polygon**	Moss Landing Marine Laboratories
Shoreline Classification	**Feature - Line**	NMS
Surfgrass Beds	**Feature - Line**	MMS
Underwater Pinnacles	**Feature - Point**	CDFG

Data	Format	Source
Marine Mammal Rookeries	**Feature - Point**	NOAA
Seabird Colonies	**Feature - Point**	NOAA/USFWS
Marine Mammal Haulouts	**Feature - Point**	NOAA
Salmonids	**Feature - Point**	TNC
Bathymetric Complexity	**Raster – 200 m^2 grid cell**	TNC

Feature Data

Each feature data set was clipped to the Central Coast Study Region for analysis. Each layer was analyzed differently, depending on the type (i.e. feature, line, point) of data and the objectives outlined by the SAT in the MLPA Master Plan Framework and CCRSG in the Central Coast Regional Profile. The following zones were identified by the SAT as key depth zones in the study region: intertidal, intertidal – 30 m, 30 – 100 m, 100 – 200 m, and >200 m (CDFG 2005b). Data layers that represent habitats identified by the SAT (identified with a * below) and contain habitats that exist in more than one depth zone were divided into those depth zones. The depth zone polygons used to clip the data were created from a MLPA depth zone shapefile. Each depth zone in this file (intertidal – 30 m, 30 – 100 m, 100 – 200 m, and >200 m) was selected and exported as a new file and used to clip the biophysical data. Intertidal substrate was analyzed separately using the shoreline classification data.

*Submarine Canyons**

After separating the data into the four deepest depth zones, each zone was converted from a feature class to a raster (grid cell = 20 m^2). Each raster was reclassified to designate grid cells with a canyon as a 1 (indicating presence of a canyon) and grid cells without a canyon as a 0 (indicating absence of a canyon). Zonal statistics were performed on each reclassified raster to determine the portion of grid cells containing a canyon per planning unit (i.e. “mean” in the GIS zonal statistics output). The mean was multiplied by the area of the planning unit to obtain the area of canyon in each planning unit.

*Kelp Forest**

Kelp exists in the intertidal – 30 m and 30 – 100 m zones and was clipped to these zones. Each zone was separated into two parts, north and south of Sand Hill Bluff near Davenport, CA (CDFG 2005a), because each region is dominated by a different species of kelp forest. The northern region is dominated by bull kelp and the southern region is dominated by giant kelp. Each zone was converted from a feature class to a raster (grid cell = 10 m^2). Each raster was reclassified to designate grid cells with kelp as a 1 and grid cells without kelp as a 0. Zonal statistics were performed on each reclassified raster to determine the portion of grid cells containing bull kelp or giant kelp per planning unit (i.e. “mean” in the GIS zonal statistic output).

The mean was multiplied by the area of the planning unit to obtain the area of bull kelp or giant kelp in each planning unit.

*Persistent Kelp Fores*t

The data were converted from a feature to a raster (grid cell = 5 m^2). The raster was reclassified to designate grid cells with kelp as a 1 and grid cells without kelp as a 0. Zonal statistics was performed on each reclassified raster to determine the portion of grid cells containing kelp per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of kelp in each planning unit.

Shelf-Slope Break (100-200 m)

From the depth zone layer, the shelf II (100-200 m) zone was selected and exported as a new feature. The layer was converted from a feature to a raster (grid cell = 10 m^2). The raster was reclassified to designate all areas within the layer as a 1 and all other areas as a 0. Zonal statistics were performed on the raster to determine the portion of grid cells containing shelf-slope break per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of shelf-slope break in each planning unit.

Sea Otter Density

The layer was converted from a feature to a raster (grid cell = 10 m^2). The raster was reclassified to designate any area with sea otters as 1 and areas without sea otters as a 0 . Zonal statistics were performed on the raster to determine the portion of grid cells containing sea otters per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of sea otter occurrences in each planning unit.

Estuaries

Elkhorn Slough and Morro Bay were selected and exported as new layer because they were identified as estuaries of biodiversity significance by the CCRSG (CDFG 2005c). The layer was converted from a feature to a raster (grid cell = 10 m^2) and reclassified to designate any area with an estuary as a 1 and areas without an estuary as a 0. Zonal statistics was performed on the raster to determine the portion of grid cells containing an estuary per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of estuary in each planning unit.

Fish Diversity and Density

The data represents the top 20th percentile region of highest diversity and density of fish. The data were converted from a feature class to a raster (grid cell = 10 m^2). The raster was reclassified two times: 1) Grid cells that were in areas of high diversity and both high diversity and density were designated with a 1 and all other grid cells were designated with a 0; 2) Grid cells that were in areas of high density and "both" were designated with a 1 and all other grid cells were designated with a 0. Zonal statistics were performed on both of the reclassified raster layers to determine the portion of grid cells containing high diversity and density per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of high fish diversity and high fish density in each planning unit.

Seabird Diversity and Density

The data represent the top 20th percentile region of highest diversity and density of seabirds.. The data were converted from a feature class to a raster (grid cell = 10 m^2). The raster was reclassified two times: 1) Grid cells that were in areas of high diversity and "both" were designated with a 1 and all other grid cells were designated with a 0; and 2) Grid cells that were in areas of high density and "both" were designated with a 1 and all other grid cells were designated with a 0. Zonal statistics were performed on both of the reclassified raster layers to determine the portion of grid cells containing high diversity and density per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of high seabird diversity and high seabird density in each planning unit.

*Eelgrass Beds**

The data were converted from a feature class to a raster (grid cell = 10 m^2) and the raster was reclassified to designate grid cells with eelgrass as a 1 and grid cells without eelgrass as a 0. Zonal statistics were performed on the reclassified raster to determine the portion of grid cells containing eelgrass per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of eelgrass in each planning unit.

*Fine and Coarse Scale Substrate**

Before clipping the data to each of the depth zones, the two data layers were merged together using the update feature in ArcGIS. This was done because the fine scale data were not comprehensive across the study region, but was more accurate than the coarse scale data, when present. Since the fine scale data were more accurate and there was a comprehensive coarse scale layer across the study region, the coarse scale data were updated with the fine scale data. In other words, the areas containing fine scale data were represented in place of the coarse scale data. In order to conduct the update feature, the "no data" features were deleted from the fine scale data. The output of the update function was used to conduct the remainder of the analysis.

The soft substrate data and hard substrate data were identified and exported as two separate data layers. The hard substrate data were stratified into three regions because each region is dominated by a different type of hard substrate (CDFG 2005a): 1) Point Conception – Point Sur, 2) Point Sur to Point Pinos, and 3) Point Pinos – Pigeon Point. Each layer was clipped to the four deepest depth zones (the intertidal rocky and sandy substrates are represented in the shoreline classification data set) and converted from a feature class to a raster (grid cell = 10 m^2). Each raster was reclassified to designate grid cells with substrate as a 1 and grid cells without substrate as a 0. Zonal statistics were performed on the reclassified rasters to determine the portion of grid cells containing substrate per planning unit (i.e. "mean" in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of substrate in each planning unit.

*Shoreline Classification**

The shoreline classification is line data and was used to represent rocky and soft habitats in the intertidal zone. Individual habitats were selected an exported as a new data layer. The rocky intertidal layer was created by selecting exposed rocky cliff, sheltered rocky shore, and wave cut rocky platforms. The soft intertidal layer was created by selecting gravel, fine-medium grain sandy beach, mixed sand gravel beach (fine to medium grain), coarse grained sand to gravel beach, and gravel (fine-medium grain sand). Each habitat intertidal layer was further analyzed independently. In GIS, microblocks that intersect the intertidal line data were selected. The selection was then exported to new layer. If a microblock contained intertidal habitat, it was given a 1 in MARXAN to indicate its presence in that microblock. If it was not present in a microblock, it was given a 0 to indicate its absence in that microblock.

*Surfgrass**

The surfgrass data were a line feature. In ArcGIS, microblocks that intersect the surfgrass line data were selected. The selection was then exported to a new layer. If a microblock contained surfgrass, it was given a 1 in MARXAN to indicate its presence in that microblock. If it was not present in a microblock, it was given a 0 to indicate its absence in that microblock.

*Underwater Pinnacles**

After clipping the layer to the four deepest depth zones, the zones were converted from a feature (point) to a raster (grid cell = $10m^2$) so that one raster cell equaled one feature point. Zonal statistics were conducted on all zones to obtain the number of pinnacles per microblock.

Marine Mammal Rookeries

In the microblock layer, all microblocks containing a rookery were selected and the selected features were exported as a new layer. If a microblock contained a rookery, it was given a 1 in MARXAN to indicate its presence in that microblock. If it was not present in a microblock, it was given a 0 to indicate its absence in that microblock.

Seabird Colonies

The data were converted from a feature (point) to a raster (grid cell = $10m^2$) so that one raster cell equaled one feature point. Zonal statistics were conducted on all zones to obtain the number of seabird colonies (“count”) per microblock.

Marine Mammal Haulouts

In the microblock layer, all microblocks containing a marine mammal haulout were selected and the selected features were exported as a new shapefile. If a microblock contained a haulout, it was given a 1 in MARXAN to indicate its presence in that microblock. If it was not present in a microblock, it was given a 0 to indicate its absence in that microblock.

Salmonids

This layer was used to locate estuaries containing salmonids. Estuaries that contained a salmonid outlet in or adjacent to the estuary were selected in GIS and exported as a new shapefile. The layer was converted from a feature to a raster (grid cell = 10 m^2) and reclassified to designate any area with an estuary containing salmonids as a 1 and all other areas as a 0. Zonal statistics were performed on the raster to determine the portion of grid cells containing an estuary containing salmonids per planning unit (i.e. “mean” in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of estuary with salmonids in each planning unit.

Bathymetric Complexity

Grid cells were selected that were in the highest of the five bathymetric complexity classes (greater than 116), and exported the data as a new raster. The raster was reclassified to designate any areas with a high value as a 1 and all other areas as 0. Zonal statistics were performed on the raster to determine the portion of grid cells containing high bathymetric complexity per planning unit (i.e. “mean” in the GIS zonal statistic output). The mean was multiplied by the area of the planning unit to obtain the area of high bathymetric complexity in each planning unit.

Appendix H: Application of MARXAN with the biophysical conservation targets identified by the SAT and CCRSG for three conservation goals (10%, 30%, 50%) and boundary length modifiers (0, 0.0001, 1). The cost of each planning unit was equal to its area.

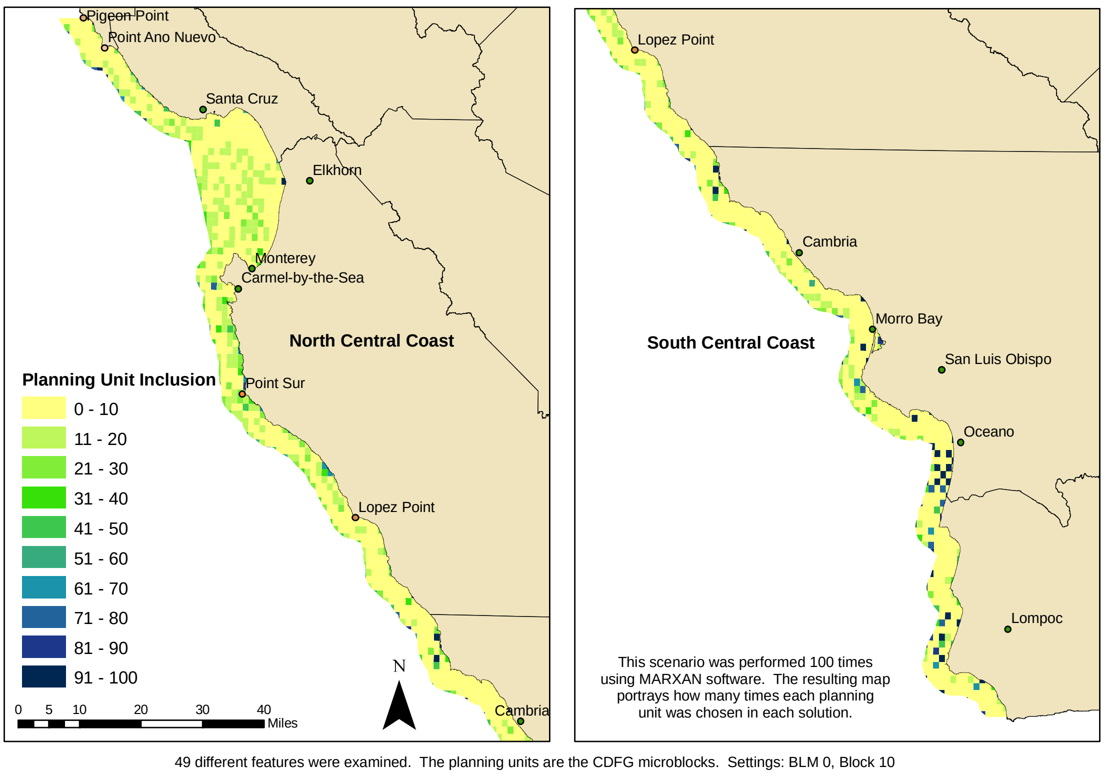
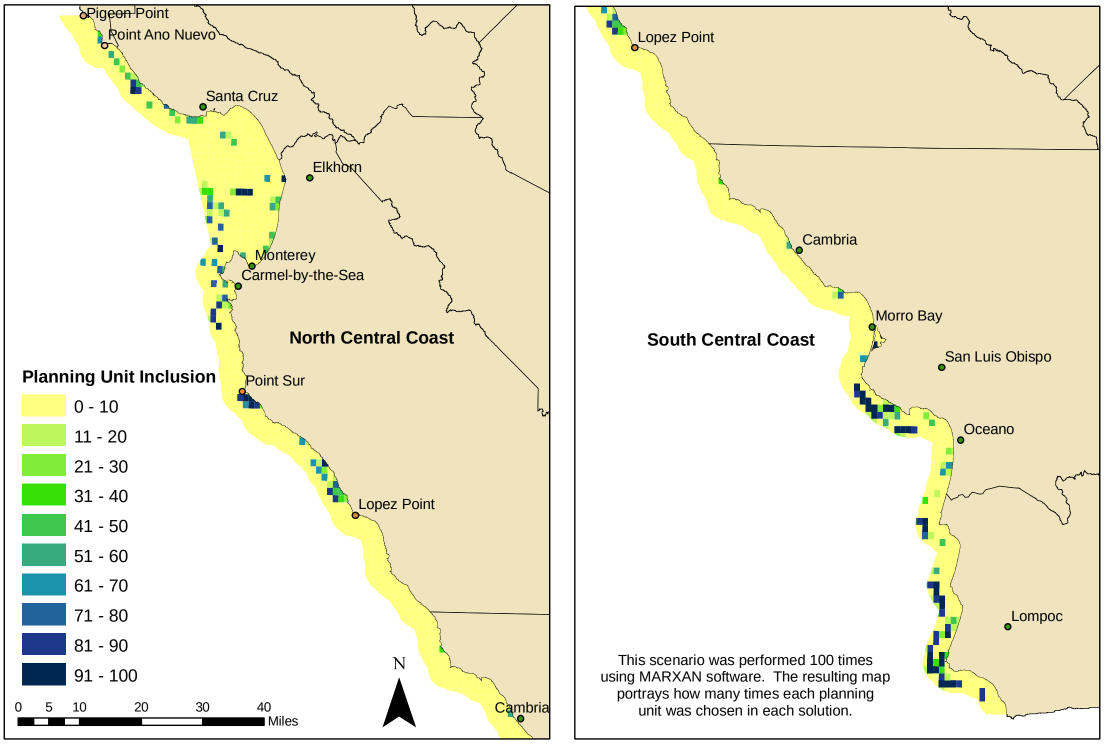
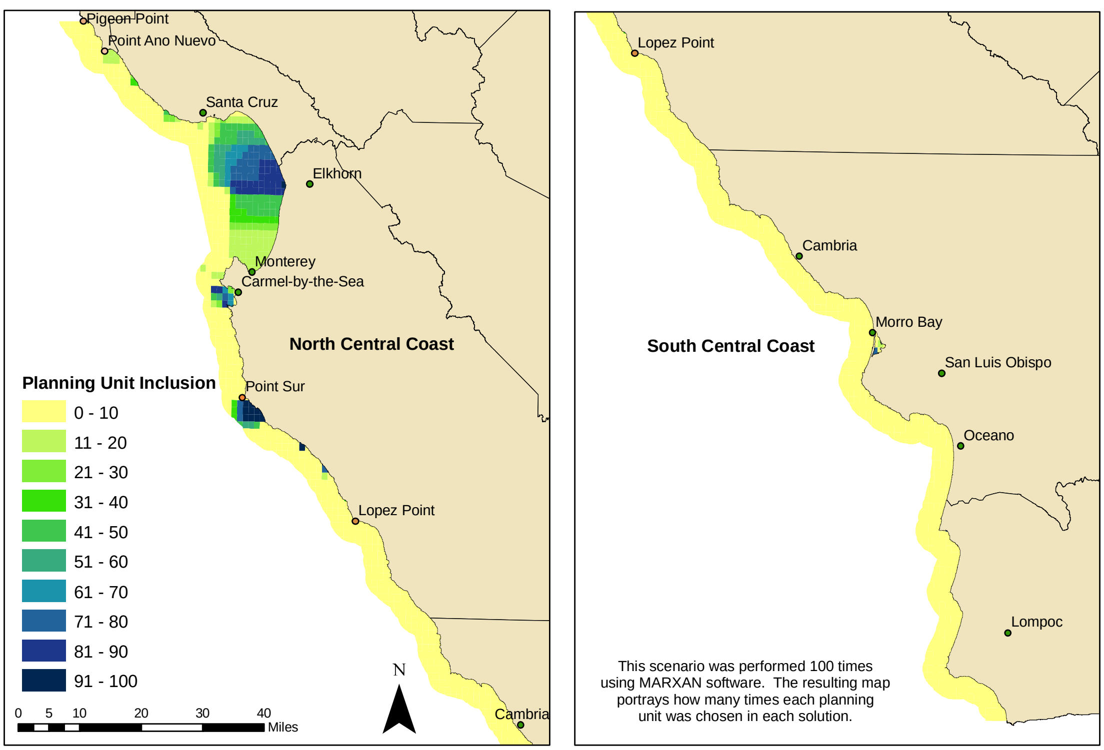


Figure H1. Application of MARXAN with the biophysical conservation targets for a conservation goal of 10% and a BLM of 0.



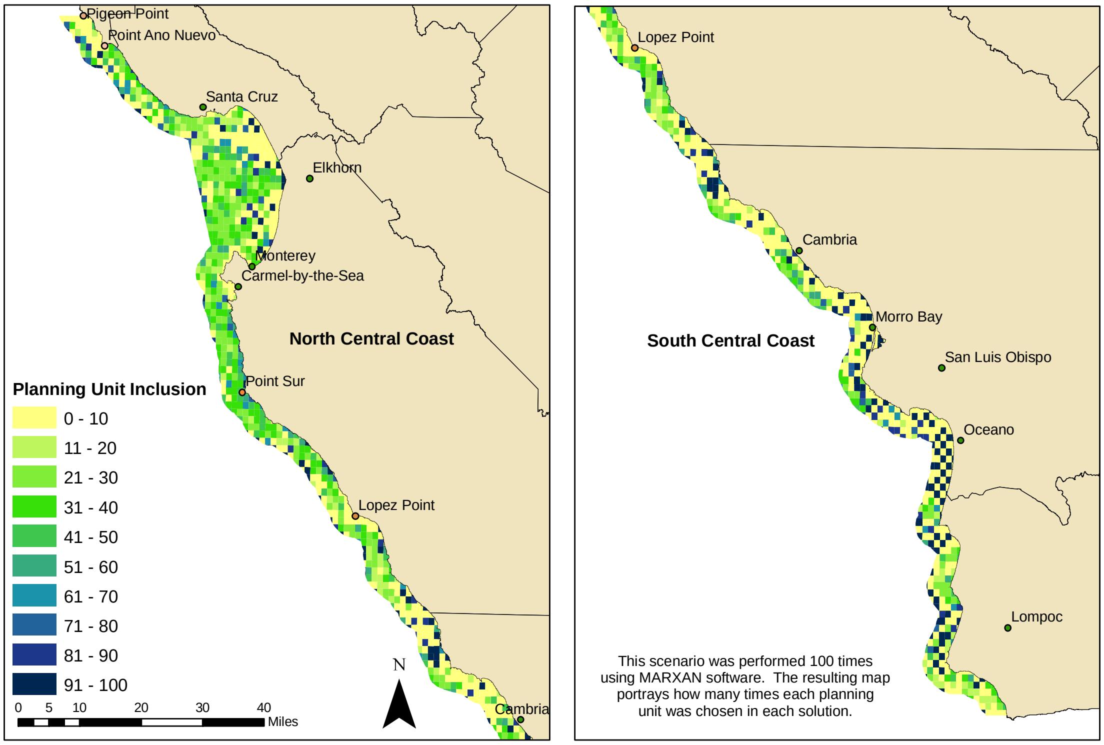
49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 10

Figure H2. Application of MARXAN with the biophysical conservation targets for a conservation goal of 10% and a BLM of 0.0001.



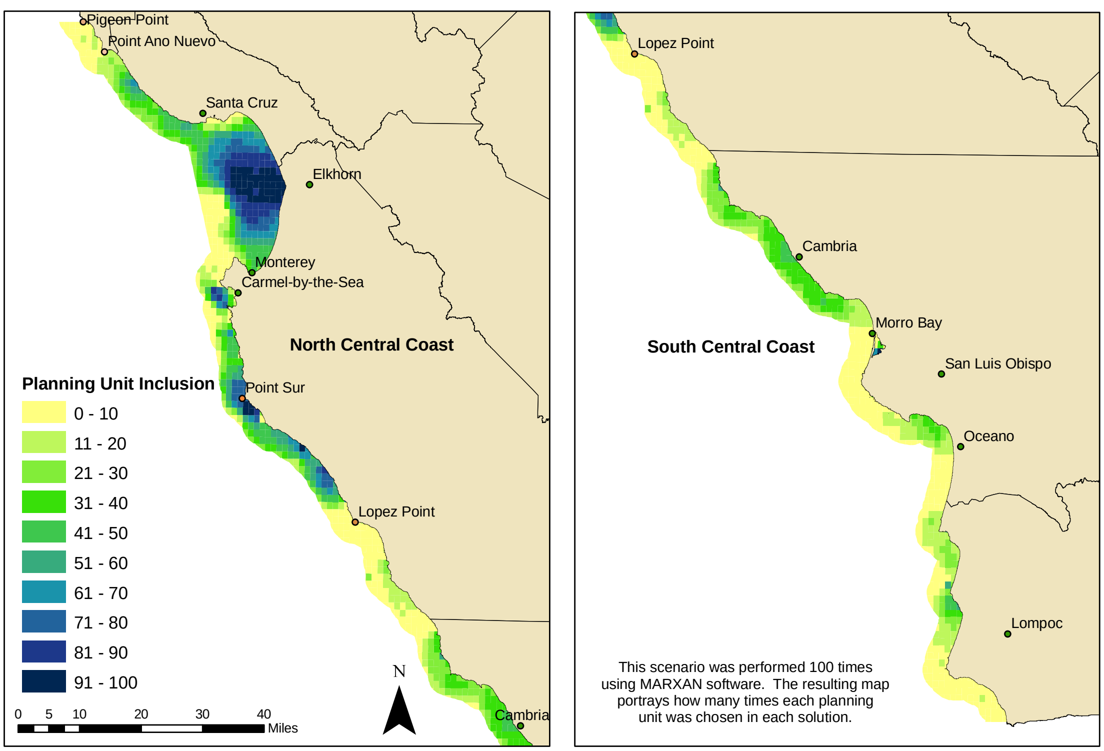
49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 1, Block 10

Figure H3. Application of MARXAN with the biophysical conservation targets for a conservation goal of 10% and a BLM of 1.



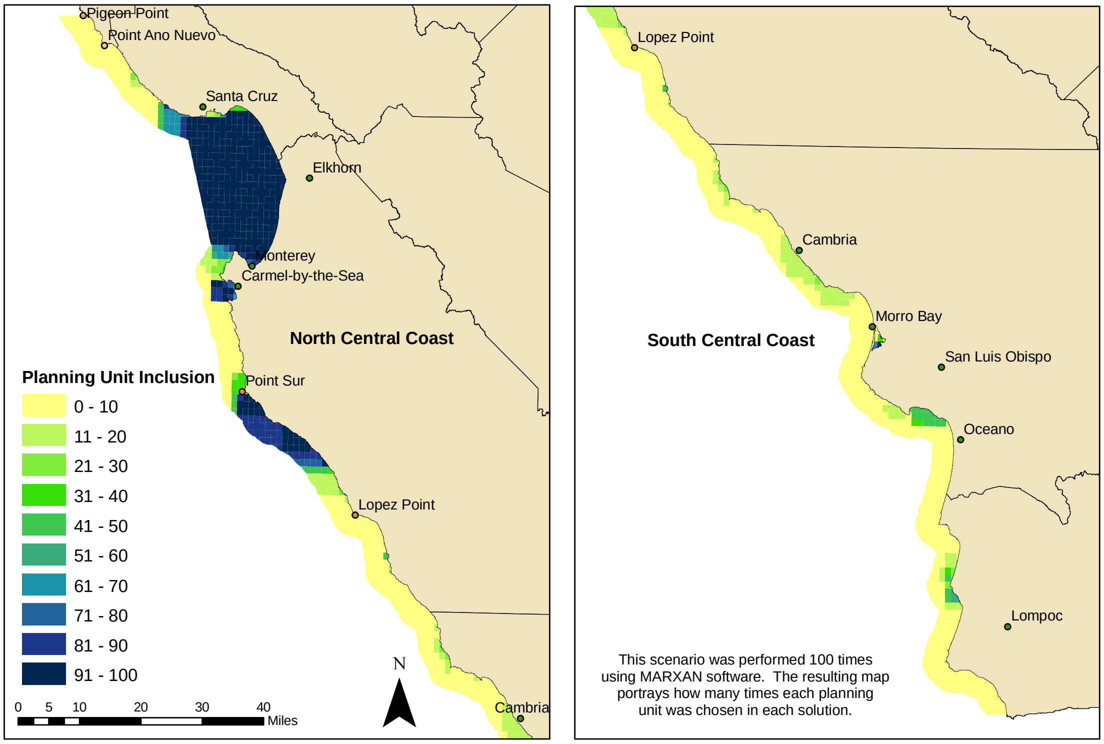
49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0, Block 30

Figure H4. Application of MARXAN with the biophysical conservation targets for a conservation goal of 30% and a BLM of 0.



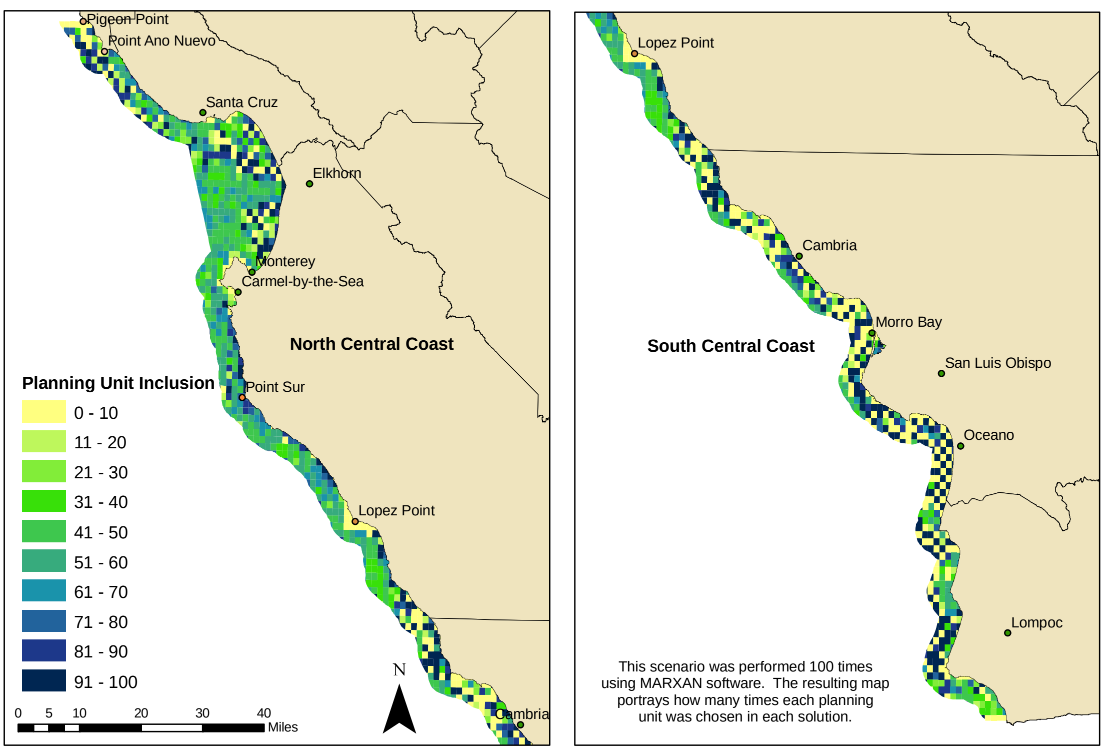
49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 30

Figure H5. Application of MARXAN with the biophysical conservation targets for a conservation goal of 30% and a BLM of 0.0001.



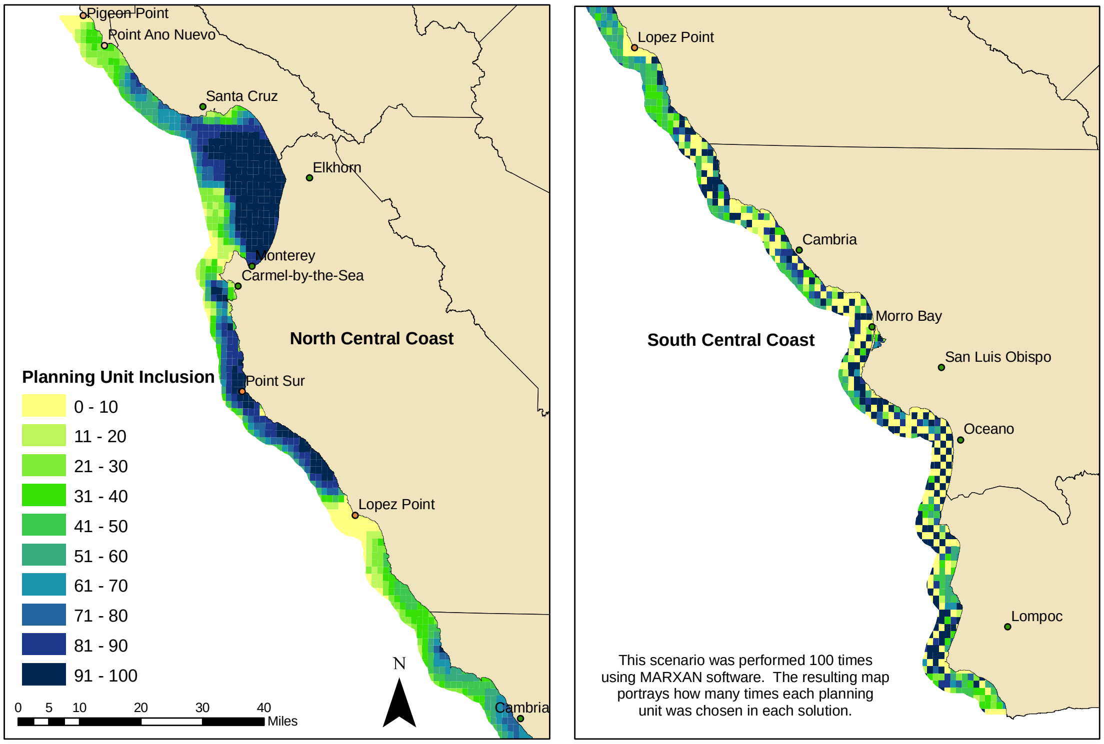
49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 1, Block 30

Figure H6. Application of MARXAN with the biophysical conservation targets for a conservation goal of 30% and a BLM of 1.



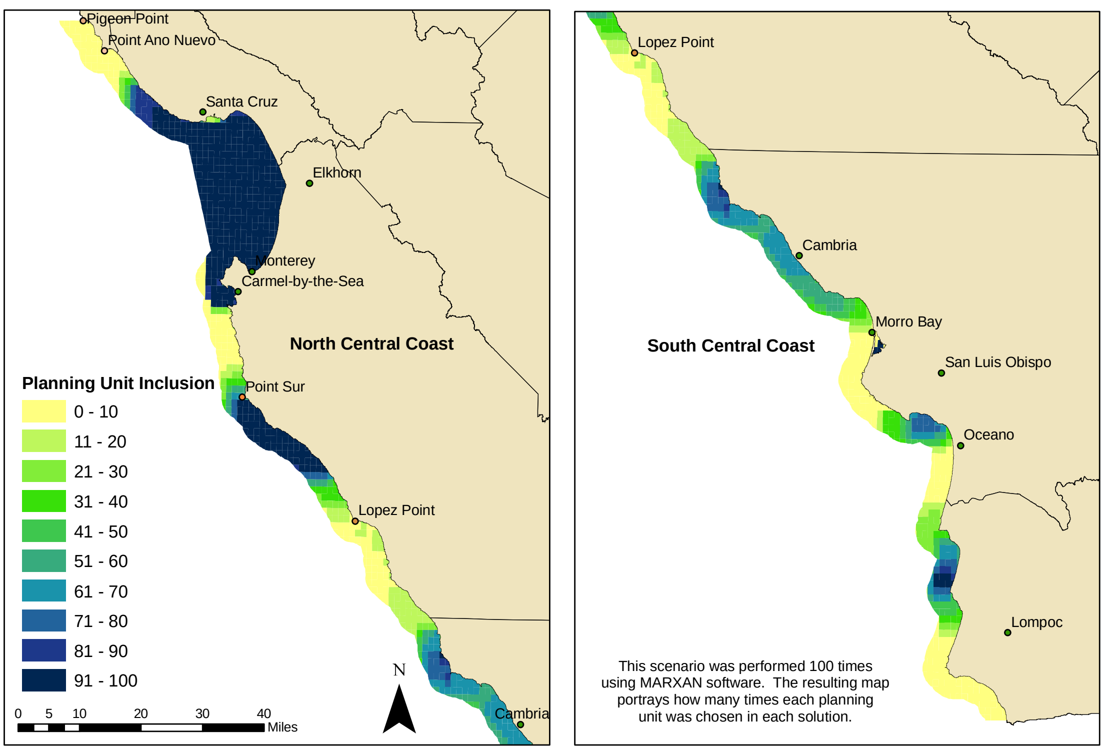
49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0, Block 50

Figure H7. Application of MARXAN with the biophysical conservation targets for a conservation goal of 50% and a BLM of 0.



49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 50

Figure H8. Application of MARXAN with the biophysical conservation targets for a conservation goal of 50% and a BLM of 0.0001.



49 different features were examined. The planning units are the CDFG microblocks. Settings: BLM 0.0001, Block 50

Figure H9. Application of MARXAN with the biophysical conservation targets for a conservation goal of 50% and a BLM of 1.

Appendix I: Overview of the socioeconomic data used in MARXAN and data analysis procedures conducted in ArcGIS for use in MARXAN.

Table I1. Sources and descriptions of socioeconomic data.

Infrastructure Data *	Source, Year	Brief Description
Population Centers	UCSB Bren School, 2005	Derived from USGS "Cities" layer. Hand selected microblocks (CRFS_SC_1minute_area) adjacent to cities or outlets of major roads from inland cities.
Research Institutions	UCSB Bren School, 2005	Derived from layer titled "Marine Research Institutions" (MarineResearchInsts, 2005), which provides location information (address and lat/long) for the marine research and education institutions in and around the MLPA study region from Point Conception to Pigeon Point. Hand selected microblocks (CRFS_SC_1minute_area) adjacent to research institutions or their marine research stations (e.g., CalPoly).
Monitoring Sites	UCSB Bren School, 2005	Derived from UCSB-Bren School layer of CRANE, MARINe, ESNERR, CCLEAN, NMFS, PISCO, and CalCOFI monitoring sites titled "Monitoring Sites Master 10_1" (MonitoringSites_DFG, 2005). Presents number of monitoring sites per microblock.
Recreational Private and Rental boat fishing effort (CRFS_Effort_DFG_050725)	CA DFG, 2004	Recreational Private and Rental boat fishing effort data provided by California Recreational Fisheries Survey (CRFS) in 2004. This layer contains the number of fishing trips made to a microblock for a particular species based upon a total of 5514 surveys conducted in 2004.
Commercial Passenger Fishing Vessel Effort (CON_CPFV_DFG_083005)	CA DFG, 2004	Recreational fishing effort data collected from the Commercial Passenger Fishing Vessel survey in 2004. This layer contains the number of fishing trips made to a microblock during 2004.
Kelp Beds	CA DFG, 2005	Boundaries and status of California administrative kelp beds managed by the California Department of Fish and Game.

* Layers are in the form of feature data and were manipulated using ArcMap.

Data Preparation

For our analyses, all feature data were clipped to the Central Coast Study Region. All data were analyzed differently, depending on the type of data and the objectives outlined by the *Regional Goals & Objectives Package*.

Infrastructure

Monitoring Sites

This data set is derived from UCSB-Bren School layer titled "Monitoring Sites Master 10_1" (MonitoringSites_DFG, 2005), which included the location of the Long-term Monitoring Program and Experiential Training for students (LiMPET), Cooperative Research and Assessment of Nearshore Resources (CRANE), Multi-Agency Rocky Intertidal Network (MARINe), Elkhorn Slough National Estaurine Research Reserve (ESNERR), Central Coast Long-term Environmental Assessment Network (CCLEAN), National Marine Fisheries Service (NMFS), Partnership for Interdisciplinary Studies of Coasts and Oceans (PISCO), and California Cooperative Oceanic Fisheries Investigations (CalCOFI) monitoring sites. We transformed this more complex layer into a simple layer expressing the presence or absence of monitoring sites in each microblock. First, we converted the feature to a raster file. Then, we used the Spatial Analyst: Zonal Statistics to produce a column with the number of monitoring sites per microblock.

Research Institutions

This data set is derived from the layer titled "Marine Research Institutions" (MarineResearchInsts, 2005), which provides location information (address and lat/long) for the marine research and education institutions in and around the MLPA study region from Point Conception to Pigeon Point. We hand selected microblocks (CRFS_SC_1minute_area) adjacent to research institutions or their marine research stations (e.g., CalPoly) and then created a layer from the selected microblocks. We pasted the resulting microblock identification numbers into an Excel spreadsheet and put a 1 in the adjacent column, expressing the presence of nearby research institutions in those microblocks.

Population Centers

This data set was derived from USGS' "Cities" layer. We hand selected microblocks (CRFS_SC_1minute_area) adjacent to cities or outlets of major roads from inland cities and then created a layer from the selected microblocks. We then pasted the resulting microblock identification numbers into an Excel spreadsheet and put a 1 in the adjacent column, expressing the presence of nearby population centers or major roads from inland population centers in those microblocks.

Fishing

Recreational Fishing

In order to integrate recreational fishing as a "cost" of placing a microblock under conservation, we used recreational fishing data from two recreational fishing surveys conducted in 2004: The California Recreational Fishing Survey (CRFS) and the Commercial Passenger Fishing Vessel

(CPFV) survey. These data were made available on the California Marine Geodatabase for the MLPA process. The data served as an index for recreational fishing "effort," which is the number of fishing trips made to each microblock over the survey period. The data characterized the effort of each individual fishery for which data existed. While these data identified which recreational fisheries were fishing in each microblock, this data from commercial fisheries did not identify fisheries or individuals due to privacy concerns. To be consistent in our analyses, we did to not integrate the relative value of individual fisheries since we were unable to identify commercial fisheries by name.

In order to incorporate recreational fishing effort into the cost of selecting microblocks in MARXAN, we developed a cost function by adapting an approach taken by Stewart and Possingham (2005). Incorporating fishing data as a cost directs MARXAN to preferentially choose microblocks in areas of lower fishing effort, minimizing potential impacts of MPAs to fishermen, while including the designated proportion of representative habitats and other targets. The cost function is:

$$\text{Cost}\,(A, R) = 0.2A + 0.8R$$

where A = Area, R = Recreational Fishing Effort

To calculate R, we summed all of the recreational fishing trips on the Central Coast for each fishery included in the CRFS and CPFV data. We divided the total number of fishing trips to each microblock by this sum, which gave us the proportional fishing effort in each microblock for each recreational fishery. We summed the proportional efforts for each microblock and divided these sums by the largest sum, giving us a normalized proportion of total recreational fishing effort per microblock. Calculating R in this way assigns greater weight to fisheries for which greater proportional effort is being exerted in a particular microblock. Appendix I provides a detailed description of the data and our data preparation.

While recreational fishing effort is the main component of the cost function, we also included area to account for the uneven size of the microblocks – especially on the shoreline and at the boundary of the federal waters – as well as concern that the fishing survey data may have been incomplete for some microblocks, suggesting that some effort is not accounted for in our analysis. Including area as a cost could therefore be considered a proxy for effort that was "missed" during the survey process (Costello 2006). To incorporate this effect of area, but give greater value to fishing, we assigned greater relative importance (0.8) to fishing effort and lesser relative importance (0.2) to area in our cost function (Costello 2006). Using this cost function, we ran MARXAN with 30 percent conservation goals for each biophysical and infrastructure target with no and moderate clustering (BLM 0 and 0.0001).

Commercial Fishing

The commercial fishing data was based on surveys conducted during 2005 by Ecotrust, an organization contracted by the MLPA Initiative to provide socioeconomic data and analysis. These data include the relative importance of a given microblock to individual fishermen for 19 commercial fisheries throughout the Central Coast Study Region. Due to the privacy concerns of commercial fishermen, the data provided to us did not identify each fishery by name. Rather, fisheries were assigned random numbers. While unidentified in the format provided to us, the following fisheries were included in the data: anchovy, cabezon, dungeness crab, deep nearshore rockfish, halibut, kelp greenling, lingcod, mackeral, rockfish nearshore, rockfish shelf, rockfish slope, rock crab, salmon, sardine, sablefish, white seabass, surfperch, spot prawn, squid (Ecotrust 2005).

In addition to the Ecotrust data, we included data on kelp bed leases administered by CDFG. As CDFG considers kelp harvest as a "fishery," we used both the Ecotrust and kelp data. The first step in preparing our kelp data was to clip the data to the Central Coast Study Region using ArcMap. We then converted the data from a feature to a raster with an output cell size of 10. Next, we reclassified the data. The attributes table of the kelp feature data included a STATUS column, which defines whether a kelp bed is open, leased, leaseable, or closed. We were only concerned with the areas closed to harvesting and leasing as the microblocks containing these areas will be of no cost if they are selected in MARXAN. We therefore reclassified the data according to the STATUS column; areas that are closed to harvest and leasing were given a value of 0 and all other statuses were given a value of 1. Using zonal statistics, we summarized the areas closed to kelp harvesting and leasing and joined this information with the CRFS microblock data. The resulting MEAN column represents the cost (0 or 1) of selecting a microblock with respect to kelp leasing.

Including the converted kelp data, our commercial cost function therefore consists of effort for 20 commercial fisheries. The cost function is:

$$\text{Cost}\ (A, C) = 0.2A + 0.8C$$

where A = Area, C = Relative importance of microblock to commercial fishermen

To calculate C, we summed the total importance of each microblock across all microblocks for each of the 20 fisheries. We divided each fishery's relative importance value for each microblock by this sum, which gave us the proportional importance of each microblock for each commercial fishery. We summed the proportional importance values for each microblock and divided these sums by the largest sum, giving us a normalized value expressing the proportional importance of each microblock to all of the commercial fishermen. Calculating C in this way assigns greater weight to fisheries that are proportionally more important to fishermen in a particular microblock.

Parks

These data were derived from the U.S. Tele Atlas North America, Inc./Geographic Data Technology, Inc. layer titled "Park Landmarks" (Parks_dtl, 2005), which represents parks and forests within United States at national, state, and local levels. We hand selected microblocks (CRFS_SC_1minute_area) adjacent to parks and then created a layer from the selected microblocks. We then pasted the resulting microblock identification numbers into an Excel spreadsheet and put a 1 in the adjacent column, expressing the presence of adjacent parks in those microblocks.

Appendix J: Boundary adjustment suggestions to improve compliance and reduce the enforcement burden for each package.

Table J1. Boundary adjustment suggestions for MPA network Package 1.

MPA	Suggestion
Carmel Bay SMCA	The western boundary runs diagonally. Would be improved by running north-south along longitude lines. Ideally, straight down from the point to which it is currently connected.
Carmel Pinnacles SMR	Tiny and not adjacent to shore. To improve, extend to northern boundary to shore.
Point Sur Deep Reef SMCA	Consider squaring off boundaries. One possibility would be aligning with Point Sur (east and south) and keeping southern boundary on its current latitude line.
Big Creek SMR	North and south boundaries are good; western boundary would be improved by running on a longitude line (north-south).
Alder Creek SMCA/Alder Creek SMR	Consider changing the common boundary between SMCA and SMR such that it runs along latitude-longitude lines.
Cambria SMP	Western boundary would be improved by running along longitude line.
Point Buchon SMCA, Point Buchon SMR, Diablo Canyon Security Zone SMCA	Common boundary should run along longitude line (as it did previously).
Vandenburg SMR	Southern boundary should be squared off to run along latitude line.

Table J2. Boundary adjustment suggestions for MPA network Package 2.

MPA	**Suggestion**
Carmel Pinnacles SMR/Carmel Bay SMCA	Common boundary would be improved by running just along longitude line (north/south) straight down from Pescadero Point.
Big Creek SMR	Western boundary is diagonal; would be improved by running along longitude line (north/south).
Cambria SMP	Diagonal western boundary would be improved by running north/south (along longitude line); one way to achieve this with no loss or addition or area would be to bring the northwestern point closer to shore and run south from there.
Ken Norris SMR	Diagonal western boundary would be improved by running north/south (along longitude line).
Point Buchon SMR/Point Buchon SMCA	Common boundary should run along longitude line (north/south) and southern boundary should be changed to run along latitude line (east/west).

Table J3. Boundary adjustment suggestions for MPA network Package 3.

MPA	**Suggestion**
Carmel Bay SMCA	The western boundary runs diagonally. Would be improved by running north-south along longitude lines. Ideally, straight down from the point to which it is currently connected.
Point Sur SMCA/Point Sur SMR	Southern boundary should run along latitude line. Common boundary should run along longitude line (north/south).
Piedras Blancas SMCA/Piedras Blancas SMR	Common boundary would be improved by running north/south (along longitude line).
Cambria SMP and Cambria SMR	Diagonal western boundary would be improved by running north/south (along longitude line); one way to achieve this with no loss or addition or area would be to bring the northwestern point closer to shore and run south from there.
Point Buchon SMCA and Point SMR	Common boundary should run along longitude line (north/south) and southern boundary should be extended to shore along latitude line instead of jutting upward at a diagonal.
Vandenburg SMR	Western boundary should be straightened to run north-south along longitude line. Southern boundary should be squared off to run along latitude line.

Table J4. Boundary adjustment suggestions for MPA network Package AC.

MPA	Suggestion
Sand Hill Bluff SMR	Boundaries running from shore to federal waters should be changed to run along longitude or latitude lines.
Soquel Canyon SMCA	The two long diagonal boundaries should be squared off on latitude and longitude lines.
Monterey Bay Shale Beds SMP	Eastern, northern, and western boundaries should be squared to run on latitude and longitude lines.
Hopkins SMR	Eastern boundary should run north/south along longitude line.
Carmel Bay SMP	The western boundary runs diagonally. Would be improved by running north-south along longitude lines. Ideally, straight down from the point to which it is currently connected.
Point Lobos SMCA/Point Lobos SMR	Common boundary between the SMCA and SMR should be straightened to run north-south along longitude line. Northern boundary of Point Lobos SMR should run along latitude line (east-west).
Big Creek SMCA/Big Creek SMR	Common boundary between SMCA and SMR should be straightened to run north/south along longitude line.
Cambria SMP and Cambria SMR	Diagonal western boundary would be improved by running north/south (along longitude line); one way to achieve this with no loss or addition of area would be to bring the northwestern point closer to shore and run south from there. Northern boundary of Cambria SMP should run east-west on latitude line.
Point Buchon SMR and Point Buchon SMCA	Northern, southern, and common boundaries should be changed to run along latitude and longitude lines.
Arguello Promontory SMR	Eastern boundary should be changed to run north/south on longitude line.

Table J5. Boundary adjustment suggestions for MPA network Package S.

MPA	Suggestion
Ano Nuevo SMR	Western boundary should be straightened to run along longitude line (north-south).
Ed Ricketts SMCA	Southern boundary should be straightened (at trivial change in area) to run west-east along latitude line.
Pacific Grove SMCA	Diagonal boundary on northeast should be squared to run along longitude and latitude lines.
Carmel Bay SMCA	Western boundary should be straightened to run along north-south longitude line.
Julia Pfeiffer Burns SMCA	The western boundary is a diagonal straight line instead of running along state water boundary. Straight lines are good, but diagonal lines are not ideal. Should extend SMCA to state water boundary.
Big Creek SMR	The western boundary is a diagonal straight line instead of running along state water boundary. Straight lines are good, but diagonal lines are not ideal. Should extend SMR to state water boundary.
Piedras Blancas SMCA/Piedras Blancas SMR	Common boundary should run north-south along longitude line instead of diagonally.
Cambria SMP and Cambria SMR	Diagonal western boundary would be improved by running north/south (along longitude line); one way to achieve this with little or no addition of area would be to bring the northwestern point closer to shore and run south from there.
Point Buchon SMCA and Point Buchon SMR	Common boundary should be changed to run north/south along longitude line.
Purisima SMR	The western boundary is a diagonal straight line instead of extending to state water boundary. Straight lines are good, but diagonal lines are not. Should extend SMR to state water boundary.

Appendix K: Name of each MPA in the 5 patrol regions.

Harbor / Patrol Region	0	1	2	3	AC	S
Santa Cruz	1. Ano Nuevo Invertebrate Area Special Closure	1. Ano Nuevo SMR 2. Greyhound Rock SMCA 3. Greyhound Rock SMR	1. Ano Nuevo SMR 2. Baldwin Creek to Natural Bridges SMR 3. Soquel Canyon SMCA (could be patrolled by Moss Landing or Monterey)	1. Ano Nuevo SMR 2. Natural Bridges Intertidal SMR 3. Opal Cliffs SMP 4. Soquel Canyon SMCA.	1. Ano Nuevo SMR 2. Ano Nuevo SMCA 3. Sand Hill Bluff SMR 4. Soquel Canyon SMCA	1. Ano Nuevo SMR 2. Natural Bridges SMR 3. Soquel Canyon SMCA
Moss Landing	1. Elkhorn Slough SMR	1. Elkhorn Slough SMR 2. Morro Cojo Estuary SMR	1. Elkhorn Slough SMR 2. Morro Cojo SMR	1. Elkhorn Slough SMR 2. Moro Cojo Estuary SMR	1. Elkhorn Slough SMR 2. Moro Cojo Slough SMR	1. Elkhorn Slough SMR 2. Morro Coho Slough SMR
Monterey	1. Hopkins SMR 2. Pacific Grove SMCA 3. Carmel Bay SMCA 4. Point Lobos SMR 5. Julia Pfeiffer Burns SMCA 6. Big Creek SMR	1. Monterey Submarine Canyon No BC SMCA 2. Ed Ricketts SMCA 3. Hopkins SMR 4. Pacific Grove-Monterey SMCA 5. Carmel Pinnacles SMR 6. Carmel Bay SMCA 7. Point Lobos SMR 8. Point Lobos SMCA 9. Point Sur Deep Reef SMCA 10. JPB Offshore SMR 11. JPB Offshore SMCA 12. Julia Pfeiffer Burns SMR 13. Big Creek SMR	1. Portuguese Ledge SMR 2. Edward C. Cooper SMR 3. Hopkins SMR 4. Pacific Grove SMCA 5. Asilomar SMR 6. Carmel Pinnacles SMR 7. Carmel Bay SMCA 8. Point Lobos SMCA 9. Point Lobos SMR 10. Point Sur SMR 11. Julia Pfeiffer Burns SMR 12. Big Creek SMCA 13. Big Creek SMR	1. Portuguese Ledge SMCA 2. Ed Ricketts SMCA 3. Expanded Hopkins SMR 4. Pacific Grove SMCA 5. Pacific Grove SMR 6. Pinnacles SMR 7. Carmel Bay SMCA 8. Point Lobos SMCA 9. Point Lobos SMR 10. Point Sur SMCA 11. Point Sur SMR 12. Expanded Big Creek SMR	1. Portuguese Ledge SMR 2. Monterey Shale Beds SMP 3. Edward F. Ricketts SMR 4. Hopkins SMR 5. Pacific Grove SMCA 6. Cypress Pinnacles SMR 7. Carmel Bay SMP 8. Point Lobos SMR 9. Point Lobos SMCA 10. Big Sur SMR 11. Big Creek SMCA 12. Big Creek SMR	1. Portuguese Ledge SMCA 2. Pacific Grove SMCA 3. Hopkins SMR 4. Ed Ricketts SMCA 5. Carmel Pinnacles SMR 6. Carmel Bay SMCA 7. Point Lobos SMCA 8. Point Lobos SMR 9. Point Sur SMCA 10. Point Sur SMR 11. JPB SMR 12. JPB SMCA 13. Big Creek SMR

Harbor / Patrol Region	0	1	2	3	AC	S
Morro Bay	1.Atascadero Beach SMCA 2. Morro Beach SMCA	1. Morro Bay Harbor SMCA 2. Morro Bay South SMRMA 3. Cambria SMP 4. Point Piedras Blancas SMR 5. Alder Creek SMCA 6. Alder Creek SMR 7. Point Buchon SMCA 8. Point Buchon SMR	1. Piedras Blancas SMR 2. Cambria SMP 3. Ken Norris SMR 4. Estero Bluff SMR 5. Morro Bay SMCA 6. Morro Bay East SMR 7. Morro Bay South SMRMA 8. Point Buchon SMR 9. Point Buchon SMCA	1. Point Buchon SMCA 2. Point Buchon SMR 3. Morro Bay SMCA 4. Morro Bay East SMR 5. Morro Bay South SMRMA 6. Estero Bluff SMP 7. Cambria SMR 8. Cambria SMP 9. Piedras Blancas SMR 10. Piedras Blancas SMCA	1. Piedras Blancas SMR 2. Cambria SMP 3. Cambria SMR 4. Morro Bay East SMR 5. Morro Bay South SMR 6. Point Buchon SMR 7. Point Buchon SMCA	1. Piedras Blancas SMR 2. Piedras Blancas SMCA 3. Cambria SMP 4. Cambria SMR 5. Estero Bluff SMR 6. Morro Bay SMCA 7. East Morro Bay SMR 8. South Morro Bay SMRMA 9. Point Buchon SMR 10. Point Buchon SMCA
Port San Luis	1. Pismo-Oceano Beach SMCA 2. Pismo SMCA 3. Vandenburg SMR	1. Vandenburg SMR 2. Vandenburg Danger Zone 4 SMCA 3. Diablo Canyon Security Zone SMCA	1. Purisima Point SMR 2. Point Arguello SMR	1. Point Sal SMR 2. Vandenburg SMR	1. Point Sal SMR 2. Purisima Point SMR 3. Purisima Point SMCA 4. Arguello Promontory SMR 5. Boathouse SMCA	1. Purisima SMR 2. Vandenburg SMR

Appendix L: Presence or absence of adjacent or proximate shoreline parks to each MPA in each patrol region.

Harbor / Patrol region	0	1	2	3	AC	S
Santa Cruz	1. Ano Nuevo Invertebrate Area Special Closure (Ano Nuevo State Park is in close proximity)	1. Ano Nuevo SMR (Ano Nuevo State Park is in close proximity) 2. Greyhound Rock SMCA (Big Basin Redwood State Park adjacent) 3. Greyhound Rock SMR (No Park)	1. Ano Nuevo SMR (Big Basin Redwoods State Park adjacent, Ano Nuevo State Park in close proximity) 2. Baldwin Creek to Natural Bridges SMR (Wilder Ranch State Park and Natural Bridges State Beach adjacent) 3. Soquel Canyon SMCA (No park, offshore)	1. Ano Nuevo SMR (Big Basin Redwoods State Park adjacent, Ano Nuevo State Park in close proximity) 2. Natural Bridges Intertidal SMR (Wilder Ranch State Park and Natural Bridges State Beach adjacent) 3. Opal Cliffs SMP (New Brighton State Beach in close proximity) 4. Soquel Canyon SMCA (No park, offshore)	1. Ano Nuevo SMR (Big Basin Redwoods State Park adjacent, Ano Nuevo State Park in close proximity) 2. Ano Nuevo SMCA (No park, offshore) 3. Sand Hill Bluff SMR (Wilder Ranch adjacent) 4. Soquel Canyon SMCA (No park, offshore)	1. Ano Nuevo SMR (Big Basin Redwoods State Park adjacent, Ano Nuevo State Park in close proximity) 2. Natural Bridges SMR (Wilder Ranch State Park and Natural Bridges State Beach adjacent) 3. Soquel Canyon SMCA (No park, offshore)
Moss Landing	1. Elkhorn Slough SMR (Moss Landing State Beach is in close proximity)	1. Elkhorn Slough SMR (Moss Landing State Beach is in close proximity) 2. Morro Cojo Slough SMR (Salinas River State Beach is in close proximity)	1. Elkhorn Slough SMR (Moss Landing State Beach in close proximity) 2. Morro Cojo SMR (Salinas River State Beach is in close proximity)	1. Elkhorn Slough SMR (Moss Landing State Beach in close proximity) 2. Moro Cojo Estuary SMR (Salinas River State Beach is in close proximity)	1. Elkhorn Slough SMR (Moss Landing State Beach in close proximity) 2. Moro Cojo Slough SMR (Salinas River State Beach is in close proximity)	1. Elkhorn Slough SMR (Moss Landing State Beach in close proximity) 2. Morro Coho Slough SMR (Salinas River State Beach is in close proximity)

Harbor / Patrol region	0	1	2	3	AC	S
Monterey	1. Hopkins SMR (No Park) 2. Pacific Grove SMCA (Asilomar State Beach adjacent) 3. Carmel Bay SMCA (Carmel River State Beach adjacent) 4. Point Lobos SMR (Point Lobos State Reserve adjacent) 5. Julia Pfeiffer Burns SMCA(Julia Pfeiffer Burns State Park and Los Padres National Forest adjacent) 6. Big Creek SMR (Los Padres National Forest adjacent)	1. Monterey Submarine Canyon No BC SMCA (No park, offshore) 2. Ed Ricketts SMCA (No park) 3. Hopkins SMR (No park) 4. Pacific Grove-Monterey SMCA (Asilomar State Beach adjacent) 5. Carmel Pinnacles SMR(No park) 6. Carmel Bay SMCA (Carmel River State Beach adjacent) 7. Point Lobos SMR (Point Lobos State Reserve adjacent) 8. Point Lobos SMCA (No park, offshore) 9. Point Sur Deep Reef SMCA (No park, offshore) 10. JPB Offshore SMR (No park, offshore) 11. JPB Offshore SMCA (No park, offshore) 12. Julia Pfeiffer Burns SMR (Julia Pfeiffer Burns State Park and Los Padres National Forest adjacent) 13. Big Creek SMR (Los Padres National Forest adjacent)	1. Portuguese Ledge SMR (No park, offshore) 2. Edward C. Cooper SMR (No park) 3. Hopkins SMR (No park) 4. Pacific Grove SMCA (No park) 5. Asilomar SMR (Asilomar State Beach adjacent) 6. Carmel Pinnacles SMR(No park) 7. Carmel Bay SMCA (Carmel River State Beach adjacent) 8. Point Lobos SMCA (No park, offshore) 9. Point Lobos SMR (Point Lobos State Reserve adjacent) 10. Point Sur SMR (Andrew Molera State Park adjacent) 11. Julia Pfeiffer Burns SMR (Julia Pfeiffer Burns State Park and Los Padres National Forest adjacent) 12. Big Creek SMCA (Los Padres National Forest adjacent) 13. Big Creek SMR (Los Padres National Forest adjacent)	1. Portuguese Ledge SMCA (No park, offshore) 2. Ed Ricketts SMCA (No park) 3. Expanded Hopkins SMR (No park) 4. Pacific Grove SMCA (No park) 5. Pacific Grove SMR (Asilomar State Beach adjacent) 6. Pinnacles SMR (No park) 7. Carmel Bay SMCA (Carmel River State Beach adjacent) 8. Point Lobos SMCA (No park, offshore) 9. Point Lobos SMR (Point Lobos State Reserve adjacent) 10. Point Sur SMCA (No park, offshore) 11. Point Sur SMR (Andrew Molera State Park and Los Padres National Forest in close proximity) 12. Expanded Big Creek SMR (Los Padres National Forest adjacent)	1. Portuguese Ledge SMR (No park, offshore) 2. Monterey Shale Beds SMP (Monterey State Beach adjacent) 3. Edward F. Ricketts SMR (No park) 4. Hopkins SMR (No park) 5. Pacific Grove SMCA (Asilomar State Beach adjacent) 6. Cypress Pinnacles SMR (No park) 7. Carmel Bay SMP (Carmel River State Beach adjacent) 8. Point Lobos SMR (Carmel River State Beach and Point Lobos State Reserve adjacent) 9. Point Lobos SMCA (Point Lobos State Reserve adjacent) 10. Big Sur SMR (Andrew Molera State Park and Los Padres National Forest adjacent) 11. Big Creek SMCA (No park, offshore) 12. Big Creek SMR (Los Padres National Forest adjacent)	1. Portuguese Ledge SMCA (No park, offshore) 2. Pacific Grove SMCA (Asilomar State Beach adjacent) 3. Hopkins SMR (No park) 4. Ed Ricketts SMCA (No park) 5. Carmel Pinnacles SMR (No park) 6. Carmel Bay SMCA (Carmel River State Beach adjacent) 7. Point Lobos SMCA (No park, offshore) 8. Point Lobos SMR (Carmel River State Beach and Point Lobos State Reserve adjacent) 9. Point Sur SMCA (No park, offshore) 10. Point Sur SMR (Andrew Molera State Beach adjacent) 11. JPB SMR (Julia Pfeiffer Burns State Park and Los Padres National Forest adjacent) 12. JPB SMCA (No park, offshore) 13. Big Creek SMR (Los Padres National Forest adjacent)

Harbor / Patrol region	0	1	2	3	AC	S
Morro Bay	1.Atascadero Beach SMCA (Morro Bay State Park adjacent) 2. Morro Beach SMCA (Montana de Oro State Park adjacent)	1. Morro Bay Harbor SMCA (Morro Bay State Park adjacent) 2. Morro Bay South SMRMA (Montana de Oro State Park adjacent) 3. Cambria SMP (San Simeon Beach State Park adjacent) 4. Point Piedras Blancas SMR (No park) 5. Alder Creek SMCA (No park, offshore) 6. Alder Creek SMR (Los Padres National Forest adjacent) 7. Point Buchon SMCA (No park, offshore) 8. Point Buchon SMR (No park)	1. Piedras Blancas SMR (No park) 2. Cambria SMP (San Simeon Beach State Park adjacent) 3. Ken Norris SMR (No park) 4. Estero Bluff SMR (No park) 5. Morro Bay SMCA (Morro Bay State Park adjacent) 6. Morro Bay East SMR (Morro Bay State Park adjacent) 7. Morro Bay South SMRMA (Montana de Oro State Park adjacent) 8. Point Buchon SMR (Montana de Oro State Park adjacent) 9. Point Buchon SMCA (No park, offshore)	1. Point Buchon SMCA (No park, offshore) 2. Point Buchon SMR (Montana de Oro State Park adjacent) 3. Morro Bay SMCA (Morro Bay State Park adjacent) 4. Morro Bay East SMR (Morro Bay State Park adjacent) 5. Morro Bay South SMRMA (Montana de Oro State Park adjacent) 6. Estero Bluff SMP (No park) 7. Cambria SMR (No park) 8. Cambria SMP (San Simeon Beach State Park adjacent) 9. Piedras Blancas SMR (No park) 10. Piedras Blancas SMCA (No park, offshore)	1. Piedras Blancas SMR (No park) 2. Cambria SMP (San Simeon Beach State Park adjacent) 3. Cambria SMR (No park) 4. Morro Bay East SMR (Morro Bay State Park adjacent) 5. Morro Bay South SMR (Montana de Oro State Park adjacent) 6. Point Buchon SMR (Montana de Oro State Park in close proximity) 7. Point Buchon SMCA (No park, offshore)	1. Piedras Blancas SMR (No park) 2. Piedras Blancas SMCA (No park, offshore) 3. Cambria SMP (San Simeon Beach State Park adjacent) 4. Cambria SMR (No park) 5. Estero Bluff SMR (No park) 6. Morro Bay SMCA (Morro Bay State Park adjacent) 7. East Morro Bay SMR (Morro Bay State Park adjacent) 8. South Morro Bay SMRMA (Montana de Oro State Park adjacent) 9. Point Buchon SMR (Montana de Oro State Park adjacent) 10. Point Buchon SMCA (No park, offshore)
Port San Luis	1. Pismo-Oceano Beach SMCA (Oceano Dunes State Vehicular Recreation Area adjacent) 2. Pismo SMCA (Pismo State Beach adjacent) 3. Vandenburg SMR (No Park)	1. Diablo Canyon Security Zone SMCA (No park) 2. Vandenberg Danger Zone 4 SMCA (No park) 3. Vandenburg SMR (No park)	1. Purisima Point SMR (No park) 2. Point Arguello SMR (No park)	1. Point Sal SMR (Point Sal State Park adjacent) 2. Vandenburg SMR (No park)	1. Point Sal SMR (Point Sal State Park adjacent) 2. Purisima Point SMR (No park) 3. Purisima Point SMCA (No park) 4. Arguello Promontory SMR (No park) 5. Boathouse SMCA (No park)	1. Purisima SMR (No park) 2. Vandenburg SMR (No park)

Appendix M: Sanctuary education team materials and distribution methods matrix.

Table M1. Education about the science of marine reserves, user groups not split. Numbers are rankings; 1 is highest priority and 5 is the lowest. For more information contact Julie Bursek (Julie.Bursek@noaa.gov) or Laura Francis Laura.Francis@noaa.gov), NOAA Education Coordinators.

User Groups		Materials and Products					Distribution Methods				
		Printed Materials	Audio-Visual Materials	Targeted Presentation	Field Trips	Signage Exhibits Posters	Internet	Media Radio/TV Print	Existing Weather Kiosk	Outreach Lecture Workshop	Direct Mail Drop Off
Private Boats	Fishing	5	3	0	0	4	4	5	3	2	1
	Diving	5	3	0	0	4	4	5	3	2	1
	Non-Consumptive	5	3	0	0	4	4	5	3	2	1
Charter Vessels (all types)	Operators	5	3	2	1	4	3	2	1	4	5
	Users/Passenger	4	3	2	0	5	3	5	0	4	2
	Boat Rentals	4	1	0	0	5	3	2	1	0	5
Commercial Fishing	Resident	5	3	0	0	4	4	3	0	0	5
	Transient	5	3	0	0	4	5	4	0	0	3
	Seasonal	5	3	0	0	4	5	3	0	0	4
Research	Agency Affiliate	5	3	4	0	0	4	2	0	5	3
	University Affiliate	5	3	4	0	0	4	2	0	5	3
	Private Group	5	3	4	0	0	4	2	0	5	3
Education	K - 12	1	2	4	3	5	3	2	0	4	5
	Community College	1	2	4	3	5	4	2	0	3	5
	University	1	4	3	2	5	4	2	0	3	5
	Aquariums/Museums	3	4	2	1	5	4	3	1	2	5
Outreach Groups	YMCA	1	4	5	2	3	4	1	0	5	0
	Boy/Girl Scouts	1	4	5	3	2	4	1	0	5	0
	Junior Life Guard	3	2	5	4	1	4	1	0	5	0
	Park Concessions	3	4	5	1	2	4	1	0	5	3
	Yacht Clubs	2	1	5	3	4	1	3	0	5	4
	Dive Shops	5	3	2	1	4	3	4	0	2	5
	Dive Associations	3	2	5	4	1	3	4	0	5	2
	Fishing Assoc.	5	4	3	0	1	5	4	0	3	1
	Tackle Shops	4	1	0	0	5	0	0	0	4	5
	West Marine, etc.	4	1	0	0	5	0	0	0	4	5
	CG Aux/Power Squad	4	2	5	0	3	3	2	0	5	4
	NGO/Edu. Partners	1	3	5	4	2	4	3	0	5	2
Military		4	2	5	1	3	3	2	0	5	4
General Public		1	2	4	5	3	4	5	0	3	2
Average		3.5	2.7	2.8	1.3	3.2	3.5	2.7	0.4	3.4	3.1
Median		4	3	3.5	0.5	4	4	2	0	4	3
Mode		5	3	0	0	4	4	2	0	5	5

Table M2. Education about the science of marine reserves, user groups split. Numbers are rankings; 1 is highest priority and 5 is the lowest. For more information contact Julie Bursek (Julie.Bursek@noaa.gov) or Laura Francis Laura.Francis@noaa.gov), NOAA Education Coordinators.

User Groups		Materials and Products					Distribution Methods				
		Printed Materials	Audio-Visual Materials		Printed Materials	Audio-Visual Materials		Printed Materials	Audio-Visual Materials		Printed Materials
Private Boats	Fishing	5	3	0	0	4	4	5	3	2	1
	Diving	5	3	0	0	4	4	5	3	2	1
	Non-Consumptive	5	3	0	0	4	4	5	3	2	1
Charter Vessels (all types)	Operators	5	3	2	1	4	3	2	1	4	5
	Users/Passenger	4	3	2	0	5	3	5	0	4	2
	Boat Rentals	4	1	0	0	5	3	2	1	0	5
Commercial Fishing	Resident	5	3	0	0	4	4	3	0	0	5
	Transient	5	3	0	0	4	5	4	0	0	3
	Seasonal	5	3	0	0	4	5	3	0	0	4
Research	Agency Affiliate	5	3	4	0	0	4	2	0	5	3
	University Affiliate	5	3	4	0	0	4	2	0	5	3
	Private Group	5	3	4	0	0	4	2	0	5	3
Education	K - 12	1	2	4	3	5	3	2	0	4	5
	Community College	1	2	4	3	5	4	2	0	3	5
	University	1	4	3	2	5	4	2	0	3	5
	Aquariums/Museums	3	4	2	1	5	4	3	1	2	5
Average		4.0	2.9	1.8	0.6	3.6	3.9	3.1	0.8	2.6	3.5
Median		5	3	2	0	4	4	2.5	0	2.5	3.5
Mode		5	3	0	0	4	4	2	0	2	5
Outreach Groups	YMCA	1	4	5	2	3	4	1	0	5	0
	Boy/Girl Scouts	1	4	5	3	2	4	1	0	5	0
	Junior Life Guard	3	2	5	4	1	4	1	0	5	0
	Park Concessions	3	4	5	1	2	4	1	0	5	3
	Yacht Clubs	2	1	5	3	4	1	3	0	5	4
	Dive Shops	5	3	2	1	4	3	4	0	2	5
	Dive Associations	3	2	5	4	1	3	4	0	5	2
	Fishing Assoc.	5	4	3	0	1	5	4	0	3	1
	Tackle Shops	4	1	0	0	5	0	0	0	4	5
	West Marine, etc.	4	1	0	0	5	0	0	0	4	5
	CG Aux/Power Squad	4	2	5	0	3	3	2	0	5	4
	NGO/Edu. Partners	1	3	5	4	2	4	3	0	5	2
Military		4	2	5	1	3	3	2	0	5	4
General Public		1	2	4	5	3	4	5	0	3	2
Average		2.9	2.5	3.9	2.0	2.8	3.0	2.2	0.0	4.4	2.6
Median		3	2	5	1.5	3	3.5	2	0	5	2.5
Mode		1	2	5	0	3	4	1	0	5	0

Table M3. Education about the rules and regulations of marine reserves. Numbers are rankings; 1 is highest priority and 5 is the lowest. For more information contact Julie Bursek (Julie.Bursek@noaa.gov) or Laura Francis Laura.Francis@noaa.gov), NOAA Education Coordinators.

User Groups		Materials and Products				Distribution Methods				
		Printed Materials	Audio-Visual Materials		Printed Materials	Audio-Visual Materials		Printed Materials	Audio-Visual Materials	
Private Boats	Fishing	1	1	3	N/A	4	3	1	2	?
	Diving	1	1	3	N/A	4	3	1	2	
	Non-Consumptive	1	1	3	N/A	4	3	1	2	
Charter Vessels (all types)	Operators	2	1	4	3	3	4	2	1	?
	Users/Passenger	1	4	2	3	4	3	1	2	
Commercial Fishing	Resident	1	2	3	4	3	5	2	4	1
	Transient	2	1	3	4	3	5	2	4	1
	Seasonal	2	1	3	4	3	5	2	4	1
Research	Agency Affiliate	2	1	N/A	3	5	4	1	3	2
	University Affiliate	2	1	N/A	3	5	4	1	3	2
	Private Group	2	1	N/A	3	5	4	1	3	2
Education	K - 12									
	Community College									
	University									
	Other									
Outreach Groups	YMCA									
	Boy/Girl Scouts									
	Junior Life Guard									
	Park Concessions									
	CG Auxiliary									
	Power Squadron									
	Dive Associations									
	Fishing Associations									
Military										
Average		1.5	1.4	3.0	3.4	3.9	3.9	1.4	2.7	1.5

Appendix N: Potential compliance and enforcement partners.

Potential Outreach Partner	Contact Information	Communication Methods	Mission Statement, user group members, or access to user group	Response
STATEWIDE				
Pacific Coast Federation of Fishermen's Associations (PCFFA)*	P.O. Box 29370, San Francisco, CA 94129-0370 Phone: (415) 561-5080 Fax: (415)561-5464 Email: Fish1ifr@aol.com	Website and column in the monthly online newsletter "Fishermen's News".	Mission: What PCFFA provides the individual fisherman is a vehicle to protect themselves and their industry, to assure the sustainable protection of the fragile resources we all depend upon, and a vehicle for empowerment. PCFFA provides fishermen a means to challenge and counter the dictates of big business or big government. PCFFA provides fishermen with a voice in their affairs, a say about their future.	No response
The Institute for Fisheries Resources*	Contact: William F. "Zeke" Grader PO Box 29196 San Francisco, CA 94129-0196 Phone: 415.561.3474 Fax: 415.561.5464 Email: zgrader@ifrfish.org	Website, weekly email newsletter "Sublegals".	Mission: The Institute for Fisheries Resources is dedicated to the protection and restoration of fish resources and the human economies that depend on them. By establishing alliances among fishing men and women, government agencies, and concerned citizens, IFR unites resource stakeholders, protects fish populations, and restores aquatic habitats.	No response
LOCAL				
Federation Of Independent Seafood Harvesters	Contact: Tony West 1423 Silvius St. San Pedro, CA 90731 Phone: (310) 832-8143 Email: twest90731@aol.com		User group members: Commercial Fishermen	No response
Half Moon Bay Fishermen's Marketing Association	Contact: Duncan MacLean P.O. Box 340 El Grenada, CA 94018 Phone: (650) 728-0209		User group members: Commercial Fishermen	No response
Morro Bay Commercial Fishermen's Organization	Contact: Cathy Novak P.O. Box 296 Morro Bay, CA 93443 Phone: (805) 772-9499 Email: cnovak@fix.net		User group members: Commercial Fishermen	No response

Potential Outreach Partner	Contact Information	Communication Methods	Mission Statement, user group members, or access to user group	Response
Port San Luis Commercial Fisherman's Association	Contact: Robert Johnson 170 Surf Street Pismo Beach, CA 93449		User group members: Commercial Fishermen	No response
Southern California Trawler's Association	Contact: Mike McCorkle P.O. Box 713 Summerland, CA 93067 Phone: (805) 566-1400	In-person	User group members: Commercial Fishermen	May be interested; need more information Willing to work with CDFG to hold an outreach event with members **Comments:** "I don't support MLPAs (sic) as large ways to save the fish, ocean. I've fished 50yrs in the ocean and see many changes – not because of over fishing. Just stopping fishing in area isn't going to help anything. Problems: pollution, seal, sea lion predation are huge problems, no solved by closing areas to fishing."
RECREATIONAL FISHERMEN				
STATEWIDE				
The Recreational Fishing Alliance* California State Chapter	**Contact:** Jim Martin (West Coast Regional Director) P.O. Box 2420 Ft. Bragg, CA 95437 Phone: 707-964-8326 Cell: 707-972-5226 Email: Flatland@mcn.org	Website, online discussion forum, online newsletter.	Mission: Safeguard the rights of saltwater anglers. Protect marine, boat and tackle industry jobs. Ensure the long-term sustainability of our Nation's fisheries.	No response
Sportfishing Association of California	Contact: Robert Fletcher 2917 Canon Street San Diego, CA 92106 Phone: (619) 226-6455 Email: dart@sacemup.org		User group members: Recreational Fishermen	No response
HARBORS				

Potential Outreach Partner	Contact Information	Communication Methods	Mission Statement, user group members, or access to user group	Response
Port San Luis	Contact: Jay K. Elder (Harbor Manager) Office: 3950 Avila Beach Drive Avila Beach, CA 93424 Phone: (805) 595-5400 Email: lochd@portsanluis.com	Website	Access to user groups: Boaters, commercial and recreational fishermen	No response
Morro Bay	Contact: Rick Algert (Director) 1275 Embarcadero Morro Bay, CA 93442 Phone: (805) 772-6259 Email: ralgert@morro-bay.ca.us	Website, public access TV broadcast of advisory board meetings, local paper, quarterly newsletter.	Mission: The Harbor Department is a service oriented organization providing boater assistance and emergency response for the waters of Morro Bay including water safety, education programs; i.e.: Summer Beach Lifeguards, Jr. Lifeguard program and school and community outreach programs. Access to user groups: boaters, commercial and recreational fishermen	Willing to assist CDFG, but have no extra resources or time to commit to partnership.
Monterey	Contact: Steve Scheiblauer (Harbormaster) Office of the Harbormaster, City Hall Monterey, CA 93940 Phone: (831) 646-3950 Email: scheibla@ci.monterey.ca.us	Website, Yearly Newsletter "Tidelines", email, direct mail, gate notices.	Mission: The Harbor and Marina provide access to a variety of recreational as well as commercial opportunities for residents and visitors alike in this scenic setting. Access to user groups: Boaters, commercial and recreational fishermen	"Happy to help in any way I can." "Will information regarding the results of the MLPAI process include what I and other local stakeholders think about how the process went?"
Santa Cruz	Contact: Jim Thoits (Chairman, Santa Cruz Port District Commission) Santa Cruz Port District 135 Fifth Ave. Santa Cruz, CA 95062 Phone: (831) 475-6161 Email: scpd@santacruzharbor.org	Website, Outreach Activities/ Programs.	Mission: Santa Cruz Small Craft Harbor provides berthing and dry storage for a variety of boats ranging from kayaks to commercial fishing vessels. Access to user groups: Boaters, commercial and recreational fishermen	No response

Potential Outreach Partner	Contact Information	Communication Methods	Mission Statement, user group members, or access to user group	Response
Moss Landing	Contact: Linda G. McIntyre, Esq. (Harbormaster) 7881 Sandholdt Road Moss Landing, CA 95039 Phone: (831) 633-5417 Email: mcintyre@mosslandingharbor.dst.ca.us	Website, posting at dock gates, Board meeting packets (i.e. community relations report), annual U.S. postal mailing.	Mission: The mission of the Moss Landing Harbor District is to provide a functional, visitor-friendly harbor for commercial and recreational use. The Moss Landing Harbor is the #1 commercial fishing harbor in Monterey Bay and is a year-round port of safe refuge partnering with marine research and education with full public access to the environment. Access to user groups: Boaters, commercial and recreational fishermen	"Happy to help to the extent that we are able." Willing to find out if e-commerce billing service will allow an additional line to monthly e-statements such as "click on our web page at www.mosslandingharbor.ca.us for the latest MLPA info." Conference/board room available for user groups free of charge
DIVERS				
Central California Council of Diving Clubs, Inc. (CenCal)	Contact: Steve Campi (President) PO Box 779 Daly City, CA 94017 Phone: (650) 583-8492 Fax: (650) 583-0614 Email scampi@campin.net	Website, bimonthly newsletter "Odyssey" includes current regulations 1x per year, monthly council meetings. Has hosted "Warden's night" to inform members of DFG regulations.	Mission: Cen Cal is dedicated to the principles of wise and equitable legislation, safety, conservation, access, sportsmanship, underwater sports and to furthering the knowledge of the marine phenomena. User group members: Scuba divers	No response
STATE PARKS				
Interpretation & Education Division	P.O. Box 942896 Sacramento, CA 94296 Phone: (916) 654-2249 Fax: (916) 654-9048 Email: interp@parks.ca.gov	Outreach programs, website	Access to user groups	Not contacted
Partnership Support	Jonathan Williams (State Park Supt. III) Phone: (916) 651-8451 Email: jwill@parks.ca.gov Margo Cowan (Program Coordinator) Phone: (916) 653-8819 Email: mcowan@parks.ca.gov John Mott (Program Manager) Phone: (916) 654-5397 Email: jmott@parks.ca.gov			Not contacted

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NON-GOVERNMENTAL ORGANIZATIONS				
Algalita Marine Research Foundation	Contact: Marieta Francis (Director of Operations) 148 Marina Drive Long Beach, CA 90803 Phone: (562) 598-4889 Email: info@algalita.org http://www.algalita.org/	Mostly in-person.	Mission: AMRF is dedicated to the preservation of the marine environment. AMRF is actively engaged in innovative research, education and restoration of the marine environment.	"…we would like to work in any way possible to get info out about the reserves. Because we have a small membership base we are not always able to staff an event but we can provide information."
American Cetacean Society	P.O. Box 1391 San Pedro, CA 90733-1391 Phone: (310) 548 - 6279 Email: info@ACSonline.org http://www.acsonline.org/		The American Cetacean Society protects whales, dolphins, porpoises, and their habitats through public education, research grants, and conservation actions.	No response
California Coastkeeper Alliance	Contact: Linda Sheehan (Executive Director) P.O. Box 3156 Fremont, California 92106 Phone: (510) 770-9764 Email: lsheehan@cacoastkeeper.org http://www.cacoastkeeper.org	Website	Formed in 1999, the California Coastkeeper Alliance is a coalition of local waterkeepers dedicated to protecting and restoring the quality of California's aquatic ecosystems. Waterkeeper programs are environmental "neighborhood watch" organizations, citizen patrols that protect communities and the waters they depend on. The California Coastkeeper Alliance provides a network of support among our member organizations and presents a unified voice on regional issues.	"I am happy to pass around email alerts to the Waterkeeper groups that are part of the Alliance. They have local contacts that they can send things to."
Central Coast Salmon Enhancement, Inc.	Contact: Stephnie Wald (Watershed Projects Manager) PO Box 277 Avila Beach, CA 93424 Phone: (805) 473-8221 Email: salmonfix@aol.com http://www.centralcoastsalmon.com/	Newsletter	Mission: dedicated to the enhancement and restoration of the Central Coast salmon fishery and local creeks. CCSE is also devoted to educating the community on the ecology and economy of these resources.	May be interested; need more information

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Environmental Center of San Luis Obispo County (ECOSLO)	Contact: Miranda Leonard (Environmental Education Coordinator) 1204 Nipomo Street San Luis Obispo, CA 93401-3933 P.O. Box 1014 San Luis Obispo, CA 93406/ 93401 Phone: (805) 544-1777 Fax: (805) 544-1871 http://www.ecoslo.org/	Primary method: E-mail. We also send seasonal newsletters and periodic direct mail.	ECOSLO actively supports dozens of groups and individuals striving to promote sustainable solutions to the problems of environmental health hazards, pesticide use, nuclear waste, habitat destruction, offshore oil development, water use and development sprawl.	"We would definitely be able to help get the word out. Of course, if we were a project partner and funding were available, we would be much more effective at this effort! So, I would have to say our answer would depend on the amount of support from the DFG."
Environment in The Public Interest (San Luis Obispo Coastkeeper)	Gordon R. Hensley (San Luis Obispo Coastkeeper) EPI-Center 1013 Monterey Street, Suite 207 San Luis Obispo, CA 93401 Phone: (805) 781-9932 Email: GRHensley@aol.com	Newsletter Email Listserve	The San Luis Obispo Coastkeeper is a program of Environment in the Public Interest (EPI) dedicated to enforcement of water quality, watershed, and coastal planning regulations in Northern Santa Barbara, San Luis Obispo, and Southern Monterey County.	May be interested and would like more information Willing to periodically update members with current CDFG information
Environmental Commons	PO Box 1135 Gualala, CA 95445 Phone: (707) 884-5002 Email: info@environmentalcommons.org http://www.rcwa.us/environmentalcommons/		One of three current projects is "protecting wild salmon," www.environmentalcommons.org/salmon.html	No response
Friends of the Estuary at Morro Bay	P.O. Box 1375 Morro Bay, CA 93443-1375 http://www.friendsofestuary.org/		With a membership of over 1,500, trying to extend the life of this relatively undisturbed place through research, planning and cooperative efforts with other organizations and agencies.	No response
Friends of The Elephant Seal	250 San Simeon Ave San Simeon, CA PO Box 490 Cambria, CA 93428 Phone: (805) 924-1628 Email: fes@elephantseal.org http://www.elephantseal.org		Mission: to promote stewardship and understanding of the rich marine life and unique marine environment of the Central Coast	No response

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Greenspace-Cambria Land Trust	800 Hillcrest Drive Cambria P.O. Box 1505 Cambria, CA 93428-1505 Phone: 805-927-2866 http://www.greenspacecambria.org	Newsletter Direct mail Events	Mission: The North Coast area of San Luis Obispo County is a national treasure. Greenspace will protect and enhance its ecological systems through land acquisition and management, public education and advocacy. One of goals: Engaging in strategic partnerships that foster Greenspace objectives of preservation, education, restoration, and advocacy of the environment of the North Coast of San Luis Obispo County.	Willing to periodically update members with new information from the CDFG Willing to work with CDFG to hold an outreach event with members Willing to partner with CDFG in any way possible to educate members
Marine Science Institute	Contact: Andrea Swensrud (Program Manager) 500 Discovery Parkway Redwood City, CA 94063 Phone: (650) 364-2760 Email: andrea@sfbaymsi.org http://www.cmiregistration.com/user/splash.jxp?org=261	Email listserve	Mission: The Institute's mission is to cultivate a responsibility for the natural environment and our human communities through interdisciplinary science education. We achieve this goal through innovative marine science education programs that: Place students of all ages in direct contact with the natural environment; Emphasize the interdependence of all living things, their connection to the physical environment, and the special responsibilities of humans to the environment;	Willing to work with CDFG to hold an outreach event with members
Monterey Peninsula Audubon Society	Contact: Craig Hohenberger (President of Board of Directors) P.O. Box 5656 Carmel, CA 93921 Email: chohenbe@monterey.k12.ca.us http://www.montereyaudubon.org/	Newsletter		Willing to periodically update our membership with new information from CDFG, in our newsletter whenever needed.
Morro Bay National Estuary Program	601 Embarcadero, Suite 11 Morro Bay CA 93442 Phone: (805) 772-3834 Fax: 805-772-4162 Email: staff@mbnep.org http://www.mbnep.org http://www.mbnep.org/index.php	Public meetings	The Morro Bay National Estuary Program is a collaborative organization that brings local citizens, local government, non-profits, agencies, and landowners together to protect and restore the physical, biological, economic, and recreational values of the Morro Bay Estuary.	No response

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Morro Coast Audubon Society	Contact: Henry Pontarelli PO Box 1507 Morro Bay, CA 93443 Email: mcas@morrocoastaudubon.org http://morrocoastaudubon.org/	Newsletter (distribution > 1000 members in San Luis Obispo County) Website Public programs, fundraisers and field trips Word-of-mouth	Mission: to promote the appreciation, conservation, and restoration of ecosystems, focusing on the biological diversity of birds, other wildlife, and their habitats, particularly in San Luis Obispo County, California.	MCAS is interested and willing to participate at the highest level.
Morro Estuary Greenbelt Alliance	Contact: Marla Morrissey P.O. Box 6801 Los Osos, CA 93412 Phone: (805) 528-5708 Phone: (831) 528-4955 Email: savedunes@aol.com	Email In-person Website Newsletter	Mission: Conservation of Coastal Dunes in Los Osos Area	"Yes, we are willing to partner in any way possible."
National Audubon Society	1120 13th Street Los Osos, CA http://www.audubon-ca.org		Mission: to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity. Our national network of community-based nature centers and chapters, scientific and educational programs, and advocacy on behalf of areas sustaining important bird populations, engage millions of people of all ages and backgrounds in positive conservation experiences.	No response
La Purisima Audubon Society	P.O. Box 2045 Lompoc, CA 93438 Phone: (805) 733-5501 http://www.lapurisimaaudubon.org			

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National Wildlife Federation: Western Natural Resource Center	3500 Fifth Avenue, Suite 101 San Diego, CA 92103 Phone: (619) 296-8353 Email: wnrc@nwf.org Nat'l: 800-822-9919 Mailing: Western Natural Resource Center, NWF 6 Nickerson Street, Suite 200 Seattle, WA 98109 Phone: (206) 285-8707 http://www.nwf.org http://www.nwf.org/western		Mission: to educate, inspire, and assist individuals and organizations of diverse cultures to conserve wildlife and other natural resources and to protect the earth's environment in order to achieve a peaceful, equitable, and sustainable future.	No response
Ocean Futures Society	325 Chapala Street Santa Barbara, CA 93101 Phone: (805) 899-8899 Email: contact@oceanfutures.org http://www.oceanfutures.org		Mission: to explore our global ocean, inspiring and educating people throughout the world to act responsibly for its protection, documenting the critical connection between humanity and nature, and celebrating the ocean's vital importance to the survival of all life on our planet. "Protect the ocean and you protect yourself"	No response
Oceana	Regional Office: *Southern California* Oceana 501 Santa Monica Blvd, Suite 312 Santa Monica, CA 90401 Phone: (310) 899-3026 Email: SoCal@oceana.org	Email Website		No response
Oceans Alive (Environmental Defense Network)	Regional Office - Oakland 5655 College Avenue, Suite 304 Oakland, CA 94618 Phone: (510) 658-8008	Newsletter	"Among our accomplishments: Helping to craft and pass California's Marine Life Protection Act."	Not interested in being an outreach partner.

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Point Reyes Bird Observatory	205 N 8th Street, Suite 217 Lompoc, CA Phone: (805) 735-7300 http://www.prbo.org/ William J. Sydeman, PhD, *Marine Ecology Division Director:* wjsydeman@prbo.org (Sydeman sits on SAT) Melissa Pitkin, *Director of Education & Outreach:* MPitkin@prbo.org	Newsletter Events Website	PRBO Marine Ecology Division's projects focus on four key areas, one of which is creation of Marine Protected Areas (MPA's) and Marine Reserves (MRV's) to protect ocean ecosystems.	May be interested; need more information Willing to provide information to members one time "PRBO would be interested in helping with this, we could do an article in one of our newsletters, but I would like to get more information from you."
Sierra Club, Santa Lucia Chapter	Contact: Andrew Christie (Chapter Coordinator) P.O. Box 15755, San Luis Obispo, CA 93406 Phone: (805) 543-8717 Email: sierra8@charter.net Santa.Lucia.Chapter@sierraclub.org http://santalucia.sierraclub.org/	Newsletter Email Listserve		Willing to partner with CDFG in any way possible to educate members "Our local newsletter, the *Santa Lucian*. Articles include conservation issues and legislative alerts. Submit articles to Andrew Christie at e-mail: sierra8@charter.net"
SLO Coast Alliance	Contact: Nancy Graves (Chair) PO Box 14422 San Luis Obispo, CA 93406 Email: info@slocoastalliance.org http://www.slocoastalliance.org/		Mission: to provide information and education on issues regarding the protection of the biological, cultural, visual, and agricultural resources of the coastal environment; and provide information and education on the equitable application and administration of the California Coastal Act; and conduct research and critical review of scientific data and information relating to the coastal environment; and provide information and opportunities for empowerment so the public might take a more active and creative role in the decision-making processes that affect the coast; and increase public understanding of, and capacity for, involvement in coastal conservation issues and their equitable resolution; and to create and foster partnerships in the advancement of these goals.	No response
Small Wilderness	P.O. Box 6442 Los Osos, CA 93412	Newsletter (bimonthly) Website		Willing to periodically update members with new

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Area Preservation	Phone: (805) 528-0392 http://www.lososobaywoodpark.org/swap/www.elfin-forest.org			information from the CDFG
Surfrider Foundation San Luis Bay	Contact: Matt Fleming (Chair) Patt Heatherington (Treasurer) P.O. Box 13222 San Luis Obispo, CA 93406 Phone: (949) 492-8170 Email: sanluisbay@surfrider.org pheatherington@charter.net http://www.sanluisbaysurfrider.org	Newsletter Email Direct mail In-person	Mission: The Surfrider Foundation is a non-profit environmental organization dedicated to the protection and enjoyment of the world's oceans, waves and beaches for all people, through conservation, activism, research and education.	Willing to partner with the CDFG in any way possible to educate members.
Surfrider Foundation Santa Cruz	Contact: Tim Tringali (Volunteer Coordinator) 2222 East Cliff Drive #234 Santa Cruz, California 95062 Phone: (831) 476-7667 Email: surfridersantacruz@yahoo.com http://www.surfridersantacruz.org	Email Listserve In-person	Mission: The Surfrider Foundation is a non-profit environmental organization dedicated to the protection and enjoyment of the world's oceans, waves and beaches for all people, through conservation, activism, research and education.	Willing to periodically update members with new information from the CDFG Willing to work with CDFG to hold an outreach event with members
The Bay Foundation of Morro Bay	Phone: 805 756-2193 http://www.thebayfoundation.org		The mission of the Bay Foundation is to provide leadership in restoring, enhancing, and protecting the marine resources and watersheds of Morro Bay, Estero Bay, and the Central Coast of California.	No response
The Nature Conservancy: Central Coast Office	Contact: Chuck Cook (Director of CA's Marine and Coastal Program) 99 Pacific Street, Suite 200G Monterey, CA, 93940 Phone: (831) 333-2044 Email: ccook@tnc.org Also: Dr. Mary Gleason (mgleason@tnc.org)		Mission: to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.	No response
The Nature Conservancy: San Luis Obispo Office	P.O. Box 1004 San Luis Obispo, CA 93406 75 Higuera St. Suite 200 San Luis Obispo, CA 93401 Phone: (805) 544-1767			

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The Ocean Conservancy	Contact: Kaitilin Gaffney 55 C Municipal Wharf Santa Cruz, Ca 95060 Phone: (831) 425-1363 Email: kgaffney@psinet.com http://www.oceanconservancy.org	Direct mail		Willing to partner with CDFG in any way possible to educate members
Windstar Foundation (California Connection)	Contact: Bill Templin, Laurie Kern Email: wtemplin@surewest.net kern@sbcglobal.net http://www.wstar.org	Email Listserve Other: web postings	Windstar is a non profit environmental education organization which promotes a holistic approach to addressing environmental concerns.	Willing to partner with CDFG in any way possible to educate members