Establishing Marine Reserves

How Can Science Best Inform Policy?

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Incorporating scientific information into policymaking is distinctly challenging. Various policy initiatives—from ecosystem restoration projects, such as the Chesapeake Bay Program to restore the bay's watershed, to long-term storage of nuclear waste, such as the Yucca Mountain Project—can differ in many ways, but all of them require scientific input. Every day, natural resource managers grapple with making decisions in the face of uncertainty due to complex and unpredictable natural environments. These decisions depend heavily upon the best available scientific knowledge.

Some approaches to incorporating the best available knowledge into the policy outcome are more successful than others. The chosen approach may be as influential in determining the degree to which science informs decisionmaking as the quality of the science itself. Ongoing efforts to implement marine protected area (MPA) policy initiatives along the U.S. West Coast provide case studies with which to analyze the efficacy of different methods of incorporating science into decisionmaking.

An MPA is an area of ocean protected from some or all human activities. There are various types of MPAs around the world that protect against activities such as oil drilling and bottom trawling. Marine reserves—also known as fully protected areas or "no-take MPAs"—are one type of MPA that prohibits the extraction and alteration of all living and nonliving marine resources.[1] In the realm of ocean resource policy and science today, marine reserves are one of the most hotly debated tools among managers, scientists, and stakeholders because of their protective and therefore restrictive nature. Proposed as conservation tools in the 1980s and applied to a limited extent around the world, marine reserves have received increasing consideration in recent years.[2]

More than 20 nations have established marine reserves, which range in size from less than one square mile to hundreds of square miles. These protected areas are being formed through grassroots organizing (in Mexico and the Philippines, for example) as well as through top-down government mandates (such as those in Canada and Australia). Many regional, state, and local entities around the world are implementing MPAs. Despite these efforts, however, less than 1 percent of the world's oceans currently is protected as MPAs. Less than one-hundredth of 1 percent is designated as marine reserves.[3]

In the United States, the National Marine Sanctuary Program encompasses approximately 18,000 square miles of ocean waters and associated habitat under the 1972 National Marine Sanctuaries Act, but only a small percentage of that area is fully protected.[4] An executive order issued by President Bill Clinton in 2000 mandated that the National Oceanic and Atmospheric Administration (NOAA) establish a Marine Protected Area Center. Under this directive, the center is "to develop a framework for a national system of MPAs, and to provide federal, state, territorial, tribal, and local governments with the information, technologies, and strategies to support the system."[5]

Most of the ongoing processes to implement MPAs include some level of community involvement. Within a typical top-down management structure, the lead entity forms a stakeholder body consisting of local constituents such as fishers, environmental groups, other management agencies, and scientists to provide advice. In other cases, fishing communities have come together to protect an area from overextraction through self-imposed exclusion. In all cases, sport and commercial fishers are affected and typically are a vocal constituent—both for and against MPAs.

Proponents of marine reserves ground their arguments in conservation science and advocate that reserves have the potential to protect habitat and biodiversity and to ensure that ecosystems within reserves will continue to function into the future. In addition, protecting both habitat and fished populations within a reserve is purported to buffer populations from overexploitation and contribute to the replenishment of fished populations by exporting individual organisms from reserves to fished populations. On the other hand, opponents criticize the notion of another layer of regulation on fisheries within an already complex regulatory system. They argue that there is a lack of evidence supporting the efficacy of MPAs as a management tool, particularly regarding fishery benefits. Within this forum of debate, natural science continues to play a critical role in conceptualizing and designing proposed reserve systems, elucidating reserve objectives, defining realistic magnitudes of reserve effects, and identifying temporal and geographic scales over which reserve effects will likely manifest.

It is important to consider how science has helped to formulate and inform the current policy-driven discussions of MPAs. The incorporation of this science into three MPA policy processes under way on the West Coast can be compared to provide some insight into procedures that might benefit future MPA processes around the world—as well as other ecosystem-driven management practices.

Potential Benefits of Marine Reserves

Biological science—ecology in particular—has been important in informing the development of marine reserve policy. Marine ecologists and fishery biologists continue to identify the need for a conservation tool to protect declining ocean resources. Scientists also have elucidated potential roles for marine reserves in ecosystem management. This work has raised the visibility of marine reserves and helped clarify some specific objectives for them.

Enhancing reproductive potential. Ecological studies have documented the effects of fishing on the structure and dynamics of coastal marine populations, communities, and ecosystems.[6] For instance, by removing large individuals from a population, fishing decreases the average size and reproductive potential of a population. As individuals get older, they allocate more energy to reproduction than growth; therefore, larger and older individuals produce significantly more offspring. For example, one 60 cm red snapper in the Gulf of Mexico produces as many eggs as do 212 40 cm snapper.[7] Therefore, a larger average size in a population can have profound effects on its reproductive potential and its ability to regenerate depleted populations.

Maintaining species diversity. Ecological interactions among species can influence the composition, diversity, and persistence of a community or ecosystem. Higher-level predators such as lobsters and California sheephead, which are often targeted for extraction, limit grazers (primarily sea urchins) that commonly deforest rocky reef habitats.[8] If such predators are removed and grazers are not hindered, entire kelp forests that provide shelter, recruitment habitat, and food for a wide variety of fish and invertebrates can become overgrazed and deforested.

Preserving habitat. Human practices such as dredging, trawling, and using underwater explosives for fishing can severely damage marine habitats. (In some coral reef areas, fishers use dynamite to kill and collect fish. The explosions also destroy the corals.) These actions remove geologic and biologic structure that provides habitat for many species. The loss of habitat affects species' ability to survive and decreases local species diversity. A striking example of how closing an area can protect and enhance habitat and ecosystem productivity is the closure of Georges Bank, off the New England coast, in 1994 to improve cod populations. Within only four years of closure, the scallop population within the protected area had increased 14-fold because scallops reproduce at an early age.[9] Cod did not rebuild as rapidly because they develop more slowly than scallops and reproduce later in life.

Preserving ecosystem function. Ecologists recognize the value in protecting large areas to study how unaltered ecosystems function. In a recent study of a reserve that prohibits sea urchin harvesting, ecologists found that replenishment of young abalone—a threatened and economically important fishery—was enhanced inside the reserve because they are more likely to survive when they are protected under the spines of the urchins.[10] The relationship between abalone and urchins highlights the potential existence of previously unidentified MPA benefits. In comparing areas inside and outside of reserves and gathering data over time, protected areas will allow researchers to distinguish natural changes in the marine environment from those caused by humans.

Supporting fisheries. Biologists also recognize potential roles for MPAs in fisheries.[11] The two most widely discussed potential functions of MPAs are "larval export" (transporting on ocean currents the young born inside a reserve to outside the reserve boundaries) and "spillover" (adult fish traveling outside reserve boundaries). Scientists are devoting more attention to these potential roles of reserves because of recently identified fisheries collapses and habitat destruction in the ocean environment. The projected harm of these threats is convincing many scientists and managers of the difficulty of successfully implementing traditional management approaches—such as catch limits and gear restrictions—and that a more precautionary approach is necessary.[12] Because currents can carry fish larvae great distances from protected populations in reserves, protected adult stocks could act as buffers against overharvesting and as sources of production to enhance the rebuilding rate outside the reserve.

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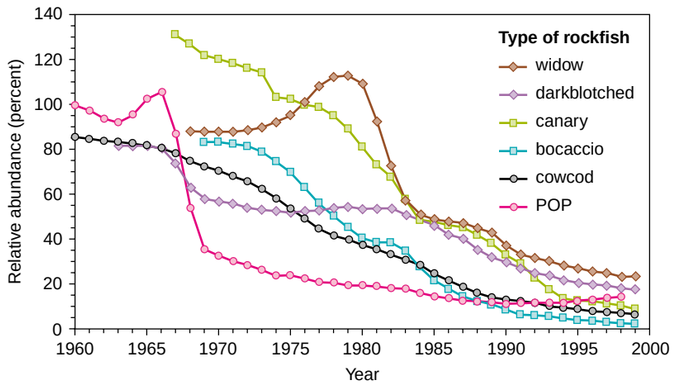
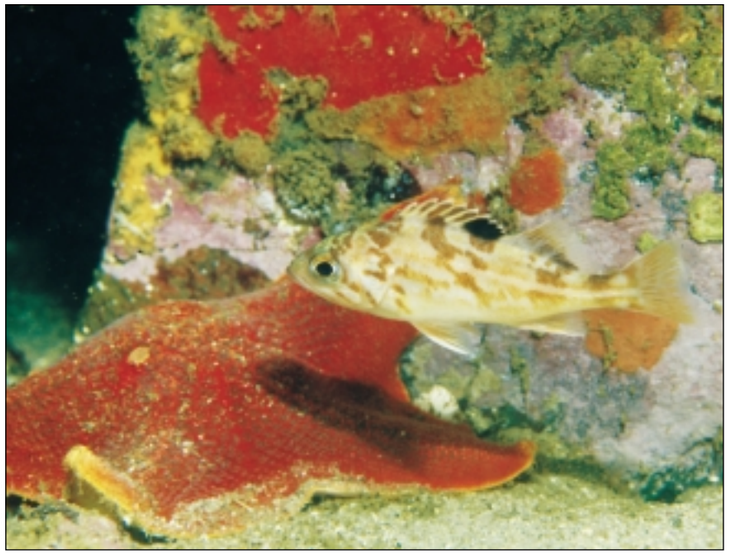
Proponents of marine reserves believe that reserves in areas such as the Big Sur region of California's central coast have the potential to protect habitat and biodiversity and ensure that ecosystems within reserves will continue to function into the future.

Figure 1. Rockfish population decline on U.S. West Coast



NOTE: POP = Pacific ocean perch.
SOURCE: National Marine Fisheries Service, 2002.

One extreme example that illustrates the difficulty of implementing traditional fisheries management is the steady decline of several rockfish populations on the West Coast over the past four decades (see Figure 1 on this page). The National Marine Fisheries Service has tracked the abundance of rockfish stocks during the past several decades. In recent years, the health of some of these stocks (such as bocaccio, darkblotched, canary, and yelloweye rockfish) has become so poor that the Pacific Fisheries Management Council announced in June 2002 that as of 1 January 2003, the entire groundfish fishery along the West Coast continental shelf would be closed indefinitely to allow stocks to rebuild.[13]



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This juvenile canary rockfish is one of many types of rockfish whose populations on the West Coast have steadily declined over the past several decades.

Despite proposed and documented benefits of marine reserves, criticisms have raised questions about their limitations and purported contributions, especially with respect to fisheries management. Some scientists argue that the fisheries benefits of MPAs are merely speculative and that applying traditional fisheries management tools can achieve the same ends. In addition, some are concerned that regulators will view MPAs as a panacea for ocean management and abandon other tools in favor of reserves.[14] This is problematic because if fishing effort is not controlled outside of reserves, it may intensify and cause degradation of fished stocks and their habitats in the unprotected areas. At their core, however, MPAs are a conservation tool and may have only a tangential role in fisheries management. Regardless of fisheries benefits, most scientists agree that MPAs provide benefits by protecting critical ecosystems. The box on page 13 provides information on a consensus statement on marine reserves and MPAs.

Science-Based Reserve Design

Increased awareness of the potential value of reserves for protecting coastal ecosystems has prompted numerous proposals for their implementation around the world. As proposals for marine reserves have increased in number and geographic scope, science-based criteria have shaped three key features of their design: size, number, and location. Each feature varies depending upon the objectives of the MPA, but ecological studies of the life history and population ecology of coastal marine organisms imply some general conclusions regarding each feature. Figure 2 on page 14 illustrates some design choices.

How big should an MPA be? Most studies addressing this question suggest that to be effective, an MPA should cover a large area. Studies that have examined the relationship between area and species diversity indicate that, as on land, diversity increases with area.[15] Thus, a larger MPA would protect a greater number of species. In addition, a large MPA is likely to protect a greater representation of the habitats that an individual organism uses during its lifetime. Marine species often move among different types of habitat as they grow because they require different resources such as food and shelter. Large MPAs are also more likely to contain dispersed young within their boundaries, thereby allowing the protected populations to replenish themselves. For species whose juveniles and adults move over large areas, reserves must be large enough to encompass the area of movement of a substantial portion of the population to ensure the protection of that population over its lifetime.

A large number of MPAs in a given region is beneficial for several reasons. First, it is unlikely that all representative habitats and associated species in a region will be included within any one MPA. For adequate habitat and biogeographic representation, many MPAs are necessary. In addition, to ensure that protected populations can sustain themselves, they must be largely self-replenishing. Most marine species produce offspring that can disperse great distances (as far away as hundreds of kilometers) on ocean currents. For such species, only very large MPAs (on the order of 400 square kilometers) allow protected populations within a single reserve to self-replenish. Populations within smaller MPAs rely on the delivery of young from distant, unprotected populations. Therefore, a network of multiple smaller areas—separated from one another at distances that allow connectivity among reserves through larval dispersal—could enhance the persistence of reserve populations independent of conditions outside reserves.[16] Many smaller MPAs also can broaden the range of unprotected populations that benefit from enhanced larval export out of the protected areas.

Siting MPAs across representative habitats and biogeographic regions will likely help achieve many MPA objectives. Biodiversity hotspots, critical or rare habitats, and spawning grounds where one or more target species con-

Consensus Statement on Marine Reserves and Marine Protected Areas

One hundred sixty-one scientists signed a consensus statement that was generated from the findings of an international working group of scientists convened by the National Center for Ecological Analysis and Synthesis in 1997. The objective of this team of scientists was to develop a better scientific understanding of marine protected areas and marine reserves. The statement was prepared at the request of fishing communities, resource managers, and conservation groups that wanted a concise, nontechnical statement summarizing the latest scientific assessment of the effects of marine reserves. The text that follows is taken from the consensus statement.[1]

The first formal marine reserves were established more than two decades ago. Recent analyses of the changes occurring within these marine reserves allow us to make the following conclusions:

Ecological effects *within* reserve boundaries:

1) Reserves result in long-lasting and often rapid increases in the abundance, diversity and productivity of marine organisms.

2) These changes are due to decreased mortality, decreased habitat destruction and to indirect ecosystem effects.

3) Reserves reduce the probability of extinction for marine species resident within them.

4) Increased reserve size results in increased benefits, but even small reserves have positive effects.

5) Full protection (which usually requires adequate enforcement and public involvement) is critical to achieve this full range of benefits. Marine protected areas do not provide the same benefits as marine reserves.

Ecological effects *outside* reserve boundaries:

1) In the few studies that have examined spillover effects, the size and abundance of exploited species increase in areas adjacent to reserves.

2) There is increasing evidence that reserves replenish populations regionally via larval export.

Ecological effects of reserve *networks*:

1) There is interesting evidence that a network of reserves buffers against the vagaries of environmental variability and provides significantly greater protection for marine communities than a single reserve.

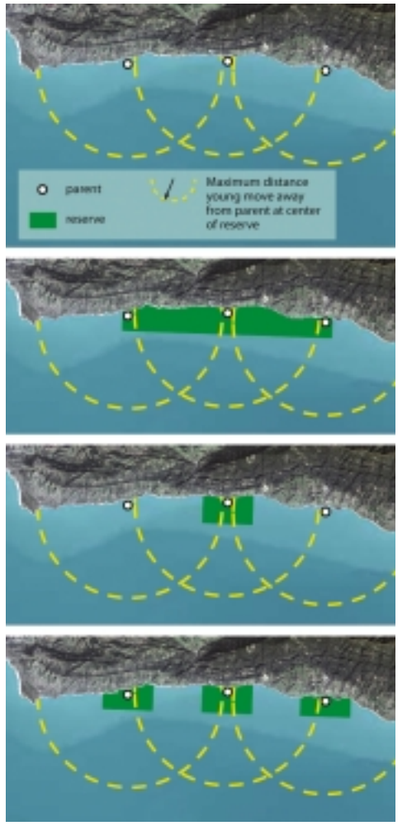
2) An effective network needs to span large geographic distances and encompass a substantial area to protect against catastrophes and provide a stable platform for the long-term persistence of marine communities.

The above language succinctly compiles the findings of the experts who analyzed the body of evidence surrounding the effectiveness of established marine protected areas. This language and the associated conclusions signify a unique occasion: A large number of academic scientists came together to actively support a general conclusion based on new information. In the statement, the signatories agree that there is enough scientific evidence to support the continued development of marine reserves as a tool for conserving biodiversity and fisheries. The rarity of a group of academic scientists boldly promoting the use of a particular resource-management tool indicates the significance of this statement.

The National Center for Ecological Analysis and Synthesis is sponsoring a follow-up marine reserves working group to examine the scientific design and evaluation of marine protected areas and marine reserves. Meetings commenced in summer 2002.

1. National Center for Ecological Analysis and Synthesis, "Scientific Consensus Statement on Marine Reserves and Marine Protected Areas" (Santa Barbara, Calif., 2001), accessed via http://www.nceas.ucsb.edu/Consensus/consensus.pdf on 25 July 2002.

Figure 2. Marine reserve design alternatives



Young organisms born in one place are often carried by currents to a certain distance, indicated by dashed lines.

Young produced in a large reserve are likely to stay in the reserve, contributing to population conservation. However, large reserves reduce the area open to local commercial and recreational fishing.

A small reserve may protect organisms while they are in the reserve, but many may settle in surrounding waters. If reserves are too small, fewer populations in the reserve will be able to sustain themselves, and they will be unlikely to "seed" adjacent fishing grounds.

An alternative is to establish a network of reserves that protects different portions of critical habitats that are connected to each other through the movement of plants and animals.

SOURCE: Partnership for Interdisciplinary Studies of Coastal Oceans, *The Science of Marine Reserves* (Santa Barbara, Calif., 2002), 16.

gregate are some likely locations for MPAs. The influence of coastal features such as embayments and oceanographic conditions such as current patterns on larval movement is still under study, and scientists therefore recommend that several of these characteristics be included within an MPA network to ensure adequate protection. As the relative value of the effects of these features becomes clear, managers can adjust the network to improve the regional benefit. The distance between adjacent MPAs is important regarding larval dispersal among MPAs. Studies of the dispersal distances of coastal marine species indicate that spacing areas tens of kilometers apart would allow for a large number of species to replenish adjacent reserve populations.[17]

Integrating Science and Policy

Scientific knowledge of the potential benefits of MPAs has provided a springboard for action. Federal and state managers on the West Coast have undertaken multiple processes to employ MPAs within nearshore regions.[18] Examples include a joint federal and state process in the Channel Islands of southern California, the state of California's legislated mandate to create a statewide network of MPAs, and the state of Oregon's ocean advisory panel that analyzed the feasibility of implementing MPAs within state waters. In each case, slightly different approaches used to inject natural science into the process have led to diverse public perceptions, management opportunities, and outcomes.

Channel Islands Marine Reserves Working Group

A group of recreational fishers concerned about fisheries resources within the Channel Islands National Marine Sanctuary initiated the consideration of marine reserves in this area with a proposal to the California Fish and Game Commission in January 1998. Simultaneously, the sanctuary began a federally mandated process to update its management plan. Sanctuary staff identified the consideration of marine reserves as part of this plan. Rather than address the issue separately, the California Department of Fish and Game (CDFG) and the Sanctuary Advisory Council joined efforts in 1999 to create the Marine Reserves Working Group (MRWG), which became a center of debate, discussion, and negotiation among resource managers, stakeholders, scientists, economists, and the public for the following three years.

MRWG consisted of representatives from state and federal agencies and a diverse group of stakeholders.[19] The Sanctuary Advisory Council formed two expert panels—a science panel and a socioeconomic panel—to advise MRWG on relevant topics. MRWG provided the science panel with goals—to protect species and habitats and to contribute to sustainable fisheries in the region—as guidelines for developing criteria for the design and location of potential reserve sites. To meet these goals, the science panel recommended that MRWG designate 30 to 50 percent of all key habitat types within sanctuary waters as marine reserves. This recommendation was based on scientific models that relied upon criteria similar to those required by MRWG.[20] In addition, the science panel used a geographic information systems–based siting model to identify potential reserve sites. Considering MRWG's additional goals to minimize socioeconomic impacts and maintain economic viability in the region, some representatives opposed the science panel's recommended percentage as too large.

Ultimately, MWRG achieved consensus on the goals of the reserve network but not on a specific design. Instead, MWRG generated two proposals for the Sanctuary Advisory Council that set aside 29 percent and 12 percent of sanctuary waters. The council submitted these proposals to CDFG and the sanctuary staff, who in turn used the information to create an intermediate proposal of 25 percent set-aside. The commission received this intermediate proposal and five alternatives, including the two proposals developed by MRWG, for consideration.

On 23 October 2002, the commission voted to implement the intermediate proposal within state waters beginning 1 January 2003. Now the sanctuary and the Pacific Fishery Management Council must consider whether to protect the federal waters adjacent to those designated in state waters, as indicated in the proposal that was selected. Only with the designation of those additional areas will the targeted 25 percent set-aside come to fruition. The federal decision will likely take two years.

California's Marine Life Protection Act

On 8 October 1999, the California legislature passed the Marine Life Protection Act. The act requires explicit consideration of marine protected areas as one of several complementary management approaches for conserving nearshore marine ecosystems. The act also mandates a "scientifically sound" process for siting and designing marine reserves and other types of MPAs. Ultimately, the act requires the adoption of a comprehensive plan for installing a network of MPAs in state waters.[21]

The act designates the California Department of Fish and Game as the lead implementation entity. CDFG was required to delegate a "master plan team" of natural scientists responsible for advising and assisting the department in the development of the plan. In April 2000 the CDFG director approved the master plan team, which consists of 14 members, including marine ecologists, fisheries biologists, and agency representatives.[22] The team then convened closed meetings over the course of one year.

The team developed a series of criteria for designating MPAs along the coast and drew up "Initial Draft Concepts for Marine Protected Areas in California."[23] These concepts consisted of a series of maps with proposed MPAs based on their defined characteristics (such as habitat representation, fisheries diversity, oceanographic features, and biologic features) and some description of the approach used to reach their conclusions. CDFG presented the draft concepts to the public for initial input in July 2001 at a series of open forums.

The public did not respond to the draft concepts as the master plan team had anticipated. Although CDFG intended the draft maps to serve as a starting point for discussion, the public—particularly MPA opponents—felt that the lack of stakeholder involvement in the development of the concepts was unacceptable. Following numerous heated public meetings and deliberation by CDFG, the department discarded the draft concepts and initiated a new, stakeholder-driven, facilitated process to inform the siting of MPAs along California's coast on a regional basis. The regional meetings began in July 2002 and will likely continue for at least two years.[24]

Oregon's Ocean Policy Advisory Council

In July 2000, Oregon Governor John A. Kitzhaber requested that the Ocean Policy Advisory Council (OPAC) convene a working group to consider the implementation of marine reserves within state waters.[25] OPAC selected eight of its members to join the new MPA Working Group in April 2001 and set a deadline of August 2002 to report to the governor.

The working group met 11 times between May 2001 and August 2002, in an open-meeting setting, to gather information and to prepare a draft recommendation for review and deliberation by the full council. To inform their recommendations, the working group heard presentations from individual scientists and natural resource personnel and convened a two-day intensive dialogue session. The full council (including members of the working group) heard from a panel of local scientists working in the marine environment and a panel of local experts,

including fishers. This format allowed for in-depth discussions between OPAC members and these experts.[26]

The working group submitted draft recommendations to OPAC in April 2002. After OPAC approved their distribution, the working group convened a series of 11 public meetings in May and June 2002 to accept comments on the draft. Public feedback ranged from marine reserve advocates who attacked the process as too slow and the proposal as too weak to opponents who argued that marine reserves were unnecessary and a waste of state resources.

In June the MPA Working Group agreed to refine its recommendations based on the constructive comments received at the public meetings. On 16 August 2002 the group presented OPAC with a stronger and more comprehensive recommendation to employ marine reserves along the coast of Oregon.[27] The executive summary of the revised draft recommendation states that OPAC "finds that sufficient evidence exists to recommend that Oregon establish a limited system of marine reserves to test and evaluate the effectiveness of reserves in meeting marine resource conservation objectives." The working group suggests no specific locations for MPAs in its report but does recommend implementing an inclusive stakeholder-driven process to site them along the coast. OPAC accepted the recommendation with only a few minor changes.[28] On 13 November 2002 Governor Kitzhaber endorsed the proposal to establish a system of marine reserves along the Oregon coast.

Contrasting Approaches

Each of these examples used a different approach to insert natural science into the policy process. At the Channel Islands, the Sanctuary Advisory Council formed a science panel to provide scientific background, criteria to meet the Marine Reserves Working Group goals, and analysis of different design alternatives. Thus, the science panel provided support to the stakeholder group—MRWG—in its effort to generate a reserve proposal. In contrast, the Marine Life Protection Act master plan team, independent of stakeholder involvement, was the sole source of a draft MPA network design from the outset. In further contrast, to date the Oregon MPA Working Group has received scientific input in a more interactive and less formal manner than the two California processes. However, OPAC tasked the working group only to determine whether to consider the establishment of marine reserves, and it has not begun to develop specific design recommendations. Each example illuminates different advantages and disadvantages. Figure 3 on page 17 summarizes the policy process for each case.

At the Channel Islands, the autonomous nature of the science panel protected the objectivity and integrity of the scientific information and recommendations. Despite good intentions to remain objective, however, the lack of clear communication between the scientists and others generated some mistrust in the quality of the science. For example, the public often misinterpreted the heated debates that occurred during the panel's open meetings as uncertainty in the science. In addition, the conservation community's quick adoption of the panel's recommendations led to a public perception that the science was biased. As a result, MRWG at times considered the scientific advice as a negotiating position between involved stakeholders rather than integrated advice.

By designating an independent team of scientists from the outset, the Marine Life Protection Act program purposefully set the master plan team's mandate aside from the broader political process. However, when presented with the team's findings, the public refused to accept them. In this case, the managing agency miscalculated the reaction of its largest stakeholder group—the fishing community. The minutes from the master plan team meetings reveal that substantial time was spent developing criteria that each stakeholder group would approve (such as avoiding closing all the fishing areas related to one fishery, considering bottom habitat, and including water-quality factors), and yet their presentation did not carry weight with opposing stakeholders.[29] It is not clear whether a different approach to disseminating the material or much greater stakeholder involvement in the draft plan's development from the outset would have caused less controversy. Seven regional stakeholder groups, each with one natural scientist, will inform the revised Marine Life Protection Act process. The outcome of this new process is unclear, but it is certain that science is no longer the primary emphasis.

Oregon's Ocean Policy Advisory Council benefited from starting its MPA assessment in the wake of California's efforts. The MPA Working Group meetings began around the time that California's draft master plan and the Channel Islands' MRWG meetings were ending. Consequently, Oregon limited its initial goals to determining whether marine reserves were worthy of implementation and did not address critical design criteria such as location or percent set-aside. In the end, Oregon also limited its consideration of reserves to conservation purposes and not fisheries management. To inform their decision, in addition to hearing from experts, MPA Working Group members were required to educate themselves on the conservation and fisheries roles of reserves and evidence of their effectiveness through reading materials suggested by the OPAC staff and attendance at various public forums on MPAs. In part, this reflected the limited time available for the decisionmaking process, restricting the number and breadth of possible scientific presentations. In its integration of science, the MPA Working Group clearly learned from the two California processes in the way that it solicited advice. The group kept its meetings open, and it treated local knowledge on par with scientific knowledge during the expert panel presentations.

Lessons Learned

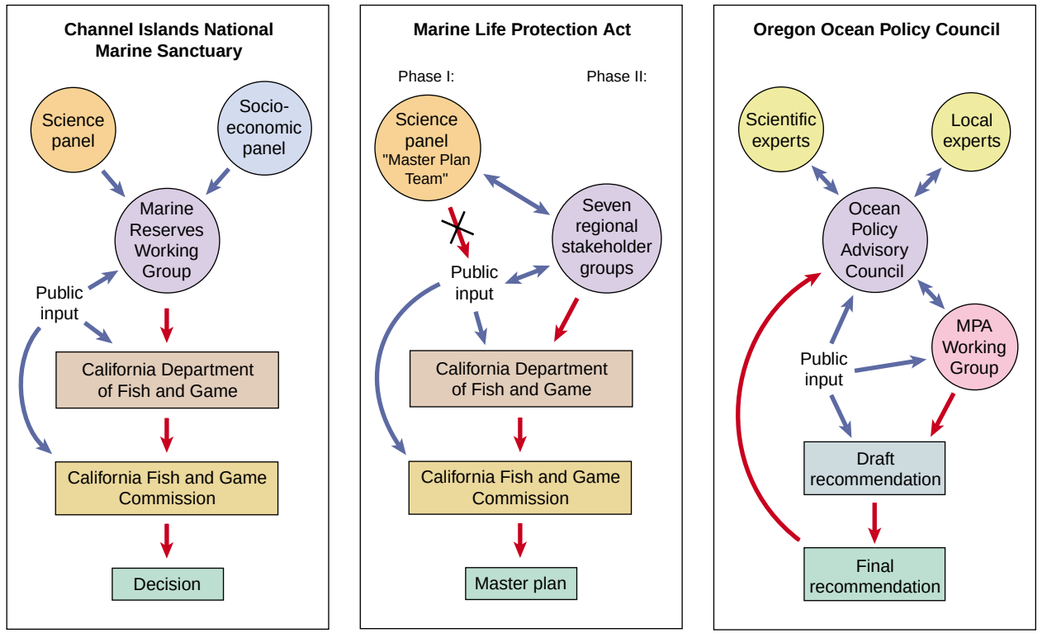
What can be learned from these contrasting approaches to integrating science into reserve policy and environmental policy in general? In all three cases, the process included science from the beginning. But the relative emphasis on science and stakeholder input at the outset varied markedly. The difficulty of striking a balance between science-driven and stakeholder-driven consideration extends beyond the marine environment and appears at the core of many environmental initiatives.

The importance of science can be illustrated with an analogy: A group of stakeholders is considering the purpose and design of an oceangoing vessel. Stakeholders have differing interests in the purpose of the vessel, its design, its amenities, and the allocation of duties on and use of the vessel. Regardless of how decisions about these interests are made, if the vessel is not designed and built by someone with intimate knowledge of hydrodynamics and construction materials, the vessel will sink upon launching. Likewise, any system of reserves designed in the absence of an ecological understanding of the organisms and habitats it intends to protect is doomed. But even the best-designed, best-built vessel cannot leave port unless there is agreement among owners and crew as to the purpose of its voyage.

It is important to point out that decisionmaking at the level of all three processes described occurs within a set political system. Oregon's governor has served as a champion for marine reserves in supporting OPAC's recent recommendation. Similarly, the Channel Islands process seemingly had a supporter in California Governor Gray Davis, who, through his appointed commissioners, has at least an indirect influence on the California Fish and Game Commission. Despite the best science in the world—and the most effective approach to incorporating that science—the political environment will continue to weigh heavily on any decision at any given time.

In California's Marine Life Protection Act effort, science took the driver's seat at the outset, and the process eventually shifted into a stakeholder forum. A stronger position by the sponsoring governmental agency could possibly have rebutted the political opposition, in turn expediting reserve establishment. However, in either case, the eventual success of the program remains uncertain. In contrast, the stakeholder-dominated process that characterizes the Oregon approach may take much longer to implement. Because OPAC's efforts began later and will likely take longer

Figure 3. Three policy processes



NOTE: Stakeholder panels are shown in purple; science panels are shown in orange. Advisory paths are marked with blue arrows, and decision paths are marked with red arrows.

SOURCE: L. K. Bergen and M. H. Carr.

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Juvenile gopher rockfish. Some scientists argue that the fisheries benefits of marine protected areas are merely speculative and that applying traditional fisheries management tools can achieve the same ends.

than the California processes, the relative successes have yet to manifest themselves, but it is clear that in each case, both the ecological and political systems are fundamental to the success of the process and the end result.

The designation of the Channel Islands marine reserves in October 2002 illustrates the importance of integrating the ecological and political systems. The Channel Islands program designated one of the largest systems of reserves ever allocated within U.S. waters, and scientific information had a considerable influence on the process. Although the final area set aside does not encompass 30–50 percent of each of the key habitats, as the science panel recommended, it does include a significant proportion of each one, ranging from 21 to 35 percent coverage. In addition, the chosen areas successfully create a science-based network of reserves around the islands that incorporates distinct oceanographic regimes, bottom types, and biological assemblages. Furthermore, 25 percent of sanctuary waters is a fairly substantial area in its own right. But science alone did not generate this outcome; successful negotiation among multiple agencies, stakeholder groups, and the various advisory bodies produced the Channel Islands designation.

One critical aspect of the relative emphasis of science and stakeholder input is timing. The California processes emphasized science from the beginning, but in the Oregon process, science is likely to be incorporated gradually and increasingly as issues of design and evaluation receive more attention. How these differences in emphasis influence both the rate of policy development and critical attributes of the result (such as the degree to which ecological understanding underpins the final reserve design) will not be determined until all three processes have run their course. However, the seeming success in incorporating scientific information into the Channel Islands process indicates that an iterative relationship between science and the political process is beneficial. The failure of the Marine Life Protection Act process to implement its first-round science-based design due to a lack of direct stakeholder input from the outset bolsters this conclusion. Without a working relationship between the managers, the people affected, and the information sources (such as the scientists), it was not possible to implement a purely science-based design.

Clearly, marine reserve activities along the West Coast provide resource managers, policy makers, and policy analysts with empirical information from which much can be learned about how to incorporate science into the development of environmental policy and what consequences differing approaches can have on the realized outcome. As resource managers continue to struggle with incorporating science into ecosystem management within a complex political and natural environment, the processes of implementing marine reserves on the West Coast serve as models of dos and don'ts. Over time, as the Marine Life Protection Act and OPAC processes move forward and the Channel Islands reserves plan is implemented, an even broader spectrum of findings will be available to inform future processes.

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NOTES

1. National Research Council, *Marine Protected Areas: Tools for Sustaining Ocean Ecosystems* (Washington, D.C.: National Academy Press, 2001), 12.

2. In the l990s, marine protected areas (MPAs) and marine reserves received increasing attention. Recent reviews that reference this trend and provide an overview of the latest MPA science include T. S. Agardy, *Marine Protected Areas and Ocean Conservation* (Georgetown, Tex.: Academic Press and R. G. Landers Co., 1997); National Research Council, ibid.; and the Partnership for Interdisciplinary Studies of Coastal Oceans, *The Science of Marine Reserves* (Santa Barbara, Calif., 2002).

3. C. M. Roberts and J. P. Hawkins, *Fully-Protected Marine Reserves: A Guide* (Washington, D.C.: WWF Endangered Seas Campaign; and York, U.K.: University of York, 2000), accessible via http://www.panda.org/resources/publications/water/mpreserves/mar_dwnld.htm.

4. For more information on the National Marine Sanctuaries Act, see the National Oceanic and Atmospheric Administration's (NOAA) National Marine Sanctuary Program web site at http://www.sanctuaries.nos.noaa.gov/.

5. Executive Order 13158: Marine Protected Areas, 26 May 2000 (Washington, D.C.), accessed via the Marine Protected Areas of the United States web site at http://mpa.gov/frontmatter/sup1_eo.html on 30 July 2002.

6. Population structure refers to the genetic makeup, age, size, and gender of the individuals that constitute it. Community structure refers to the number, diversity, and relative abundance of species at a site. Ecosystem structure refers to the diversity and composition of habitat types and associated biological communities.

7. NOAA, Plan Development Team, "The Potential of Marine Fishery Reserves for Reef Fish Management in the U.S. Southern Atlantic," NOAA Technical Memo NMFS-SEFC-261 (Washington, D.C., 1990).

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9. S. A. Murawski, R. Brown, H. L. Lai, P. J. Rago, and L. Hendrickson, "Large-Scale Closed Areas As a Fisheries-Management Tool in Temperate Marine Systems: The Georges Bank Experience," *Bulletin of Marine Science* 66, no. 3 (2000): 775–98.

10. L. Rogers-Bennett and J. S. Pearse, "Indirect Benefits of Marine Protected Areas for Juvenile Abalone," *Conservation Biology* 15 (2001): 642–47.

11. J. A. Bohnsack, "Application of Marine Reserves to Reef Fisheries Management," *Australian Journal of Ecology* 23 (1998): 298–304; and S. N. Murray et al., "No-Take Reserve Networks: Sustaining Fishery Populations and Marine Ecosystems," *Fisheries* 24, no. 11 (1999): 11–24.

12. D. Pauly, V. Christensen, J. Dalsgaard, R. Froese, and F. Torres Jr., "Fishing Down Marine Food Webs," *Science*, 6 February 1998, 860–63; J. A. Hutchings, "Collapse and Recovery of Marine Fishes," *Nature*, 24 August 2000, 882–85; D. Pauly et al., "Towards Sustainability in World Fisheries," *Nature*, 8 August 2002, 689–95; and D. O. Conover and S. B. Munch, "Sustaining Fisheries Yields over Evolutionary Time Scales," *Science*, 5 July 2002, 94–96.

13. The groundfish fishery is a suite of several species that are collectively managed by the Pacific Fisheries Management Council. It includes 65 rockfish species, 12 flatfish species, 6 roundfish species, and 6 species of sharks and skates. For more information, visit the council's web site at http://www.pcouncil.org/groundfish/gfback.html.

14. Numerous concerns have been raised regarding the effects of marine reserves on fisheries, including modeling studies that indicate that only enormous reserve areas will enhance fishery yields and only for heavily depleted stocks; potential increases in fishing intensity and habitat destruction in nonreserve areas due to displacement; a lack of regionally relevant evidence of reserve effectiveness; and potentially detrimental consequences of failing to accurately assess reserve effectiveness. See R. Parrish, "Marine Reserves for Fisheries Management: Why Not," *California Cooperative Oceanic Fisheries Investigations* 40 (1999): 77–86; C. Walters, "Impacts of Dispersal, Ecological Interactions, and Fishing Effort Dynamics on Efficacy of Marine Protected Areas: How Large Should Protected Areas Be?" *Bulletin of Marine Science* 66, no. 3 (2000): 745–58; M. H. Carr and D. C. Reed, "Conceptual Issues Relevant to Marine Harvest Refuges: Examples from Temperate Reef Fishes," *Canadian Journal of Aquatic Sciences and Fisheries* 50 (1993): 2,019–28; M. H. Carr and P. T. Raimondi, "Marine Protected Areas As a Precautionary Approach to Management," *California Cooperative Oceanic Fisheries Investigations* 40 (1999): 71–76; and Murray et al., note 11 above, pages 11–25.

15. J. Neigel, "Species-Area Relationships and Marine Conservation," *Ecological Applications* (forthcoming).

16. A reserve network is a system of reserves in which the individual reserves are spaced at distances that allow young produced in one reserve to disperse to and replenish populations in another reserve. This movement of offspring carried by ocean currents from one population to another is referred to as population connectivity.

17. A. L. Shanks, B. Grantham, and M. H. Carr, "Propagule Dispersal Distance and the Size and Spacing of Marine Reserves," *Ecological Applications* (forthcoming); and B. P. Kinlan and S. D. Gaines, "Propagule Dispersal in Marine and Terrestrial Environments: A Community Prospective," *Ecology* (forthcoming).

18. The Federal Marine Protected Area Center currently is monitoring 11 ongoing MPA processes on the West Coast of the United States. These processes range from county-level volunteer MPA programs to international efforts to devise a network of MPAs from the Bering Strait to Baja California. The center recently developed a new web site to track these West Coast processes; see http://www.pacificmpa.org.

19. Members of the Channel Islands National Marine Sanctuary Marine Reserves Working Group included recreational and commercial fisheries, nonconsumptive user groups, the diving community, local businesses, the public at large, and representatives from the California Department of Fish and Game (CDFG), the National Marine Fisheries Service, California Sea Grant, and the sanctuary staff. To view the full list of members, see the Channel Islands National Marine Sanctuary web site at http://www.cinms.nos.noaa.gov/marineres/WGmembreserves.html.

20. Channel Islands National Marine Sanctuary Advisory Council, Marine Reserves Working Group, meeting summary, Santa Barbara, Calif., 21 March 2001, accessed via http://www.cinms.nos.noaa.gov/pdf2/3-21-01MRWGmin.pdf on 25 July 2002.

21. For more information on the Marine Life Protection Act, see CDFG, "Marine Life Protection Act," accessible via http://www.dfg.ca.gov/mrd/mlpa/index.html.

22. To view the complete list of master plan team members, see CDFG, "Marine Life Protection Act: Master Plan Team," accessible via http://www.dfg.ca.gov/mrd/mlpa/team.html.

23. CDFG, "Marine Life Protection Act: Initial Draft Concepts" (Sacramento, Calif., 2001), accessed via http://www.dfg.ca.gov/mrd/mlpa/concepts_toc.html on 6 January 2003.

24. For a good summary of the new Marine Life Protection Act process, see CDFG, "Marine Life Protection Act: Working Group Process," accessible via http://www.dfg.ca.gov/mrd/mlpa/working_group.html.

25. The Ocean Policy Advisory Council (OPAC) of Oregon was established in 1991 to provide policy guidance to Oregon's governor and state agencies.

26. OPAC, "OPAC Process Overview" (Salem, Ore., 2001), accessed via http://www.oregonocean.org/process.shtml on 25 July 2002.

27. To view the full text of the revised draft recommendations, see OPAC, "Recommendation to the Governor: Oregon and Marine Reserves," revised working group draft (for discussion 16 August 2002), accessible via http://www.oregonocean.org/upload/Revisedraft Aug.pdf.

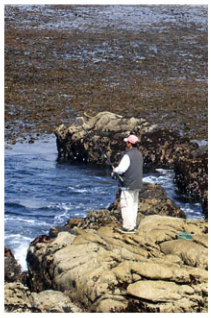
28. Changes to the MPA Working Group draft include the removal of a strict planning period of three to five years that now provides the opportunity for marine reserves to be sited sooner, the removal of language that allowed the design and siting of individual reserves in an uncoordinated manner if funding limitations occurred, and the identification of Oregon's existing Rocky Shore Strategy as a fundamental component of the marine reserves recommendation.

29. For the full text of the master plan team's meeting minutes, see CDFG, "Marine Life Protection Act: Meeting Minutes," accessible via http://www.dfg.ca.gov/mrd/mlpa/minutes.html.

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

September 19, 2005 (v.3.0)






CALIFORNIA MARINE LIFE PROTECTION ACT INITIATIVE

MLPA MASTER PLAN FRAMEWORK

Adopted by the
California Fish and Game Commission
August 18, 2005

California Department of Fish & Game

August 22, 2005

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Appendices (a separate document)

Executive Summary

Section 1. Introduction

In 1999, the legislature approved and the governor signed the Marine Life Protection Act (MLPA; FGC Section 2851-2863). The MLPA requires that the Department of Fish and Game (Department) prepare and present to the Fish and Game Commission (Commission) a master plan that will guide the adoption and implementation of a Marine Life Protection Program, which includes a statewide network of marine protected areas (MPAs). Other recent related legislation includes the Marine Life Management Act of 1998 (MLMA), Marine Managed Areas Improvement Act of 2000 (MMAIA), and California Ocean Protection Act of 2004 (COPA).

This legislation continues a long tradition of legislation addressing the conservation of California's diverse coastal and marine wildlife and habitats. Since World War II especially, pressures on these resources have grown as fishing effort and ability have increased and as coastal development has transformed coastal habitats and generated pollutants. In the last 35 years, both federal and state government programs have made an effort to address, if not solve, all of these problems. Marine and coastal wildlife populations also are affected by environmental factors, such as short and long-term shifts in oceanographic conditions, the total effect of which are not clearly understood.

Since passage of the MLMA in 1998, restrictions on commercial and recreational fishing have grown as fishery managers have sought to maintain sustainable fisheries in the face of uncertainty and of declining fish populations. The MLMA reflects shifts in the goals of fishery management away from a single-species focus on maximum yields toward sustainable yields and an ecosystem perspective.

The MLPA reflects prevailing scientific views regarding the role of MPAs in conserving biological diversity, protecting habitats, aiding in the recovery of depleted fisheries, and promoting recreation, study, and education. There remains disagreement whether MPAs, particularly no-take marine reserves, provide direct benefits to fisheries. These scientific viewpoints are discussed in more detail in this document.

In August 2004, the California Resources Agency, California Department of Fish and Game, and Resources Legacy Fund Foundation launched an effort to implement the MLPA, after two unsuccessful earlier attempts. The MLPA Initiative established an MLPA Blue Ribbon Task Force, together with a Master Plan Science Advisory Team (science team) and stakeholder advisory groups, to oversee the completion of several objectives. The first of these objectives is this master plan framework, which includes guidance, based on the MLPA, for the development of alternative proposals of MPAs statewide, beginning in an initial central coast study region. The task force will forward both the master plan framework and, by March 2006, the package of alternative MPA proposals for central coast study region to the Department for its consideration and subsequent submission to the Commission for its consideration and action. The following framework is expected to be an evolving document, which will be modified based on lessons learned in various regional processes and through monitoring and evaluation of MPAs throughout the State.

Section 2. Process for Designing Alternative Marine Protected Area Network Proposals

Rather than attempting to design a single network for the entire state at one time, the MLPA Initiative envisions the assembly of a statewide network by 2011 from a series of regional processes, beginning with an area along the central coast. This master plan framework will guide that process. It describes a series of activities, most of which will be undertaken by a regional stakeholder group and a sub-team of the statewide science team.

The overall aim of this five-step process is developing alternative MPA proposals for consideration by the Department, selection of a preferred alternative by the Department, and adoption of a proposal by the Commission. These five steps are:

1. Regional planning, starting with the identification of a study region moving through the preparation of a regional profile and additional advice, designing regional goals and objectives, analyzing existing MPAs and other management and ending with the identification of alternative approaches to networks and potential MPA sites;
2. MPA planning, in which proposals for potential MPAs are developed, after evaluation of existing and new MPAs and other management activities,
3. Assembling alternative proposals, in which MPAs developed in the previous stage are assembled into alternatives, which are evaluated generally and a feasibility analysis is conducted;
4. Evaluating the proposals, in which the MLPA Blue Ribbon Task Force evaluates the proposals and forwards a package to the Department, which sponsors a peer review and develops initial regulatory documents and forwards these along with a preferred alternative to the Commission;
5. Commission action on MPA proposals, which includes preparing regulatory analyses (including California Environmental Quality Act review), public testimony, and action by the Commission.

It is expected that the Master Plan Framework and the process described above will be reviewed upon completion and that changes will be made based on lessons learned. This adaptive use of the framework will help facilitate future regional processes and statewide implementation.

Section 3. Considerations in the Design of MPAs

Achieving the MLPA's goals and objectives to improve a statewide network of MPAs will require consideration of a number of issues, each of which is discussed in this section.

Goals of the Marine Life Protection Program

The MLPA identifies a set of goals for the Marine Life Protection Program including: conservation of biological diversity and the health of marine ecosystems; recovery of wildlife populations; improving recreational and educational opportunities consistent with biodiversity conservation; protection of representative and unique habitats for their intrinsic value; ensuring that MPAs have defined objectives, effective management and enforcement, and are designed on sound science; and ensuring MPAs are managed, to the extent possible as a network.

The MLPA notes that a variety of levels of protection may be included in MPAs and that the above program shall include several elements. These are: an “improved marine life reserve component”; specified objectives and management and enforcement measures; provisions for monitoring and adaptive management; provisions for educating the public and encouraging public participation; a process for the establishment, modification, or abolishment of existing or future new MPAs.

Each regional preferred alternative submitted by the Department to the Commission must include recommended no-take areas that encompass a representative variety of marine habitat types and communities across a range of depths and conditions and avoid activities that upset the natural functions within reserves. Collectively the regional alternatives must include replicates of similar types of habitats in each biogeographical region to the extent possible.

MPA Networks

The MLPA calls for improving and managing the state’s MPAs as a network, to the extent possible. The MLPA itself does not define a network. However, there are two common approaches to MPA networks: MPAs linked biologically and/or oceanographically, and MPAs linked through administrative function. Biological and oceanographic linkages are described in more detail in this section. At a minimum, the statewide network should function at an administrative level which reflects a consistent approach to design, funding and management.

Science Advisory Team Guidance on MPA Network Design

Explained in more detail below, the science team for the MLPA Initiative developed guidance regarding the design of MPA networks. This guidance, which is expressed in ranges for some aspects such as size and spacing of MPAs, should be the starting point for regional discussions of alternative MPAs. Although this guidance is not prescriptive, any significant deviation from it should be consistent with both regional goals and objectives and the requirements of the MLPA. The following guidelines are linked to specific objectives and not all guidelines will necessarily be achieved by each MPA:

- The diversity of species and habitats to be protected, and the diversity of human uses of marine environments, prevents a single optimum network design in all environments.
- To protect the diversity of species that live in different habitats and those that move among different habitats over their lifetime, every ‘key’ marine habitat should be represented in the MPA network.
- To protect the diversity of species that live at different depths and to accommodate the movement of individuals to and from shallow nursery or spawning grounds to adult habitats offshore, MPAs should extend from the intertidal zone to deep waters offshore.
- To best protect adult populations, based on adult neighborhood sizes and movement patterns, MPAs should have an alongshore extent of at least 5-10 km (3-6 m or 2.5-5.4 nm) of coastline, and preferably 10-20 km (6-12.5 m or 5.4-11 nm). Larger MPAs would be required to fully protect marine birds, mammals, and migratory fish.

- To facilitate dispersal among MPAs for important bottom-dwelling fish and invertebrate groups, based on currently known scales of larval dispersal, MPAs should be placed within 50-100 km (31-62 m or 27-54 nm) of each other.
- To provide analytical power for management comparisons and to buffer against catastrophic loss of an MPA, at least 3-5 replicate MPAs should be designed for each habitat type within each biogeographical region.
- To lessen negative impact while maintaining value, placement of MPAs should take into account local resource use and stakeholder activities.
- Placement of MPAs should take into account the adjacent terrestrial environment and associated human activities.
- To facilitate adaptive management of the MPA network into the future, and the use of MPAs as natural scientific laboratories, the network design should account for the need to evaluate and monitor biological changes within MPAs.

Consideration of Habitats in the Design of MPAs

The MLPA calls for protecting representative types of habitat in different depth zones and environmental conditions. The science team generally confirmed that all but one of the habitats identified in the MLPA occur within state waters: rocky reefs, intertidal zones, sandy or soft ocean bottoms, underwater pinnacles, kelp forests, submarine canyons, and seagrass beds. They noted that seamounts do not occur within state waters. The science team also noted that rocky reefs, intertidal zones, and kelp forests are actually broad categories that include several types of habitat.

The science team identified five depth zones which reflect changes in species composition: intertidal, intertidal to 30 meters, 30 meters to 100 meters, 100 meters to 200 meters, and deeper than 200 meters. The science team also called for special delineation of estuaries as a critical California coastal habitat. Finally, the science team recommended expanding the habitat definitions to include ocean circulation features, principally upwelling centers, freshwater plumes from rivers, and larval retention areas.

Species Likely to Benefit from MPAs

The MLPA requires the identification of species likely to benefit from MPAs. Identifying these species may also assist in identifying habitat areas that can contribute to achieving the goals of the MLPA. The Department prepared a list of such species, which appears in Appendix G. The Department will work with the science team in refining this list for each region. This will include identifying species on the list that are in direct need of consideration when designing MPAs, as opposed to those that may benefit but are not in immediate need of additional protection.

Geographical Regions

The MLPA requires that representative habitats be included, to the extent possible, in more than one marine reserve in each biogeographical region. The MLPA identifies the following three biogeographical regions:

- The area extending south from Point Conception,
- The area between Point Conception and Point Arena, and
- The area extending north from Point Arena.

The MLPA also authorizes a master plan science team to modify these regions. A variety of options for the possible definition of biogeographical regions are presented:

1) The three biogeographical regions defined in the MLPA;
2) The two *biogeographic provinces* recognized by many scientists with a boundary at Point Conception;
3) The four *marine regions* identified by the Master Plan Team convened by the Department in 2000, with boundaries at Pt. Conception, Pt. Año Nuevo, and Pt. Arena; and
4) The biogeographical regions recognized by scientists who have identified borders based on species distributional patterns or on abundance and diversity data with boundaries at Pt. Conception, Monterey Bay and/or San Francisco Bay, and Cape Mendocino.

Accepting the strong scientific consensus of a major biogeographical break at Point Conception, the Blue Ribbon Task Force confirms that two biogeographical regions exist along the California coast for purposes of implementing the Marine Life Protection Act. The more refined information on other breaks will be useful in designating study regions and in designing a statewide network of MPAs.

Types of MPAs

The MLPA recognizes the role of different types of MPAs in achieving the objectives of the Marine Life Protection Program. Three types of MPAs are defined by the Marine Managed Areas Improvement Act: state marine reserve, state marine park, and state marine conservation area. Each designation provides authority for different levels of restriction on human uses and includes various objectives. The MLPA sets other requirements for the use of state marine reserves. These differences are briefly described below and their potential use in zoning of areas is discussed.

Setting Goals and Objectives for MPAs

The MLPA requires that all MPAs have clearly identified goals and objectives and suggests several possible objectives. The MPA design process will begin with setting regional goals and objectives that are consistent with the MLPA, then identifying goals and objectives for individual MPAs. Once set, goals and objectives will influence crucial decisions regarding size, location and boundaries, as well as management measures and the focus of monitoring and evaluation programs. The goals and objectives of other complementary programs will be consulted, such as the Nearshore Fishery Management Plan adopted under the Marine Life Management Act and the Abalone Recovery and Management Plan.

Enforcement and Public Awareness Considerations in Setting Boundaries

Public acceptance and understanding of and compliance with MPA regulations can be increased if certain criteria are considered in the design of MPAs. First, boundaries should be clear, well-marked where possible, recognizable, measurable and enforceable. Ease of access to MPAs may influence the level of enforcement activity required to ensure compliance and protection. Siting MPAs where there are other special management programs such as national marine sanctuaries may enhance enforceability.

Information Supporting the Design of MPAs

The MLPA calls for the use of the "best readily available science" in designing and managing MPAs. Baseline data needs will be identified in regional profiles and MPA management plans, and the framework offers several examples of these types of information. The MLPA also calls for soliciting information from local communities and interested parties regarding the marine environment, the history of fishing, water pollution, and the socioeconomic and environmental impacts of MPA alternatives. Considerations in evaluating the economic value of marine ecosystems and the economic effects of specific MPAs are described.

Other Programs and Activities Other than Fishing

Current and anticipated human activities that may affect representative habitats and focal species in each region and at each MPA site should be described. Where non-fishing activities may have a significant impact, a proposal for an MPA may include recommendations to appropriate agencies for reducing the impacts of those activities. Such recommendations generally should be referred also to the California Ocean Protection Council established under the California Ocean Protection Act of 2004.

Section 4: Management

The MLPA requires that California's MPAs have effective management measures. The initial focus for meeting this requirement is the preparation of a regional management plan, a suggested outline of which is found in Appendix K. Besides generally guiding day-to-day management of MPAs, a management plan also distills the reason for key elements of MPAs that should be monitored, evaluated, and revised in response to new information and experience. A management plan should describe the allocation of responsibility to various government agencies, non-governmental organizations and industry groups. Where possible, management of MPAs should rely on collaboration among groups, including volunteer efforts. Finally, advisory committees formed for the purpose of designing MPAs in a region may serve important purposes in the implementation of MPAs. Likewise, a statewide MPA advisory committee that can assist with implementation should be considered. Much of the material required for a management plan will be developed during the regional design of MPAs.

Section 5: Enforcement

The MLPA identifies enforcement as one of the chief deficiencies in California's existing MPAs. Therefore, the MLPA requires that the Marine Life Protection Program provides for adequate

enforcement and includes enforcement measures for all MPAs, and that the master plan include recommendations for improving enforcement.

A general discussion of the capacities of the Department's enforcement program as well as the programs of other state and federal agencies, with which the Department may collaborate is included. A set of enforcement program objectives, including cooperative efforts, community involvement, education and operations is identified.

Section 6: Monitoring and Adaptive Management of MPAs

Like the Marine Life Management Act, the MLPA calls for adaptive management. The MLPA requires that the master plan include recommendations for monitoring and evaluation in selected areas for adaptive management. The MLPA also requires that all MPAs have measurable goals and objectives.

A process for developing monitoring and evaluation programs in different regions is described. A communications plan that will help ensure that results of monitoring are provided to decision makers and the public in terms that they can understand and act upon should be developed. A comprehensive review of monitoring results and performance should be conducted every three to five years. If monitoring results are not consistent with the goals and objectives of an individual MPA, the region, and overall network, recommendations should be developed for altering the MPAs and their management.

General considerations in identifying indicators as part of a monitoring and evaluation program, and specific examples of indicators for biophysical, socioeconomic and governance objectives are discussed. Collaborative monitoring efforts with fishermen and other groups are encouraged.

Section 7. Financing

The MLPA requires that the master plan include recommendations for funding MPA management activities and for implementing the Marine Life Protection Program. The inclusion of financing considerations in management plans for regional MPAs is discussed and examples of various sources of funding are provided. The MLPA Initiative will produce a long-term funding strategy for implementing the MLPA by the end of 2005.

Appendices

A separate volume includes appendices with more extensive information on a number of issues raised.

Section 1. Introduction

The rich natural heritage of California has supported commercial and recreational fisheries, which have provided consumers with a healthy source of high-quality protein, recreational anglers with enjoyable experiences, and many coastal communities with sources of employment and revenues. California's nearshore waters are among the top destinations for recreational scuba divers from around the world. Whether watching the flight of birds or the graceful forms of dolphins and whales, people also have increasingly sought enjoyment from observing marine wildlife. The dramatic growth of marine aquaria along the coast also serves as evidence of growing public interest in ocean wildlife, while California's century-long renown as a leader in marine science has only grown. California enjoys beautiful and productive marine resources.

In 1999, the State of California adopted the Marine Life Protection Act (MLPA, FGC Section 2851-2863), one in a long history of statutes and regulations designed to protect California's ocean and estuarine waters and the species and habitats found within them. The Department of Fish and Game (Department) is required to prepare and present to the Fish and Game Commission (Commission) a master plan that will guide the adoption and implementation of the Marine Life Protection Program (FGC Section 2855).

Another relevant law, the Marine Managed Areas Improvement Act (Public Resources Code, Sections 36600 et seq.), was adopted in 2000. The two measures, taken together, represent a declaration that California intends to protect its oceans and the marine species that live there and provide direction on how to proceed.

In 2004 the legislature approved and the Governor signed the California Ocean Protection Act (Public Resources Code, Sections 35500 et seq.). One purpose of this law is to coordinate activities of state agencies that are charged with the protection and conservation of coastal waters and ocean ecosystems, in order to improve the effectiveness of state efforts to protect ocean resources within existing fiscal limitations. The legislation identifies the following objectives:

> (a) Provide a set of guiding principles for all state agencies to follow, consistent with existing law, in protecting the state's coastal and ocean resources.
> (b) Encourage cooperative management with federal agencies, to protect and conserve representative coastal and ocean habitats and the ecological processes that support those habitats.
> (c) Improve coordination and management of state efforts to protect and conserve the ocean by establishing a cabinet level oversight body responsible for identifying more efficient methods of protecting the ocean at less cost to taxpayers.
> (d) Use California's private and charitable resources more effectively in developing ocean protection and conservation strategies.
> (e) Provide for public access to the ocean and ocean resources, including to marine protected areas, for recreational use, and aesthetic, educational, and scientific purposes, consistent with the sustainable long-term conservation of those resources.

Related to this legislation, on October 18, 2004, Governor Arnold Schwarzenegger released an ocean action plan, *Protecting Our Ocean: California's Action Strategy,* with four primary goals:

- Increase the abundance and diversity of species in California's oceans, bays, estuaries and coastal wetlands.
- Make water in these bodies cleaner.
- Provide a marine and estuarine environment that Californians can productively and safely enjoy.
- Support ocean dependent economic activities.

Part of this ocean action plan is full implementation of the MLPA. Among other policies, the ocean action plan also addresses the relationship between California's management activities and the Department of Defense as follows:

- Coordinate California ocean and coastal management activities that impact military facilities/operations with the Department of Defense, as well as requesting the Department of Defense to coordinate their activities and operational needs with the State of California to the extent possible without compromising national security objectives.

Early Years

From its very first days as a state in 1850, California has adopted statutes and regulations dealing with the ocean, fisheries, and protection of resources, commerce and industry. In an historic sense, California's history of involvement (as with most other states) has been through early steps to regulate fishing and define health and safety requirements for those who earn a living on the waters, and to protect outstanding areas and features along the California coast and in state waters.

In the early decades of statehood, California's policy toward natural resources reflected the desire of government at all levels to promote economic expansion by bringing natural resources into production (McEvoy 1986). Even so, lawmakers in California, as elsewhere, became concerned that the expansion of fishing might well threaten the long-term economic health of the fishing industry. In 1852, the California State Legislature passed its first fishing statute to regulate the Sacramento River salmon fishery, and continued to pass more regulations over the next several decades. In 1870, the legislature responded to the concerns of sport fishermen by establishing a State Board of Fish Commissioners, which later became the Commission. In this and other ways, California led the nation. By the end of the 19th century, the California State Legislature had adopted a body of fisheries management law that was a model for its time.

At the same time, the courts repeatedly upheld the importance of the state's role in protecting its resources. In 1894, for instance, the California State Supreme Court found that "The wild game within a state belongs to the people in their collective, sovereign capacity; it is not the subject of private ownership, except in so far as the people may elect to make it so; and they may, if they see fit, absolutely prohibit the taking of it, or any traffic or commerce in it, if deemed necessary for its protection or preservation, or the public good."

Californians often feel strongly about both available fisheries and regulations on access. Some assert that article 1, section 25, of the California Constitution gives the public a "right to fish." It states "The people shall have the right to fish upon and from the public lands of the State and in the waters thereof…provided, that the legislature may by statute, provide for the season when and the conditions under which the different species of fish may be taken."

However, this "right to fish" is not absolute. In 1918, the California Supreme Court considered whether a law providing for the licensing of fishermen was unconstitutional because it violated article 1, section 25. The court rejected the argument, finding that the provision authorizing the legislature to fix the seasons and conditions under which fish are taken was intended to leave the matter under the legislature's discretion [*Paladini v. Superior Court* (1918) 178 Cal. 369]. As recently as 1995, a court reaffirmed the qualified, not fundamental, right to fish and that the language of the State Constitution was not intended to curtail the ability of the legislature (or the Commission through legislated authority) to regulate fishing [*California Gillnetters Association v. Department of Fish and Game* (1995) 39 Cal.App.4th 1145].

Also, section 25 must be read in connection with article 4, section 20 (formerly section 25½), which states that the California State Legislature may enact appropriate laws for protection of fish and game, and may delegate to the Commission such powers relating to protection and propagation of fish and game [*Ex parte Parra* (1914) 24 Cal.App. 339, 340]. In that respect, the California Supreme Court found it "most apparent" that the purpose of (now) article 4, section 20 "was to clothe the Legislature with ample power to adequately protect the fish and game of the state." Further, the California Supreme Court has long declared that the power to regulate fishing has always existed as an aspect of the inherent power of the legislature to regulate the terms under which a public resource may be taken by private citizens [*In re Phoedovius* (1918) 177 Cal. 238, 245-246; *People v. Monterey Fish Products Company* (1925) 195 Cal. 548, 563]. This regulatory power clearly includes the regulation of fishing within MPAs [Section 2860, FGC].

Like other economic activities, from agriculture to manufacturing, fishing began expanding rapidly in the first few decades of the 1900s. In 1912, the legislature responded by authorizing staff for the Commission, which found itself with greater and greater responsibilities for managing industrial fisheries, in particular. In 1927, the legislature created a Department of Natural Resources, within which it housed a Division of Fish and Game.

Post World War II

After World War II, the marine policies of California and other state and federal governments were based largely on several assumptions that reflected the progressive thinking of the time. First, the abundance of marine wildlife was thought to be nearly without practical limits. Second, scientists and fishery managers believed that we possessed enough knowledge to exploit marine populations at very high levels over long periods of time without jeopardizing them. Third, the value of marine wildlife was principally as a commodity to be processed and traded. Finally, the chief challenge in commercial fisheries management was to expand domestic fishing fleets in order to exploit the assumed riches of the sea.

In 1945, the legislature granted the Commission discretionary authority over recreational fisheries. In 1947, the legislature instituted a tax on sardine landings that was used to fund research into causes for the decline in sardine abundance. These activities led to the inauguration of one of the world's longest series of fisheries research cruises, the California Cooperative Oceanic Fisheries Investigations, CalCOFI, a cooperative venture of the California Department of Fish and Game, Scripps Institution of Oceanography and the National Marine Fisheries Service.

Several factors combined to challenge these assumptions. Changing fishing technologies and expanding fleets increased harvests. Poor forestry practices resulted in sediment loading to coastal watersheds that impeded spawning. Development decreased wetlands, reducing their important capacities in marine life cycles and in filtering run off.

In the face of disturbing declines in a number of fisheries, state and federal fisheries agencies around the country began an intensive review of prevailing policies in the mid-1960s. In 1967, the California State Legislature passed the California Marine Resources Conservation and Development Act to develop a long-range plan for conservation and development of marine and coastal resources (1967 California Statutes Ch. 1,642). In the same year, Governor Ronald Reagan imposed an emergency two-year moratorium on commercial sardine fishing (1967 California Statues Ch. 278).

During the 1960s, recreational fishermen convinced the legislature to remove certain species of fish from commercial exploitation, such as calico bass and striped marlin. Beginning in the 1970s, traditional views of marine fish populations as commodities began shifting more rapidly. Marine wildlife and ecosystems were increasingly valued for themselves and for uses such as tourism, education, and scientific research. Recognition of the need to balance the capacity of fishing fleets with the often limited and uncertain productive capacity of marine species grew. Rather than seeking to extract the maximum yield from marine species, fisheries managers began seeking levels that would be sustainable into the distant future.

Changes also occurred in marine recreational activities. Catch and release programs became important in some fisheries. The value of the experience of fishing was recognized as being greater than just the monetary value of fishing to local businesses. Non-consumptive recreation, including surfing, diving, sightseeing, and other activities, increased dramatically. Additionally, the public became more interested in the value of healthy marine environments for both recreational use and the intrinsic value of the ocean itself.

California's Marine Heritage

For 1,100 miles, the spectacular mass of California's lands meets the Pacific Ocean. In many areas, mountains plunge into the oceans. Elsewhere, ancient shorelines stand as terraces above the surf. Streams and rivers break through the coastal mountains and lowlands and, in some places, flow into bays and lagoons rimmed with wetlands. Offshore, islands and rocks break the surface.

This is what we can easily see. But beneath the surface of the water offshore, California's dramatic geological formations continue. Unlike the Atlantic or Gulf coasts, California's shallow continental shelf is quite narrow, generally no wider than 5 miles. At its broadest point off San Francisco, the shelf extends 30 miles offshore before plunging from 600 feet to the abyssal region at 6,000 feet. Beyond state waters, peaks called seamounts rise from the depths and are generally recognized as areas where prey species aggregate, attracting a variety of marine life.

Whether near or far from shore, the ocean bottom may be rocky, sandy, or silty. It may be flat or formed of rocky reefs. In areas along the coast, great canyons cut into the continental shelf quite close to shore. For example, the Monterey submarine canyon, which is larger than the Grand Canyon of the Colorado, begins within miles of the shoreline. There, as in other submarine canyons, marine life normally found far offshore occurs close to land in the deep waters. Off southern California, the ocean bottom appears like a piece of crumpled paper, with basins, troughs, canyons, peaks, and cliffs alternating in a checkerboard pattern.

Ocean currents introduce other dimensions to California's coastal waters. For much of the year, the California Current brings colder northern waters southward along the shore as far as southern California. There, where the coastline juts eastward, the California Current moves offshore. In the gap between the California Current and the mainland, the Southern California Countercurrent flows into the Santa Barbara Channel. Around Point Conception, these two currents meet, creating a rich transition zone. Closer to shore and deeper, the California Undercurrent also carries warmer water northward.

Seasonal changes in wind direction commonly create seasonal patterns for these currents. Beginning in March, for instance, northwesterly winds combine with the rotation of the Earth to drive surface waters offshore, triggering the upwelling of cold, nutrient-rich water from the depths. Fueled by sunlight and these nutrients, single-celled algae bloom and create a rich soup that fuels a blossoming of marine life, attracting larger animals from seabirds and swordfish to humpback and blue whales.

By September, as the northwesterly winds die down, the cold water sinks again and warmer waters return to the coast. This oceanic period lasts into October, when the predominant winds move to the southwesterly direction. These winds drive a surface current, called the Davidson Current, which flows north of Point Conception and inside the California Current, generally lasting through February.

Laid over this general pattern are both short-term and long-term changes. Local winds, topography, tidal motions, and discharge from rivers create their own currents in nearshore

waters. Less frequently, a massive change in atmospheric pressure off Australia floods the eastern Pacific with warm water, which suppresses the normal pattern of upwelling. These short-term climatic changes, called El Niño, reduce the productivity of coastal waters, causing some fisheries and seabird and marine mammal populations to decline and others to increase. For instance, warm waters that flow north in an El Niño carry the larva of California sheephead and lobster from the heart of their geographical range in Mexico into the waters off California.

Other oceanographic changes last for a decade or more and these natural fluctuations can have significant impacts on the health and composition of marine life. In these regime shifts, water temperatures rise or fall significantly, causing dramatic changes in the distribution and abundance of marine life. The collapse of the California sardine fishery occurred when heavy commercial fishing continued on sardine populations that were greatly reduced by a cooling of offshore waters in the late 1940s and early 1950s. In response to the decline in sardines, California law severely curtailed the catch. In 1977, waters off California began warming and remained relatively warm. The warmer water temperatures were favorable for sardines, whose abundance greatly increased. But the warmer waters also reduced the productivity of other fish, including many rockfishes, lingcod, sablefish, and those flatfishes that favor cold water for successful reproduction.

Currents and other bodies of water may differ dramatically in temperature and chemistry, as well as speed and direction. These factors all influence the kinds of marine life found in different bodies of water. In general terms, geography, oceanography, and biology combine to divide California marine fisheries and other marine life into two major regions north and south of Point Conception. Within each region, other differences emerge. Conservation and use of California's marine life depends partly upon recognizing these differences.

Marine Life of California

The waters off California are host to hundreds of species of fish and marine plants and algae. Thousands of species of marine invertebrates inhabit the sea floor from tidepools along the shoreline to muddy plains thousands of feet deep. Dozens of species of coastal and offshore birds spend some part of the year in California's waters, as do 35 species of marine mammals.

This great variety of marine life reflects the different responses of groups of animals and plants to changing environmental conditions over long periods of time. In successfully meeting their needs for growth, survival, and reproduction, individual species have developed a set of characteristics that biologists call life history traits. These traits include age at maturity, maximum age, maximum size, growth rate, natural mortality rate, and feeding and reproductive strategies.

Differences among species can be dramatic. For instance, California market squid mature within 12 months and die soon after spawning, whereas widow rockfish do not mature until age five at the earliest and may live as long as 59 years. This has profound consequences for managing fisheries so that they are sustainable.

Reproductive strategies also vary. Queenfish, for instance, may spawn 24 times in a season, ultimately releasing their body weight in eggs into the open water, where most will be eaten

whether or not they are fertilized. In contrast, species such as olive rockfish spawn just once a year, releasing up to 500,000 larvae, which have been fertilized and developed internally. Other species, including sharks and surfperches, bear a small number of fully functional and live young each year.

Amid the variety, the life histories of fish tend to fall into several larger categories. For instance, fish species that have low rates of mortality as adults, such as many species of sharks, bluefin tuna, and billfish, also mature late and reproduce in smaller numbers. Organisms that have high rates of mortality as adults, such as anchovies and squid, mature early, and reproduce in large numbers. Some species spend the first several months of their lives floating as planktonic larvae in ocean currents. Climate and oceanographic changes influence the abundance of these species more than does the number of spawning adults. Many mollusks and some sharks produce eggs which are physically attached to the substrate until hatching. For these species, local conditions and predation play a major role in abundance.

Species differ also in their movements. For instance, during winter Dover sole move into deeper water where they reproduce, then move back into shallower water in the summer to feed. Pacific whiting migrate from their summer feeding grounds off Oregon and Washington to their winter spawning grounds off southern California and Baja California. By contrast, gopher rockfish, which can live to 30 years, venture less than a mile from their home range.

Individual plants and animals are part of larger communities that are linked in many ways. One of the clearest of relationships concerns what eats what, also known as the food web. Generally, this begins with herbivores, which consume plants that have manufactured food through photosynthesis. These herbivores may be as small as the larva of an anchovy or as large as a basking shark. The smaller herbivores pass along much of the food value of the plants when they are eaten by primary carnivores, which in turn may be consumed by higher level carnivores. Humans enter the food web at a variety of levels, removing not only higher level carnivores, but herbivores, and even the lowest level algae.

These relationships among wildlife populations differ considerably among different habitats and communities. A decrease in the abundance of some species, habitat alteration, or climate changes, for instance, can affect species that feed upon them. Conversely, an increase in predator species may reduce the abundance or prey species. Healthy habitat can also play an important role in the abundance of marine wildlife. A large percentage of the state's coastal wetlands have been destroyed or degraded, causing incalculable losses in coastal wildlife. Pollution of coastal waters can expose marine animals to toxic chemicals and can foster changes in plant communities that wildlife depends upon. A decrease in the abundance of some species, due to habitat alteration, pollution, fishing, or climate changes, can produce a ripple effect throughout the marine environment. Considering these interrelationships when managing fisheries requires an ecosystem perspective. In addition, it is important to consider existing risk-averse fishery management regulations that have, for example, restored species such as sardine to "fully recovered" status, and integrate these considerations into the ecosystem management context.

Factors Affecting Marine Wildlife Populations

The abundance and diversity of populations of marine wildlife are influenced by a wide range of natural and human-caused factors, including short-term and long-term shifts in oceanographic conditions and numerous human activities, which may have direct or indirect effects (Parrish and Tegner 2001; Sheehan and Tasto 2001; NRC 1995). The impact of each factor varies with distance from shore and with individual species.

Some types of natural phenomena, such as El Niño and La Niña fluctuations, in which especially warm or especially cool waters respectively dominate, may have transitory impacts on marine wildlife and their habitats, while other natural phenomena, such as longer-term shifts in oceanographic conditions, may affect the abundance of some types of marine wildlife over much longer periods (Parrish and Tegner 2001). Increasingly, fisheries managers are attempting to adjust to these natural phenomena.

As in other coastal states, the development and growth of California's population and economy, especially since World War II, introduced additional stresses to coastal ecosystems. Coastal development transformed coastal watersheds, wetlands, and estuaries, and placed greater demands on coastal ecosystems. These stresses include chemical pollution and eutrophication (input of excessive nutrients into the environment), alteration of physical habitat, and the invasion of exotic species (NRC 1995). Intake structures for "once-through" cooling systems at electrical power plants kill marine life, and the thermal discharges from these facilities contribute the largest volume of effluent into California's coastal ocean. Chemical pollution and eutrophication can alter the abundance and biodiversity of wildlife in coastal environments, especially bays and estuaries (NRC 1995). Pollution ranges from toxic chemicals to partially treated sewage, and the sources of potential pollution range from point sources, such as sewage treatment plants, to non-point sources, such as runoff from agricultural and urban lands (Sheehan and Tasto 2001). Similarly, estuarine and shoreline habitats have been especially affected by residential, commercial and industrial development (Sheehan and Tasto 2001).

The degree of impact from these stresses on water quality and habitats varies markedly along the state's coastline. Storm-water runoff is a particular problem in major urban areas, while some waters of the central coast are most affected by agricultural runoff (Sheehan and Tasto 2001). San Francisco Bay's waters are affected both by industrial discharges and by dairy farm runoff. In some areas, particularly bays and estuaries, waters are so impaired that certain uses are prohibited or restricted. Many north coastal streams are impaired due to sedimentation, habitat modification, altered temperature and eutrophication. Timber harvest activities in north coast watersheds are a particular concern.

In the last 35 years, both federal and state governments have carried out regulatory and other programs to reduce these threats to coastal ecosystems. At the federal level, the Clean Water Act launched an enormous effort to reduce the flow of sewage and industrial pollutants into coastal waters (Sheehan and Tasto 2001). Since 1990, the federal government, in cooperation with state governments, has encouraged efforts to reduce the flow of non-point source pollution. In July 2000, California was the first state in the nation to receive full federal approval of its Coastal Non-point Source Pollution Control Program by the U.S. Environmental

Protection Agency and the National Oceanic and Atmospheric Administration (the lead federal agencies that administer the Clean Water Act and Coastal Zone Management Act, respectively). Storm water runoff from large and medium sized urban areas is now regulated as a point source under the National Pollutant Discharge Elimination System Program. The Governor's ocean action plan outlines many other such programs.

Passage and implementation of the state coastal legislation in the 1970s slowed the rate of loss of sensitive coastal habitats, and in some areas, efforts are underway to restore converted wetlands. In the last several years, the state has devoted more resources to addressing coastal water quality and habitat, including major state bonds. Nonetheless, future population and economic growth will continue to stress on coastal ecosystems.

The Marine Life Management Act

Like these other factors, fishing can have impacts on marine fish populations and other wildlife and has likely been having these effects since humans began to harvest marine species (NRC 1995, Jackson, et al. 2001). California has long sought to manage fisheries in its waters for long-term sustainability. In 1998 the California State Legislature responded to the shifts in understanding and public values as well as declines in some fisheries and nearshore ecosystems by adopting the Marine Life Management Act (MLMA).

Before the MLMA, the responsibility for managing most of California's marine resources harvested by commercial fisheries within state waters lay with the State Legislature, while the Department and the Commission managed the recreational fisheries and those commercial fisheries with catch quotas that changed periodically. Management of commercial fisheries under this division of responsibility was complicated, piecemeal, and often untimely, with necessary regulatory changes only occurring after much political deliberation and approval by both the California State Assembly and California State Senate.

The MLMA transferred permanent management authority to the Commission for the nearshore finfish fishery, the white seabass fishery, emerging fisheries, and other fisheries for which the Commission had some management authority prior to January 1, 1999. As importantly, the MLMA broadened the focus of fisheries management to include consideration of the ecosystem - the entire community of organisms (both fished and unfished) and the environment and habitats that those species depend on.

Recent Developments

The Marine Life Protection Act (MLPA) was enacted in 1999. (See Appendix A for text of the MLPA, as amended.) In doing so, the California State Legislature recognized the benefits of setting aside some areas under special protection and of ensuring that these marine protected areas (MPAs) were developed in a systematic manner, with clear goals and objectives, and management plans and programs for monitoring and evaluating their effectiveness. Rather

than focusing on one use or value for marine protected areas, the MLPA recognized a wide range of values, including the conservation of biological diversity[1].

Between the MLPA's passage in 1999 and the creation of the MLPA Initiative in 2004, there were two other efforts at implementation. Both attempts suffered from a lack of adequate resources. The first attempt did not ensure a robust multi-stakeholder involvement. Both attempts failed to provide sufficient information needed by stakeholders, particularly regarding the potential socioeconomic impacts of potential MPAs (See Appendix C for a more detailed description of MLPA implementation).

The first attempt became problematic when the Department and the MLPA Master Plan Team developed a set of initial proposals for a statewide network of MPAs without significant stakeholder input, even though the intent was to revise these initial proposals based on public comment as required by the MLPA. The second attempt was more inclusive of stakeholders, but suffered from a lack of staff and funding. After these unsuccessful attempts, state legislators and the Department realized that this complex and controversial process required significant resources and time to implement and evaluate successfully.

Since passage of the MLPA in 1999, the Pacific Fishery Management Council established several major recreational and commercial fishery closures to protect lingcod and certain populations of rockfish that were declared overfished[2] by the National Marine Fisheries Service. The closures, which remain in effect today, are generally based on depth and affect certain types of bottom-fishing gear. The closures have changed in both their total area and season several times.

The primary closures are the Cowcod Conservation Areas in southern California, which are almost entirely in federal waters, and the Rockfish Conservation Area, which is statewide and encompasses portions of state and federal waters. The total area included in State waters within the Cowcod Conservation Area is approximately 135 square nautical miles or 3.5% of all State waters. Within this area certain types of trapping and surface fishing are allowed, as well as some trawling.

While portions of the Rockfish Conservation Area are open seasonally to bottom fishing gears which impact groundfish, and the whole area is open to surface fishing, certain depth zones in certain parts of the state are closed to groundfish take year-round. The area within State waters which is closed to groundfish take year-round is about 190 square nautical miles or 4% of all State waters. These figures are based on the 2005 fishing regulations, which may change.

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[1] Biological diversity or "biodiversity" is defined by Public Resources Code Section 12220(b) as: a component and measure of ecosystem health and function. It is the number and genetic richness of different individuals found within the population of a species, of populations found within a species range, of different species found within a natural community or ecosystem, and of different communities and ecosystems found within a region.

[2] The Federal definition of "overfished" generally describes any stock or stock complex determined to be below its overfish/rebuilding threshold (the default proxy of which is 25% of its estimated unfished biomass). Note that stocks may become overfished for a variety of reasons, including non-fishing impacts.

Such fishery conservation measures are similar to certain types of limited-take MPAs and can function as *de facto* MPAs. One important distinction between these closures and MPAs is that the former, while potentially of long-term duration, change based on assessments of specific stocks. Once the goal of rebuilding overfished populations is achieved, such closures may be abolished or greatly reduced. In contrast, MPAs are likely to be abolished if they fail to achieve such objectives as biodiversity conservation and habitat protection.

A significant increase in the total amount of state waters included in MPAs occurred in 2003 when the Commission established a system of 12 new MPAs (10 state marine reserves and 2 state marine conservation areas) around the Santa Barbara Channel Islands. The establishment of the 10 Channel Islands state marine reserves increased the area of state waters in marine reserves from 0.2% to 2.5%. This occurred after an initial year of discussion in the Commission, an approximately two and a half year stakeholder-based process, and another 1.5 years of public regulatory process. Monitoring of the new MPAs, and of the effect they are having on local fishing patterns, is now occurring. The details of the Channel Islands monitoring program are available at www.dfg.ca.gov/mrd/channel_islands.

Marine Protected Areas Generally

California is able to take advantage of several decades of experience and study regarding MPAs elsewhere in the United States and abroad, as well as within its own waters. While most of this experience is with no-take reserves, it can be applied generally to other MPAs. In 2001, for instance, a committee of the National Academy of Sciences released its report *Marine Protected Areas: Tools for Sustaining Ocean Ecosystems*. Like other reports of the National Academy of Sciences, this report can be considered an authoritative general review of the science of marine protected areas (OMB 2004). Many of their conclusions, while directed to marine reserves, may have applicability to other MPAs. Among other things, this expert panel concluded:

- A growing body of literature documents the effectiveness of marine reserves for conserving habitats, fostering the recovery of overexploited species, and maintaining marine communities.

- Networks of marine reserves, where the goal is to protect all components of the ecosystem through spatially defined closures, should be included as an essential element of ecosystem-based management.

- Choosing a location for a marine reserve or protected area requires an understanding of probable socioeconomic impacts as well as the environmental criteria for siting.

- It is essential to involve all potential stakeholders at the outset to develop plans for MPAs that enlist the support of the community and serve local conservation needs.

- Marine reserves and protected areas must be monitored and evaluated to determine if goals are being met and to provide information for refining the design of current and future MPAs and reserves.

- Sufficient scientific information exists on the habitat requirements and life-history traits of many species to support implementation of marine reserves and protected areas to improve management.

Since the National Academy of Sciences report, a vigorous discussion among scientists and decision makers has explored the benefits and costs of MPAs, particularly marine reserves (Nowlis and Friedlander 2004; Hilborn et al. 2004; SSC 2004; NFCC 2004; FAO 2004). Many of these discussions have focused upon the use of marine reserves as a fisheries management tool and on the effect of marine reserve designation on fishing operations, fisheries management, and fish populations outside reserves. There has been virtually no discussion of the value and design of other types of MPAs, such as marine parks and marine conservation areas.

Recent literature supports the potential value of marine reserves for protecting habitat and biodiversity within reserve boundaries (Nowlis and Friedlander 2004; Hilborn et al. 2004; FAO 2004). This same literature cites several potential benefits of marine reserves to fisheries management, including buffering against uncertainty, reducing collateral ecological impacts (e.g., bycatch and habitat damage), managing multi-species fisheries, and improving knowledge. Empirical evidence for increased fish catches outside marine reserves is sparse, although there are strong reasons to believe that if designed properly, marine reserves can contribute to fisheries management in some circumstances (Nowlis and Friedlander 2004; Hilborn et al. 2004). Without experience gained from the establishment of additional marine reserves, assessing the appropriateness of marine reserves for fisheries enhancement purposes will remain difficult.

At the same time, potential problems with marine reserves have been cited, including possible shifts in fishing effort, disruption of stock assessment research, and socioeconomic impacts (Hilborn et al.2004; FAO 2004; SSC 2004). Empirical evidence for these potential impacts is sparse, as well. These authors urge care in the design of marine reserves so as to minimize losses to fisheries and to increase the opportunity to obtain empirical information on marine reserves by careful experimental design (Hilborn et al. 2004; SSC 2004). These studies also note that for certain species, especially species with highly mobile adults, marine reserves are unlikely to benefit fisheries (Nowlis and Friedlander 2004; Hilborn et al.; SSC 2004; NFCC 2004). When designing marine reserves or other MPAs with a goal of enhancing fisheries, the target species and potential impacts must be considered.

It is important to remember that a primary purpose of the MLPA is to develop a plan and implement a program that will protect and restore marine biodiversity and ecosystems. The MLPA recognizes that MPAs may be a tool to accomplish those purposes, but they are not the only tool. Implementation of the MLPA must consider and respect other efforts, including traditional fishery management, water quality controls and coastal development management, in order to avoid duplication and conflicts in the state's efforts to protect California's ocean environment.

MLPA Initiative Process

In August 2004, a new effort was launched to implement the MLPA. Combining public and private sources of support, the MLPA Initiative has four key objectives to achieve by December 2006, when the initiative expires:

- the development of a draft master plan framework;
- the development of alternative proposals for an MPA network in a central coast study region;
- recommendations on funding sources for MPA implementation and management; and
- recommendations to increase the coordination between state and federal agencies with authority to manage ocean resources.

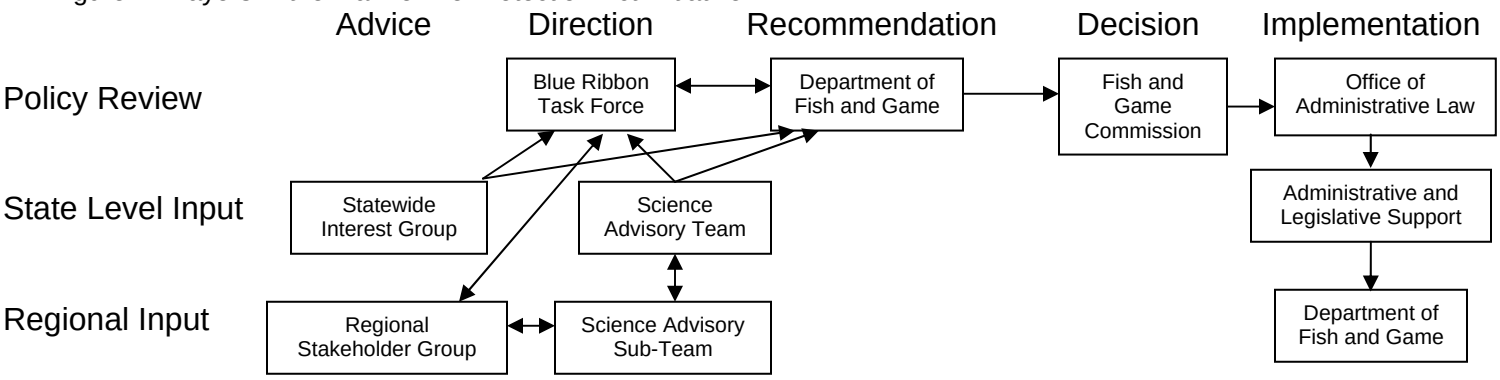
The first two of these products will be provided to the Department for its consideration and submission to the Commission, which will take action through their normal process. These products are intended to provide a strong foundation for completing the statewide network of MPAs by 2011.

The MLPA Initiative process includes the following groups and organizations:

- MLPA Blue Ribbon Task Force (an oversight body)
- MLPA Initiative staff
- Science Advisory Team (an expansion of the former Master Plan Team with additional expertise)
- Science Advisory Sub-Team for the central coast region
- MLPA Statewide Interests Group for providing advice on the initiative process,
- Regional stakeholder group for the central coast region
- Peer review group
- Department staff
- Commission

Figure 1 portrays the links among the various players in the initiative process. See Appendix D for a description of stakeholder participation strategies.

Figure 1. Players in the Marine Life Protection Act Initiative.



Note: input is solicited from the interested public and stakeholders at each step, until adoption of regulations by the Commission.

Roles in the Marine Life Protection Act Initiative

Organizational Partners

The Commission is the ultimate decision-making authority for implementation of the MLPA. Specifically, the Commission will make all final decisions on the master plan, the proposed regional marine protected area proposals, and supporting CEQA documentation, all after completing its own process of public reviews. The principal mission of the other partners is to support the Commission in making sound policy decisions required by the MLPA. Although the Commission will not be involved in the day-to-day work of the Initiative, the Initiative will include regular opportunities for informational meetings and strategic consultation with the Commission.

The California Resources Agency provides general oversight and public leadership for the initiative and implementation of the MLPA. Besides providing policy direction for coordinating funding and staffing, the agency made critical decisions in shaping the initiative. The secretary of the California Resources Agency selected the chair and other members of the MLPA Blue Ribbon Task Force. The secretary convened and charged the members of the task force with meeting the objectives identified in the task force description below. The California Resources Agency will also seek adequate current and future funding for agency and Department personnel committed to the initiative and for completing future phases of the MLPA.

The Department serves as the lead agency for the design and implementation of the MLPA master plan and a statewide network of marine protected areas. The Department will continue its traditional support of the Resources Agency and the Commission. In consultation with the Agency secretary, the Commission president, and the task force chair, the director of the Department will select the members of the science team. Through the initiative's Steering Committee (described below), the Department assisted the development of the draft master plan framework and proposals for marine protected areas along the central coast, and is ultimately responsible for presenting a final draft master plan and alternatives for marine protected areas in each region, including preferred alternatives for each region, to the Commission. The Department will also provide biological, enforcement and other relevant information, participate in meetings as appropriate, review working documents, and act as lead agency under the California Environmental Quality Act, among other activities.

The MLPA Blue Ribbon Task Force is composed of distinguished, knowledgeable and highly credible public leaders selected by the secretary of the California Resources Agency. The charge to the task force is to oversee the preparation of the draft master plan framework, and the development of alternative proposals for marine protected areas in an area along the central coast for the Department to present to the Commission; to prepare a comprehensive strategy for long-term funding of planning, management and enforcement of marine protected areas; and to develop recommendations for improved coordination of managing marine protected areas with federal agencies involved in ocean management. The task force will also work to resolve policy disputes and provide direction in the face of uncertainty, while meeting the objectives of the MLPA. The chair of the task force selected the executive director, senior MLPA project manager, operations & communications manager, and central coast MLPA project manager to the initiative; worked with the director of the Department to convene and

direct the science team; and serves as the principal link between the task force and initiative staff. At least one member of the task force serves as liaison to the central coast project.

The Resources Legacy Fund Foundation uses its best efforts to obtain, coordinate and administer philanthropic investments to supplement public funding for the Initiative, provides strategic advice to the California Resources Agency on public-private funding, and supports the operations & communications manager in managing private contracts for staffing the initiative.

Other state and federal agencies play a variety of roles in the initiative. For instance, federal agencies such as NOAA Fisheries, the National Ocean Service, and the National Marine Sanctuaries Program may be sources of valuable information and may have programs that the MLPA Initiative should take into account in designing regional MPAs. State agencies may play a similar role. The California Coastal Commission may review some aspects of establishing MPAs, such as coastal zone access and facilities development.

Committees and Teams

The director of the Department, in consultation with the chair of the task force, the secretary of the agency, and the president of the Commission, convened the Science Advisory Team (science team). The science team includes the members required by the MLPA, including staff from the Department, the Department of Parks and Recreation, the State Water Resources Control Board, one member appointed from a list provided by Sea Grant, and an expanded group of scientists knowledgeable in marine ecology, fisheries science, marine protected areas, economics and the social sciences. The role of the science team is to assist the task force in developing the draft master plan framework by reviewing supporting and draft documents, addressing scientific issues, and framing and referring policy challenges to the task force. The science team reports to the task force and the director of the Department, and will be is supported by the senior MLPA project manager.

A sub-team of the science team serves the central coast project. The Science Advisory Sub-Team for the central coast region is composed of members of the science team, and works with the central coast project manager and central coast stakeholder group to develop alterative marine protected area proposals by reviewing supporting and draft documents, addressing scientific issues and information provided by the central coast stakeholder group, and framing and referring policy challenges to the task force. At least one member of the science sub-team attends each central coast stakeholder group meeting.

The Central Coast MLPA Regional Stakeholder Group includes key, 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 marine protected areas along the central coast. The director of the Department and the central coast liaison of the task force solicited nominations, and selected from the nominees a representative group that will meet regularly over the course of the central coast process to provide input to the central coast project manager, provide information and other input for framing key scientific questions to be addressed by the science advisory sub-team, and work as a group to develop alternative

proposals for MPAs. The Department will provide enforcement staff support to the group for information and input on enforcement issues.

The MLPA Statewide Interests Group is composed of members from key interest groups who advise the task force and staff on the overall process to develop a draft master plan framework and network of marine protected areas along the California coast. The group does not vote or otherwise take formal positions on any procedural or substantive issues, but instead alerts the task force and staff to issues and opportunities that may improve public involvement in the process.

The MLPA Steering Committee is chaired by the task force's executive director, and includes the task force's senior project manager, operations & communications manager, and central coast project manager, and the Department's policy advisor, statewide technical advisor, MPA mandate coordinator, and central coast regional coordinator. The committee is responsible for coordinating all work necessary to achieve each of the objectives of the initiative.

Master Plan Framework

The MLPA calls for the development of a master plan by the Department, and its adoption by the Commission[3]. The MLPA Initiative has divided the master plan into two principal parts: a section providing guidance in the application of the MLPA to the development of a statewide MPA network (the master plan framework), and a section describing the preferred alternatives for MPA proposals. The MLPA Initiative envisions a focus on portions of the state in a series of regional processes, beginning with the central coast. The requirement for a full master plan and implementing regulations will be met when the Commission adopts the final portion of the plan and all regions of the coast have been completed.

It is important to emphasize that the physical, biological, social and economic conditions in each region of the state will affect the specific application of the MLPA and the framework recommended in this document. For example, California coastal waters, especially those in southern California, are critical for our nation's military both for training and testing as well as operations. The United States Department of Defense controls two of the Channel Islands and has installations along significant portions of the coastline. Many of the operational ocean areas are significantly restricted to public access. Based on inputs from the Department of Defense, the designation of MPAs in specified operational areas of the military is not consistent with military readiness. Therefore, in assessing the overall MLPA network, the beneficial effects of military operational areas (as well as other *de facto* MPAs such as long-term closures implemented through fishing regulations), with respect to habitat conservation goals will be considered in the needs assessment.

The central coast effort will provide concrete experience in applying the master plan framework and this more specific guidance to a specific area. It is expected that this experience will lead to recommendations to adjust the framework regarding specific topics. In this way, the master plan framework will serve as the foundation for an evolution of practice that adapts to new information as well as serve as a blueprint for developing a statewide MPA network.

[3] The Fish and Game Code requires the Department to provide a draft master plan to the Commission by January 2005 and the Commission to adopt a final master plan with regulations by December 2005 [Section 2859, FGC].

Section 2. Process for Designing Alternative Marine Protected Area Network Proposals

For practical reasons, the review and improvement of the existing array of MPAs and insuring California's MPAs function as a network mandated by the MLPA cannot be established in a single step. The resources and effort required to design and evaluate MPAs along the state's entire 1,100-mile coast at the same time are beyond the capacity of both governmental and non-governmental resources. In addition, ecological, social and economic conditions differ widely among many regions.

A sound master plan framework based on the requirements of the MLPA should enable application of the MLPA to differing conditions while maintaining a statewide perspective. For these and other reasons, this master plan framework envisions that the statewide network will be assembled through the establishment of MPAs in each of several study regions along the coast by 2011. Once established, management, research, education, and monitoring in each regional can be coordinated statewide.

The master plan framework will be first applied in developing alternative proposals in the central coast study region. Critical to understanding this process are several concepts and definitions. First, the "central coast study region" is the general area under consideration for the design of MPAs. By no means will the entire area be designated an MPA. Rather, after review of the circumstances within the region, including existing MPAs and the setting of regional goals and objectives, alternatives for the region will be developed.

Equally important, this study region will likely include a smaller area than the "biogeographical regions" defined in the MLPA. It is the biogeographical regions that are the basis for determining the number of marine reserves as required by the MLPA for replicates of similar habitats within marine reserves.

Within the study region, existing regulations (including existing MPAs), the status of the resources and habitats, and the requirements of the MLPA will be considered. Regional goals and objectives will then be developed, followed by potential goals and objectives for individual MPAs. At this point, possible boundaries and regulations will be identified for individual MPAs in the region, including alternative designs and potential changes to or removal of existing MPAs.

This variety of approaches to configuring MPAs within the region will then be assembled into alternative proposals. It is these alternatives that will be considered by the task force, and recommended, in some form, to the Department. The Department will ensure these alternatives are feasible, select a preferred alternative, and formally present them to the Commission.

The Blue Ribbon Task Force MPA Design Process

The MPA design process is composed of five general activities:

1. **Regional MPA planning**, which starts with the identification of a study region along the coast that constitutes a logical locale based on a variety of scientific and socioeconomic criteria for studying where MPAs might appropriately be placed. A regional stakeholder group will then be established for the selected region. This step ends with the identification of regional goals and objectives, an evaluation of existing MPAs and other management measures, and initial discussion of potential MPA locations.

2. **Individual MPA planning**, in which the regional stakeholder group, in consultation with a sub-team of the science team, develops proposals for potential MPAs. This includes recommendations for changes to existing MPAs and other management activities in the region.

3. **Assembling alternative MPA proposals**, which involves assembly of the MPAs developed in the previous stage into full proposals. This stage also includes an initial evaluation of the proposals, including socioeconomic effects, a feasibility study to determine whether proposals can be implemented, and preparation of a general management plan for MPAs in the region.

4. **Evaluating alternative MPA proposals,** which begins with initial evaluation by the task force. The task force then forwards the package of alternative proposals to the Department, which reviews the proposals, sponsors a peer review and selects a preferred alternative.

5. **Fish and Game Commission consideration and action on MPA proposals**, which includes public hearings, consideration of testimony and action on the proposals.

Figure 2 illustrates these five general activities and the major elements of each. Table 1 provides a summary of the activities and elements of the activities, together with a list of the lead actors and the groups to be consulted. A more detailed description of each activity follows in the text.

The ultimate goal of these activities is compliance with the MLPA, and specific elements listed here provide general guidance only. In each regional process, the specific elements undertaken must be selected and adjusted based both on the specifics of that region and adaptations suggested from prior experiences implementing the MLPA.

Once complete, the process used in the central coast study region and the master plan framework will be reviewed. Changes will be made to the framework and process based on lessons learned. This review will include the steps and guidelines presented in the framework, the regional stakeholder group process and composition, and other features of the process relevant to replicating the process statewide. It is expected that these changes and adaptive use of the framework will facilitate future regional processes and statewide implementation.

Figure 2. Process for MPA Planning in Study Regions.

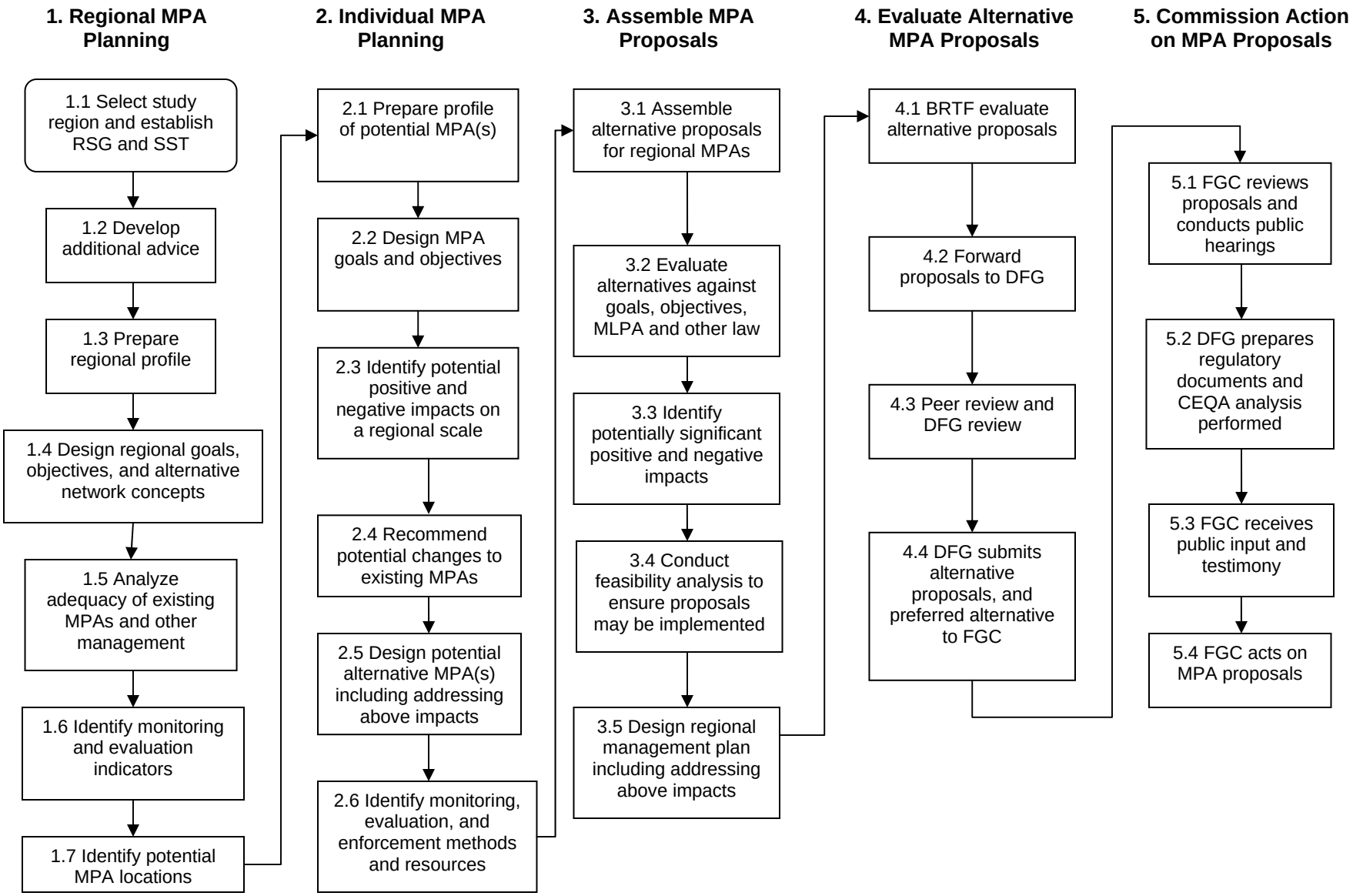


Table 1: Process for MPA Planning in Study Regions.

Key to acronyms: BRTF = Blue Ribbon Task Force; CEQA = California Environmental Quality Act; DFG = Department of Fish and Game; FGC = Fish and Game Commission; MLPAI = MLPA Initiative including the Department; RSG = Regional Stakeholder Group; SAT = Science Advisory Team; SST = Science Advisory sub-team.

	TASK	***LEAD ACTORS***	***SUGGEST/COMMENT***
REGIONAL MPA PLANNING			
1.1	***Establish regional process***		
1.1.1	Select a study region	BRTF	
1.1.2	Convene regional stakeholder group (RSG)	DFG	Stakeholders
1.1.3	Select science advisory sub-team (SST)	SAT	
1.1.4	Develop work plan and budget for regional effort	BRTF/Department	
1.2	***Develop additional advice***		
1.2.1	Identify issues requiring additional advice for designing MPAs in the study region	RSG/SST/MLPAI	Stakeholders/SAT
1.2.2	Collect and prepare additional advice for designing MPAs in the study region	MLPAI/SST	RSG/Stakeholders
1.2.3	Review additional advice for designing MPAs in the study region	BRTF/FGC/SAT	RSG/Stakeholders
1.2.4	Adopt additional advice for designing MPAs in the study region	BRTF	
1.3	***Prepare regional profile***		
1.3.1	Assemble regional information on biological, oceanographic, socioeconomic, and governance aspects of the region	MLPAI	Stakeholders
1.3.2	Review regional information and consider comments from stakeholders	RSG/SST	Stakeholders
1.3.3	Assess needs for additional information and ability to collect that information while meeting the goals of the MLPA.	RSG/SST	SAT/DFG
1.3.4	Evaluate general distribution of representative and unique habitats	RSG/SST	Stakeholders
1.3.5	Identify extent of habitat to be included in MPAs within study region	RSG/SST	Stakeholders
1.3.6	Evaluate wildlife populations, habitats, and uses of concerns	RSG/SST	Stakeholders
1.3.7	Evaluate fishing and non-fishing activities affecting populations, and habitats	RSG/SST	Stakeholders
1.3.8	Identify a list of key or critical species and document their regional distribution	RSG/SST	Stakeholders
1.3.9	Develop, review, and adopt regional profile based on the above	RSG/SST/SAT/ BRTF	Stakeholders
1.4	***Design regional ecological and socioeconomic goals and objectives and alternative network concepts***		

	TASK	LEAD ACTORS	SUGGEST/COMMENT
1.4.1	Design regional goals and objectives and alternative network concepts consistent with the MLPA and other relevant state law	RSG/SST	Stakeholders
1.4.2	Review regional goals and objectives and alternative network concepts	BRTF/FGC/SAT	Stakeholders
1.4.3	Approve regional goals and objectives and alternative network concepts	BRTF	
1.5	***Analyze adequacy of existing MPAs and management***		
1.5.1	Evaluate existing MPAs against goals and objectives	RSG/SST	Stakeholders
1.5.3	Evaluate existing fishing and non-fishing management activities against the MLPA, regional goals and objectives, and other relevant state law	RSG/SST	Stakeholders
1.5.4	Identify inadequacies if any in existing MPAs and management	RSG/SST	Stakeholders
1.6	***Identify monitoring and evaluation indicators***	SST/SAT	DFG
1.7	***Identify potential MPAs***	RSG/SST	Stakeholders
1.7.1	Based on regional profile, goals, objectives and alternative network concepts, identify potential modifications to existing MPAs or new MPA locations	RSG/SST	Stakeholders
1.7.2	After science team review, select potential modifications to existing MPAs or potential new MPAs for further evaluation	SAT/RSG	Stakeholders
INDIVIDUAL MPA PLANNING			
2.1	***Prepare profile of potential MPAs***		
2.1.1	Assemble and review information on biological, oceanographic, socioeconomic, and governance aspects of potential MPAs	MLPAI/RSG/SST	Stakeholders
2.1.2	Evaluate distribution of representative and unique habitats	RSG/SST	Stakeholders
2.1.3	Evaluate wildlife populations, habitats, and uses of concerns	RSG/SST	Stakeholders
2.1.4	Evaluate activities affecting populations, and habitats at each potential MPA site	RSG/SST	Stakeholders
2.1.5	Identify species likely to benefit or not to benefit from MPAs	RSG/SST	Stakeholders
2.1.6	Identify extent of habitat to be included in MPAs	RSG/SST	Stakeholders
2.1.7	Design, review, and adopt MPA profiles	RSG/SST	Stakeholders
2.2	***Design MPA goals and objectives (ecological and socioeconomic)for each potential MPA***		
2.2.1	Identify goals and objectives for the potential MPA	RSG/SST	Stakeholders

	TASK	LEAD ACTORS	SUGGEST/COMMENT
2.2.2	Review and request revision of goals and objectives for the potential MPA	SAT/BRTF	Stakeholders
2.2.3	Approve goals and objectives for the potential site and forward to FGC for review	BRTF	
2.3	***Identify potential positive and negative impacts (ecological and socioeconomic) of the MPA on a regional scale***	*RSG/SST*	*DFG/Stakeholder/SAT*
2.4	***Recommend potential changes to existing MPAs***	RSG/SST	DFG/SAT/Stakeholders
2.4.1	Evaluate existing MPAs against the goals and objectives and recommend potential changes	RSG/SST	Stakeholders
2.4.2	Prepare rationale for the recommendation	RSG/SST	Stakeholders
2.5	***Design Potential Alternative MPAs***		
2.5.1	Evaluate potential modifications to existing MPAs or new MPAs for meeting goals and objectives of the site, of the MLPA, and of other relevant state law	RSG/SST	Stakeholders
2.5.2	Design boundaries, management and enforcement measures for MPAs, as well as monitoring and budgets	RSG/SST	Stakeholders
2.5.3	Identify likely socioeconomic impacts of the MPAs	RSG/SST	Stakeholders
2.5.4	Identify recommended measures by other authorities regarding activities other than fishing that adversely impact the resources of the proposed MPA	RSG/SST	Stakeholders
2.6	***Identify monitoring, evaluation, and enforcement methods and resources***	SST/SAT/DFG	DFG
ASSEMBLE ALTERNATIVE REGIONAL MPAS			
3.1	***Assemble MPA proposals into alternative proposals for the region***	RSG/SST	Stakeholders
3.2	***Evaluate these alternatives against regional goals and objectives, the MLPA, and other relevant state law***	RSG/SST	Stakeholders
3.3	***Identify potentially significant positive and negative impacts (ecological and socioeconomic)***	RSG/SST	Stakeholders
3.4	***Conduct feasibility analysis to ensure proposals may be implemented***	DFG	RSG/BRTF

	TASK	LEAD ACTORS	SUGGEST/COMMENT
3.4	***Design general management plan for MPAs in the region, including monitoring, enforcement, and financing, periodic review of effectiveness***	RSG/SST	Stakeholders

EVALUATE ALTERNATIVE MPA PROPOSALS			
4.1	***Evaluate alternative MPA proposals against the MLPA and other relevant state law***	BRTF	Stakeholders
4.2	***Forward alternative proposals to the Department for consideration and submission to FGC***	BRTF	
4.3	***Conduct peer review and review proposals and relevant documents, amending as warranted***	DFG	BRTF
4.4	***Department submission of alternative proposals, preferred alternative and other documents to FGC***	DFG	
COMMISSION CONSIDERATION AND ACTION			
5.1	***FGC review of alternative proposals and public testimony***	FGC	Stakeholders/DFG/BRTF
5.2	***If FGC requests, the Department prepares regulatory documents, and a CEQA analysis is performed***	DFG	
5.3	***FGC accepts public testimony on alternative MPA proposals and supporting documents***	FGC	Stakeholders
5.4	***FGC acts on MPA proposals***	FGC	

The text below describes in greater detail the process for MPA planning in a study region. It is important to note that some of the sub-activities described below may occur simultaneously or may be repeated, such as the design of individual MPAs within a region. Other important activities, such as applying socioeconomic analyses or taking monitoring into account in the design of MPAs, are elements of broader activities throughout the process.

Task 1: Regional MPA Planning

The objective of this task is to develop background information, goals and objectives, and possible MPA network concepts (i.e., how the proposed MPAs within a region may relate to the statewide network) for the study region. Among other products is a regional profile that summarizes available ecological and socioeconomic information. This profile serves as a

foundation for setting goals and objectives, developing alternative proposals, and identifying needs for additional information.

During the MLPA Initiative process, designing MPAs begins with identification of a study region. The study region will focus initial efforts to implement this framework in a discrete area. For the MLPA Initiative process, the MLPA Blue Ribbon Task Force (BRTF) will oversee all aspects of regional planning in the initial study region. In evaluating possible initial study region alternatives along the central coast from Point Conception to Point Arena, the MLPA Initiative used the following criteria, which may be useful in future evaluations:

- Biophysical boundaries. Species of plants and animals are not distributed continuously along the California coast. Many species form natural communities with borders that may assist in determining the central coast study region. Although the borders themselves may be fuzzy, the central coast clearly has two major zones, divided by the outflow from San Francisco Bay. A weaker, but important break occurs at Point Sur, where current gyres cause abrupt changes in the composition of the community of species.

- Is the area large enough for replicates? Options were reviewed to determine if they were large enough to replicate various habitat types in more than one MPA within the entire region.

- Relative amount of habitat mapped. High-resolution mapping allows determination of bottom type on a finer scale than hard versus soft, and can distinguish relief, complexity, and rugosity, for example, of hard bottom structures. This criterion, rated as either high, moderately-high, moderate, or low, was based on the amount of available, high-resolution, fine-scale, habitat mapping data relative to the potential study region.

- Human activity boundaries. The diversity and intensity of human activities in coastal waters are discontinuous as well. As an example, recreational fishing is more prevalent south of Point Conception than north. The waters around Monterey are among the most popular sites for scuba diving in the United States. Government jurisdictions add another layer of complexity that should also be considered. Several sub-categories were considered within this criterion:

    - Recreational fishing
    - Commercial fishing
    - Scuba diving
    - County jurisdictions
    - Military/security uses
    - State/federal jurisdiction

- Progress of past MLPA and other public discussion groups. Input from outside groups' prior or ongoing discussions was considered. These groups may provide important information that will assist the regional process.

- Potential state, federal and private partners with financial or in-kind services. Potential partners were considered. The assistance provided by these partners can enhance and facilitate regional processes.

- Scientific knowledge of, and research being conducted in, the region. Public and private entities, such as universities, state and federal agencies, public waste dischargers (e.g., Southern California Coastal Water Research Project), and power generating companies (e.g., Pacific Gas and Electric's Diablo Canyon Power Plant) have conducted or are conducting research and monitoring studies in a variety of areas along the coast. Availability of region-specific information, including information on the distribution of habitats identified in the MLPA, should help determine the final study region.

- Availability of first-hand knowledge of the area. Numerous scientists, fishermen, and other informed individuals collectively provide a wealth of knowledge within specific areas. The level and availability of this type of information should be considered.

- Number of existing MPAs. Availability of scientific data about existing MPAs and how they meet or do not meet both resource protection needs and the requirements of the MLPA are important in determining a study region.

- Existing fishery regulations in the region and how they meet or do not meet both resource protection needs and the requirements of the MLPA. Existing regulations create differences in the need for additional protection in certain areas.

- Number of complete Department fishing districts and management areas (related to existing fishery regulations). The selected study region should reflect a consideration of these areas.

- Range or area over which a resource user may be expected to have a working knowledge of the resources. Similar to the range over which resources are utilized by user groups, the geographic range of a user's working knowledge will vary with the resource or resources in question. This also applies to researchers, fishery managers, and other scientists within the region. The selected study region should not be so large as to preclude the ability of individual representatives to provide input on its entire geographic extent.

- Distance members of a regional stakeholder group would need to travel in order to participate in group meetings. Choosing too large a study region could impose logistical problems for those required to, or interested in, participating in the process. This criterion was rated from high to low based on the length of coastline (nautical miles) within the potential study region as follows:

    - High = greater than 200 miles
    - Moderate to high = 151-200 miles
    - Moderate = 100-150 miles
    - Low = less than 100 miles

- Availability of Department personnel. The same considerations relative to travel that apply to the regional stakeholder group would also apply to Department staff.

A list of potential study regions was prepared and input was taken from the public both at BRTF meetings and at three public workshops. Specific areas of agreement among the majority of comments were noted. In addition, specific areas of concern became apparent. From this, a set of three potential study regions was developed. The positive and negative aspects of each potential region were presented to the BRTF, which then selected the final study region of Pigeon Point to Point Conception based on the information provided. It is expected that the process detailed below or a modified version will be used in other regions of the state for the full implementation of the MLPA.

Activity 1.1: Establish regional process

Activity 1.1.1: Based upon advice from the science team, the Department, and stakeholders, the task force selects a geographical study region within which to evaluate and design MPAs.

Activity 1.1.2: Once the study region is identified, the director of the Department convenes a regional stakeholder group to participate in the evaluation of the region and existing management, regional goals and objectives and potential changes to existing MPAs and the design of any additional MPAs.

Activity 1.1.3: The science team identifies members who will serve on a science sub-team, which will work closely with the regional stakeholder group, and will serve as a link to the science team.

Activity 1.1.4: In collaboration with the regional stakeholder group and the science advisory sub-team, staff develop a work plan and budget for designing alternative MPA proposals in the study region.

Activity 1.2: Develop additional advice

Activity 1.2.1: The regional stakeholder group, the science advisory sub-team, and staff identify issues requiring additional advice for designing MPAs in the study region.

Activity 1.2.2: In consultation with the science advisory sub-team, staff prepares draft advice on these issues.

Activity 1.2.3: the task force, Commission and science team review additional advice for designing MPAs in the study region.

Activity 1.2.4: the task force adopts the additional advice.

Activity 1.3: Prepare regional profile

Activity 1.3.1: Staff assemble regional information on biological, oceanographic, socioeconomic and governance aspects and draw upon suggestions and information provided by local communities and other stakeholders. The profile will include governance aspects related to tribal uses in the region if applicable. See Appendix E for a description of social science tools and methods. The types of the information that might be included in a regional profile may be found in Appendix F.

Activity 1.3.2: The regional stakeholder group and the science sub-team review regional information and consider comments from stakeholders.

Activity 1.3.3: The regional stakeholder group and the science sub-team assess the needs for additional information and the ability to collect that information while meeting the goals of the MLPA. It should be noted that the MLPA requires the best readily available information and does not require the process to wait for significant new information to be gathered.

Activity 1.3.4: The regional stakeholder group and the science advisory sub-team evaluate the distribution of representative and unique habitats in the study region and identify any significant gaps in information. The stakeholder group and science sub-team shall use the classifications of representative habitat as recommended by the science team and adopted by the task force.

Activity 1.3.5: Drawing upon the list of habitats that are to be represented in marine reserves in a region, the regional stakeholder group and science advisory sub-team recommend the extent of habitat to be included in MPAs within the study region.

Activity 1.3.6: The regional stakeholder group and the science advisory sub-team identify and evaluate wildlife populations, habitats, and uses of areas in the study region that may be of concern for conservation or other reasons identified in the MLPA.

Activity 1.3.7: The regional stakeholder group and the science advisory sub-team identify fishing and non-fishing activities affecting marine wildlife and habitats in the study region.

Activity 1.3.8: Drawing upon the list of species likely to benefit from protection within MPAs described in Appendix G, the regional stakeholder group and science advisory sub-team develop a list of key or critical species and document their regional distribution.

Activity 1.3.9: The regional stakeholder group reviews and adopts a regional profile based upon the above activities and submits that profile for review by the science team.

Activity 1.4: Design regional ecological and socioeconomic goals and objectives and alternative network concepts

Activity 1.4.1: Drawing upon the regional profile and the goals and objectives of the MLPA, the regional stakeholder group and the science advisory sub-team design

recommended regional goals, objectives and alternative network concepts, consistent with the MLPA and other relevant state law. (See discussion of setting goals and objectives below.)

Activity 1.4.2: The regional goals, objectives, and alternative network concepts designed in the regional effort are reviewed by the science team, whose comments are forwarded to the task force. The task force reviews the proposed regional goals, objectives, and alternative network concepts and provides comments and suggestions to the regional stakeholder group for consideration in revision. The task force subsequently forwards its comments and suggestions, together with the proposed regional goals, objectives, and network concepts, to the Department

Activity 1.4.3: The task force approves the regional goals, objectives, and alternative network concepts, when satisfied that they meet the standards of the MLPA.

Activity 1.5: Analyze adequacy of existing MPAs and management activities

Activity 1.5.1: The regional stakeholder group and the science advisory sub-team evaluate existing MPAs in the study region against the regional goals and objectives and the MLPA. This preliminary analysis will include a review of existing studies within each MPA and a determination of whether the areas are meeting their original goals as well as whether they may achieve regional goals and MLPA requirements. A further review will occur in Activity 2.

Activity 1.5.3: The regional stakeholder group and the science advisory sub-team evaluate existing management of fishing and non-fishing activities against regional goals and objectives and the MLPA (e.g., Rockfish Conservation Areas or trawl fishery closures, etc.). Where this other management meets regional goals and objectives and the goals and objectives of the MLPA in all or part of the region, it should be incorporated into the final design.

Activity 1.5.4: The regional stakeholder group and the science advisory sub-team identify inadequacies in existing MPAs and management activities in meeting the goals and objectives of the study region and of the MLPA. (See Appendix H for a description of planning processes related to the MLPA.)

Activity 1.6: Identify monitoring and evaluation indicators.
The regional stakeholder group and the science advisory sub-team will identify potential monitoring and evaluation indicators used to evaluate progress toward achieving goals and objectives.

Activity 1.7: Identify potential new MPAs

Activity 1.7.1: Based on the regional profile, regional goals and objectives, and alternative network concepts developed above, the regional stakeholder group and the science advisory sub-team will identify potential modifications to existing MPAs or new locations within the study region within which individual MPAs may be sited.

Activity 1.7.2: Upon review by the science team, the regional stakeholder group selects modifications to existing MPAs and potential new MPAs for further evaluation in the next task.

Task 2: MPA Planning

The objectives of this task are to evaluate conditions in each potential MPA identified in the previous activity, to develop goals and objectives for potential MPAs, and to design boundaries and other management measures for potential MPAs. The intent is for the sum of individual MPAs to meet the regional goals and objectives and the sum of the regions to meet the MLPA goals and objectives and network requirements while noting that any individual MPA may not meet all of the goals of the region or network.

Activity 2.1: Prepare profile of each potential MPA.
Note that the following seven steps are carried out for each of the potential MPAs identified in the previous activity.

Activity 2.1.1: Staff assemble and review information on biological, oceanographic, socioeconomic, and governance aspects of the potential MPA. The regional stakeholder group and the science advisory sub-team review this information and may request additional information.

Activity 2.1.2: The regional stakeholder group and the science advisory sub-team evaluate the distribution of representative and unique habitats in the potential MPA, based on the information assembled in Activity 2.1.1, and information provided by stakeholders, including local communities and fishermen.

Activity 2.1.3: The regional stakeholder group and the science advisory sub-team identify and evaluate wildlife populations, habitats, and various human uses that may negatively impact the populations and habitats in the potential MPA.

Activity 2.1.4: The regional stakeholder group and the science advisory sub-team identify and evaluate activities that may affect populations and habitats.

Activity 2.1.5: The regional stakeholder group and the science advisory sub-team determine which key or critical species from step 1.3.8 are likely to benefit from the potential MPA. Species not likely to benefit should also be considered as prohibition of their take may lead to unnecessary socioeconomic impact. All species should be considered for their ecological interactions, whether the individual species benefit or not.

Activity 2.1.6: The regional stakeholder group and the science advisory sub-team identify the extent of habitat to be included in the potential MPA.

Activity 2.1.7: In consultation with the regional stakeholder group and the science advisory sub-team, staff prepare a profile of the potential MPA based on the information

developed in activities 2.1.1 to 2.1.6. The regional stakeholder group and the science advisory sub-team review and adopt the profile as the basis for the next major activity.

Activity 2.2: Design MPA goals and objectives (ecological and socioeconomic) for each potential MPA

Activity 2.2.1: Based on the site planning profile, the regional goals and objectives, and the MLPA, the regional stakeholder group and the science sub-team design recommended goals and objectives for individual MPA(s) in the region.

Activity 2.2.2: The regional goals and objectives for the potential MPA(s) are reviewed by the science team.

Activity 2.2.3: The Department approves the goals and objectives for the potential MPA(s).

Activity 2.3: Identify potential positive and negative impacts (ecological and socioeconomic) of the potential MPA(s) on a regional scale.

Activity 2.4: Recommend potential changes to existing MPAs

Activity 2.4.1: The regional stakeholder group and the science sub-team review all the above information and make initial recommendations for the modification, reduction in size, expansion, or removal of existing MPAs in order to meet regional goals and objectives consistent with the goals of the MLPA and the network concepts for the region. (See Appendix I for brief descriptions of existing MPAs.)

Activity 2.4.2: The regional stakeholder group and the science team develop a rationale for this recommendation, which is included in the regional options forwarded to the task force and then to the Department.

Activity 2.5: Design potential alternative MPA(s)

Activity 2.5.1: The regional stakeholder group and science advisory sub-team evaluate potential modifications to existing MPAs or different types of new MPAs and combinations of MPAs for meeting the goals and objectives of the MLPA, regional goals and objectives, goals of the statewide network, and of other relevant state law.

Activity 2.5.2: The regional stakeholder group and science advisory sub-team design boundaries, management and enforcement measures for potential modifications to existing MPAs and potential alternative new MPA(s), as well as general features of a monitoring plan and budget.

Activity 2.5.3: The regional stakeholder group and science advisory sub-team identify likely direct and indirect socioeconomic effects of the MPA(s) that should be considered in subsequent analyses.

Activity 2.5.4: The regional stakeholder group and science advisory sub-team recommend measures that may be taken by other authorities to mitigate the effects of activities other than fishing that adversely impact the resources of the potential alternative regional MPA(s).

Activity 2.6: Identify monitoring, evaluation, and enforcement methods and resources.
The regional stakeholder group and the science advisory sub-team will identify potential monitoring and evaluation methods along with potential resources to complete monitoring. The definitions of reserves, parks and conservation areas create a potential gradient in fishing pressure that will be used in the design of the monitoring program to assess the impacts of the MPAs. With assistance from Department enforcement personnel, the regional stakeholder group will develop a potential enforcement plan for the proposed areas. This will include recommendations of which areas are key enforcement areas as well as areas with high enforcement needs due to high levels of use or critical ecological function.

Task 3: Assemble alternative regional MPAs

The objectives of this task are to assemble the results of planning regarding each potential MPA into alternative packages, to evaluate these packages against the regional goals and objectives and the MLPA, to identify likely socioeconomic impacts, and to outline a management plan for the region's MPAs.

Activity 3.1: Assemble alternative proposals.
The regional stakeholder group and science advisory sub-team assemble individual MPA proposals into alternative proposals for the study region.

Activity 3.2: Evaluate alternative proposals.
The regional stakeholder group and the science advisory sub-team evaluate these alternative proposals against regional goals and objectives, the MLPA and other relevant state law.

Activity 3.3: Identify potentially significant impacts.
The regional stakeholder group and the science advisory sub-team identify potentially significant positive and negative impact(s) (both environmental and socioeconomic) from the alternative proposals and attempts to modify the proposals to limit the negative impacts.

Activity 3.4: Feasibility Analysis.
The Department will conduct a feasibility analysis of the proposals. This analysis will include analysis of the Department's ability to enforce, monitor, manage and fund the full implementation of the proposed MPAs. The analysis will not be contingent upon existing funds, but proposals must be reasonably expected to be implemented within the MLPA implementation timeframe. Proposals that are found infeasible will be returned to the regional stakeholder group for further discussion and revision. The Department will provide the regional stakeholder group with up-to-date information on its expected ability to fund and staff implementation.

Activity 3.5: Design a management plan.
The regional stakeholder group and the science advisory sub-team design a general management plan for MPAs in the region, including monitoring, enforcement, costs and financing, and periodic review of effectiveness.

Task 4: Evaluate Alternative MPA proposals

The objectives of this task are to conduct initial reviews of the alternative MPA proposals, to conduct environmental and socioeconomic analyses as required by law, and to submit the alternative proposals and supporting materials to the Commission for its consideration.

Activity 4.1: Forward proposals to task force.
The regional stakeholder group and the science advisory sub-team forwards the alternative MPA proposals, initial evaluations and general management plan to the task force, which evaluates these proposals against the MLPA's standards and other relevant state law.

Activity 4.2: Forward proposals to Department.
The task force forwards alternative proposals for MPAs, a preferred alternative, initial evaluations, and the general management plan, together with its own evaluation, to the Department for its consideration and submission to the Commission.

Activity 4.3: Peer review and Department review.
The Department sponsors a peer review of alternative MPA proposals and reviews the alternative proposals, initial evaluations, and general management plans, and amends these documents consistent with its authorities and peer review as well as any recommendations from the task force and the public in response to the peer review.

Activity 4.4: Submit proposals to Commission.
The Department submits those alternative proposals that are consistent with the MLPA, a preferred alternative, and other pertinent information from the regional groups and the task force, to the Commission.

Task 5: Commission consideration and action

The objectives of this task are to consider public testimony and other information regarding the MPA proposals submitted by the Department and to take action on these proposals.

Activity 5.1: Commission review of proposals.
The Commission reviews the alternative regional MPA proposals, takes public testimony, and determines whether to request that the Department begin the formal regulatory process.

Activity 5.2: Formal regulatory process.
If the Commission does make such a request, the Department prepares regulatory language and other documents and analyses required by the California Environmental Quality Act (CEQA) and other relevant law.

Activity 5.3: Public testimony.
The Commission then accepts public testimony on the alternative regional MPA proposals and on the analyses conducted under CEQA and other law.

Activity 5.4: The Commission acts on alternative regional MPA proposals.

Section 3. Considerations in the Design of MPAs

Accomplishing MLPA goals and objectives to improve a statewide network of MPAs will require the consideration of a number of issues, some of which are addressed in the MLPA itself. These are as follows:

- Goals of the Marine Life Protection Program
- MPA networks
- Types of MPAs
- Settling goals and objectives for MPAs
- Geographical regions
- Representative and unique habitats
- Species likely to benefit from MPAs
- Enforcement considerations in setting boundaries
- Information used in the design of MPAs
- Monitoring and evaluation strategies and resources
- Other activities affecting resources of concern

Each of these issues is discussed below.

Goals of the Marine Life Protection Program

The foundation for achieving the goals and objectives of the MLPA is a Marine Life Protection Program (Program), which must be adopted by the Commission. The MLPA sets the following goals for the Program [FGC subsection 2853(b)]:

(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.

The goals, objectives, management, monitoring, and evaluation of an MPA network must be consistent with the MLPA goals and objectives.

The goals of the MLPA go beyond the scope of traditional management of activities affecting living marine resources, which has focused upon maximizing yield from individual species or

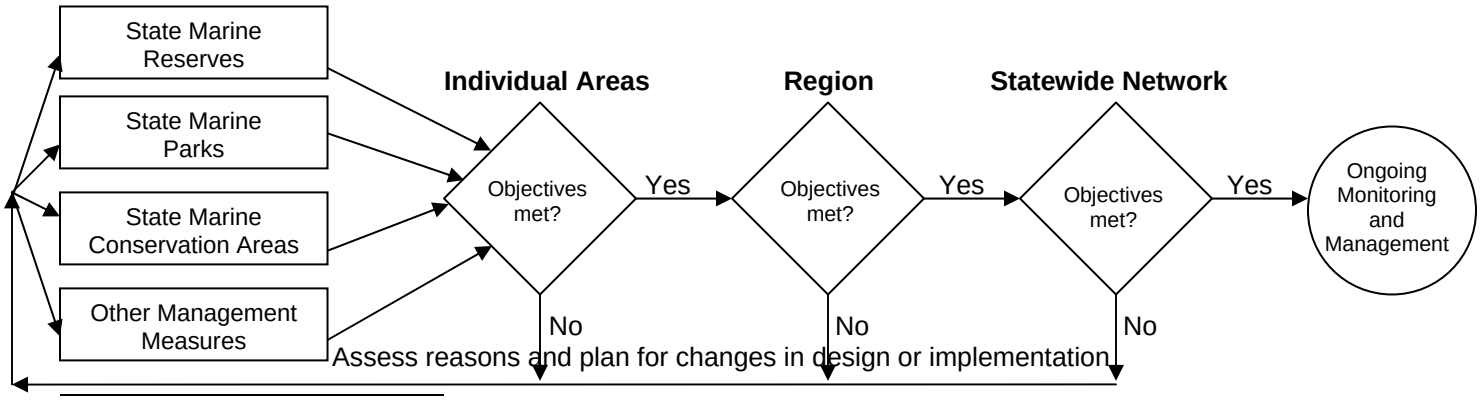
groups of species. For example, the first goal emphasizes biological diversity and the health of marine ecosystems, rather than the abundance of individual species. The second goal recognizes a role of an MPA system as a tool in fisheries management. The third recognizes the importance of recreation and education in MPAs, and balances these with the protection of biodiversity. The fourth recognizes the value of protecting representative and unique marine habitats for their own value. The fifth and sixth goals address the deficiencies in California's existing MPAs that the MLPA identifies elsewhere in the law. (See the glossary in Appendix J for definitions of some key terms in this goal statement.)

The MLPA also states that the preferred siting alternative for MPA networks, which the Department must present to the Commission, must include an "improved marine life reserve[4] component" and must be designed according to all of the following guidelines:

(1) Each MPA shall have identified goals and objectives. Individual MPAs may serve varied primary purposes while collectively achieving the overall goals and guidelines of this chapter.
(2) Marine Life Reserves in each bioregion shall encompass a representative variety of marine habitat types and communities, across a range of depths and environmental conditions.
(3) Similar types of marine habitats shall be replicated, to the extent possible, in more than one marine life reserve in each biogeographical region.
(4) Marine life reserves shall be designed, to the extent practicable, to ensure that activities that upset the natural functions of the area are avoided.
(5) The MPA network and individual MPAs shall be of adequate size, number, type of protection, and location to ensure that each MPA meets its objectives and that the network as a whole meets the goals and guidelines of the MLPA.

Overall, proposed MPAs in each region must meet their individual goals and objectives, and the collection of MPAs and other management measures in each region and throughout the State must meet the goals and objectives of the MLPA. A simple decision tree for examining this is shown in Figure 3. This diagram indicates how the various types of MPAs along with other management measures work together to meet individual goals, regional goals, and the goals of the MLPA.

Figure 3. Flowchart of the review process to determine if individual, regional, and MLPA goals are being met by the various types of MPAs and other management measures.



[4] As noted previously, marine life reserve in the context of the MLPA is synonymous with a state marine reserve.

MPA Networks

One of the goals of the Marine Life Protection Program calls for improving and managing the state's MPAs as a network, to the extent possible. Although neither statute nor legislative history defines "network," the ordinary dictionary usage contemplates *interconnectedness* as a characteristic of the term. The first finding of the MLPA highlights the fact that California's MPAs "were established on a piecemeal basis rather than according to a coherent plan" [Fish and Game Code Section 2851(a)]. The term "reserve network" has been defined as a group of reserves which is designed to meet objectives that single reserves cannot achieve on their own (Roberts and Hawkins, 2000). In general this definition may infer some direct or indirect connection of MPAs through the dispersal of adult, juvenile, and/or larval organisms or other biological interactions. In most cases, larval and juvenile dispersal rates are not known and oceanography or ocean current patterns may be combined with larval biology to help determine connectivity.

Portions of the overall network will likely differ in each region of the state. The MLPA also requires that the network as a whole meet the various goals and guidelines set forth by the law and contemplates the adaptive management of that network [Fish and Game Code Section 2857(c)(5)]. In order to meet those goals a strict interpretation of an ecological network across the entire state, based on biological connectivity, may not be possible.

As stated above, the MLPA also requires that MPAs be managed as a network, to the extent possible. This implies a coordinated system of MPAs. MPAs might be linked through biological function as in the case of adult and juvenile movement or larval transport. MPAs managed as a network might also be linked by administrative function. The important aspects of this interpretation are that MPAs are linked by common goals and a comprehensive management and monitoring plan, and that they protect areas with a wide variety of representative habitat as required by the MLPA. MPAs should be based on the same guiding principles, design criteria, and processes for implementation. In this case, a statewide network could be one that has connections through design, funding, process, and management. At a minimum, the master plan should insure that the statewide network of MPAs reflects a consistent approach to design, funding and management. The desired outcome would include components of both biological connectivity and administrative function to the extent each are practicable and supported by available science.

Because of the long-term approach of the MLPA Initiative, the statewide network of MPAs called for by the MLPA will be developed in phases, region by region. Within each region, components of the statewide network will be designed consistent with the MLPA and with regional goals and objectives. Each component ultimately will be presented as a series of options, developed in a regional process involving a regional stakeholder group and a sub-group of the science team. Each will include a preferred alternative identified by the Department and delivered to the Commission. Another application of phasing may be an incremental implementation of a portion of the statewide MPA network within a single region. This type of phasing could allow for the completion of baseline surveys or the time necessary to secure additional funding for enforcement and management. Final proposals should include an explanation of the timing of implementation.

Science Advisory Team Guidance on MPA Network Design

The MLPA calls for the use of the best readily available science, and establishes a science team as one vehicle for fostering consistency with this standard. The MLPA also requires that the MPA network and individual MPAs be of adequate size, number, type of protection, and location as to ensure that each MPA and the network as a whole meet the objectives of the MLPA. In addition, the MLPA requires that representative habitats in each bioregion be replicated to the extent possible in more than one marine reserve.

The availability of scientific information is expected to change and increase over time. As with the rest of this framework, the following guidelines should be modified if new science becomes available that indicates changes. Additionally, changes should be made based on adaptive management and lessons learned as MPAs are monitored throughout various regions of the state.

The science team provided the following guidance in meeting these standards. This guidance, which is expressed in ranges for some aspects such as size and spacing of MPAs, should be the starting point for regional discussions of alternative MPAs. Although this guidance is not prescriptive, any significant deviation from it should be consistent with both regional goals and objectives and the requirements of the MLPA. The guidelines are linked to specific objectives and not all guidelines will necessarily be achieved by each MPA. For each recommendation below, detailed references are provided in the bibliography with notation linking them to the appropriate section.

Overall MPA and network guidelines:

- The diversity of species and habitats to be protected, and the diversity of human uses of marine environments, prevents a single optimum network design in all environments.

- For an objective of protecting the diversity of species that live in different habitats and those that move among different habitats over their lifetime, every ‘key’ marine habitat should be represented in the MPA network.

- For an objective of protecting the diversity of species that live at different depths and to accommodate the movement of individuals to and from shallow nursery or spawning grounds to adult habitats offshore, MPAs should extend from the intertidal zone to deep waters offshore.

- For an objective of protecting adult populations, based on adult neighborhood sizes and movement patterns, MPAs should have an alongshore span of 5-10 km (3-6 m or 2.5-5.4 nm) of coastline, and preferably 10-20 km (6-12.5 m or 5.4-11 nm). Larger MPAs would be required to fully protect marine birds, mammals, and migratory fish.

- For an objective of facilitating dispersal of important bottom-dwelling fish and invertebrate groups among MPAs, based on currently known scales of larval dispersal, MPAs should be placed within 50-100 km (31-62 m or 27-54 nm) of each other.

- For an objective of providing analytical power for management comparisons and to buffer against catastrophic loss of an MPA, at least three to five replicate MPAs should be designed for each habitat type within a biogeographical region.

- For an objective of lessening negative impact while maintaining value, placement of MPAs should take into account local resource use and stakeholder activities.

- Placement of MPAs should take into account the adjacent terrestrial environment and associated human activities.

- For an objective of facilitating adaptive management of the MPA network into the future, and the use of MPAs as natural scientific laboratories, the network design should account for the need to evaluate and monitor biological changes within MPAs.

1. MPAs should be in different marine habitats, biogeographical regions and upwelling cells *(See references noted "A" in literature cited)*

The strong association of most marine species with particular habitat types (e.g., sea grass beds, submarine canyons, shallow and deep rock reefs), and variation in species composition across latitudinal, depth clines and biogeographical regions, implies that habitat types must be represented across each of these larger environmental gradients to capture the breadth of biodiversity in California's waters.

Different species use marine habitats in different ways. As a result, protection of all the key habitats along the California coast is a critical component of network design. A 'key' habitat type is one that provides distinctive benefits by harboring a different set of species or life stages, having special physical characteristics, or being used in ways that differ from the use of other habitats. In addition, many species require different habitats at different stages of their life cycle - for example, nearshore species may occur in offshore open ocean habitats during their larval phase. Thus, protection of these habitats, as well as designs that ensure connections between habitats, is critical to MPA success. Individual MPAs that encompass a diversity of habitats will both ensure the protection of species that move among habitats and protect adjoining habitats that benefit one another (e.g., exchange nutrients, productivity). Habitats with unique features (educationally, ecologically, archeologically, anthropologically, culturally, spiritually), or those that are rare should be targeted for inclusion. Habitats that are uniquely productive (e.g. upwelling centers or kelp forests) or aggregative (e.g., fronts) or those that sustain distinct use patterns (e.g. dive training centers, fishing or whale watching hot spots) should also get special consideration in design planning

2. Target species are ecologically diverse *(See references noted "B" in literature cited)*

MPAs protect a large number of species within their borders, and these species can have dramatically different requirements. As a result, MPA networks cannot be designed for the specific needs of each individual species. Rather, design criteria need to focus on maximizing collective benefits across species by minimizing compromises where possible. Commonly, it is

more practical to consider protecting groups of species based on shared functional characteristics that influence MPA function and design (e.g., patterns of adult movement; patterns of larval dispersal; dependence on critical locations such as spawning grounds, mammal haul out areas, bird rookeries). It is also reasonable to emphasize protection of ecologically and economically dominant species groups when siting MPAs. The former play the largest roles in the function of coastal ecosystems, and the latter often experience the greatest impacts from human activities. In addition, knowledge of the distribution of rare, endemic, and endangered species should supplement the use of species groups. Generally, MPAs should not be used solely to enhance single-species management goals.

3. *Uses of marine and adjacent terrestrial environments are diverse* *(See references noted "[C]" in literature cited)*

The way people use coastal marine environments is highly diversified in method, goals, timing, economic objectives, spatial patterns, etc. The wide spectrum of environmental uses should be a part of decisions comparing alternatives networks of MPAs. The heterogeneity of uses, both between and within consumptive and non-consumptive categories make it unlikely that any one design will satisfy all user groups. The design will need to make some explicit provisions for trading off between the various negative and positive impacts to user groups. Placement of MPAs should also take into account the adjacent terrestrial environment and associated human activities. Freshwater runoff can be an important source of nutrients but also a potential source of contaminants to the adjacent marine environment. Terrestrial protected areas (e.g., preserves, parks) can regulate human access, restrict discharge of contaminants and provide enforcement support to adjoining MPAs.

4. MPA permanence is especially critical for long lived animals

Two clear objectives for establishing self-sustaining MPAs are to protect areas that are important sources of reproduction (nurseries, spawning areas, egg sources) and to protect areas that will receive recruits and thus be future sources of spawning potential. To meet the first objective of protecting areas that serve as sources of young, protection should occur both for areas that historically contained high abundances and for areas that currently contain high abundances. Historically productive fishing areas, which are now depleted, are likely to show a larger, ultimate response to protective measures if critical habitat has not been damaged. Protecting areas where targeted populations were historically abundant alone is insufficient, however, because the pace of recovery may be slow, especially for species with relatively long life spans and sporadic recruitment (for example, top marine predators). Including areas with currently high abundances in an MPA network helps buffer the network from the inevitable time lag for realizing the responses of some species. The biological characteristics of longevity and sporadic recruitment also suggest that the concept of a rotation of open and closed areas will probably not work well for the diversity of coastal species in California.

5. Size and shape guidelines *(See references noted "[D]" in literature cited)*

To provide any significant protection to a target species, the size of an individual MPA must be large enough to encompass the typical movements of many individuals. Movement patterns vary greatly among species. Some are completely immobile or move only a few meters. Others

forage widely. The more mobile the individuals, the larger the individual MPA must be to afford protection. Therefore, minimum MPA size constraints are set by the more mobile target species. Because some of California's coastal species are known to move hundreds of miles, MPAs of any modest size are unlikely to provide real protection for these species. Fortunately, tagging studies indicate that net movements of many of California's nearshore bottom-dwelling fish species, particularly reef-associated species, are on the order of 5-20 km (3-12.5 m or 2.5-11 nm) or less over the course of a year. These individual adult neighborhood or home range sizes must be combined with knowledge of how individuals are distributed relative to one another (e.g., in exclusive versus overlapping neighborhoods) to determine how many individuals a specific MPA design will protect. Current data suggest that MPAs spanning less than about 5-10 km (3-6 m or 2.5-5.4 nm) in extent along coastlines may leave many individuals of important species poorly protected. Larger MPAs, spanning 10-20 km (6-12.5 m or 5.4-11 nm) of coastline, are probably a better choice given current data on adult fish movement patterns. With MPAs of this size, pelagic species with very large neighborhood sizes will likely receive little protection unless the MPA network as a whole affords significant reductions in mortality during the cumulative periods that individuals spend in different MPAs, or unless other ecological benefits are conferred (e.g., protection of feeding grounds, reduction in bycatch). Protection for highly mobile species will come from other means, such as state and federal fisheries management programs, but MPAs may play a role.

Less is known about the net movements of most of the deeper water sedentary and pelagic fishes, especially those associated with soft-bottom habitat, but it is reasonable to suspect that the range of movements will be similar or greater than those of nearshore species. One cause of migration in demersal fishes is the changing resource/habitat requirements of individuals as they grow. Thus, individual ranges can reflect the gradual movement of an individual among habitats, and MPAs that encompass more diverse habitat types will more likely encompass the movement of an individual over its lifetime. Although fisheries may not target younger fish, offshore MPAs that include inshore nursery habitats increase the likelihood of replenishment of adult populations offshore. Such MPAs would also protect younger fish from incidental take (i.e. by-catch). Fish with moderate movements, especially those in deeper water, will require larger MPA sizes. Because several species also move between shallow and deeper habitat, MPAs that extend offshore (from the coastline to the three-mile offshore boundary of State waters) will accommodate such movement and protect individuals over their lifetime.

Typically, the relative amount of higher relief rocky reef habitat decreases with distance from shore. In such situations, a MPA shape that covers an increasing area with distance offshore (i.e. a wedge shape) may be an effective design. This shape also better accommodates the greater movement ranges of deeper water and soft-bottom associated fishes and the larval/juvenile stages of nearshore species which may occur offshore during their planktonic phase of life. However, this may conflict with the optimum design for enforcement purposes of using lines of latitude and longitude for boundaries.

Coupling of pelagic and benthic habitats is an important consideration in both offshore and nearshore MPA design. The size of a protected area should also be large enough to facilitate enforcement and to limit deleterious edge effects caused by fishing adjacent to the MPA. MPA shape should ultimately be determined on a case-by-case basis using a combination of

information about bathymetry, habitat complexity, and species distribution and relative abundance.

6. Spacing between MPAs *(See references noted "[E]" in literature cited)*

The exchange of larvae among MPAs is the fundamental biological rationale for MPA "networks". Larval exchange has at least three primary objectives: to assure that populations within MPAs are not jeopardized by their reliance on replenishment from less protected populations outside MPAs; to ensure exchange and persistence of genetic traits of protected populations (e.g., fast growth, longevity); and to enhance the independence of populations and communities within MPAs from those outside MPAs for the use of MPAs as reference sites. For MPAs to act as reference sites for comparison with less protected populations or communities, MPAs must act independently from areas with less protected populations. Independence is enhanced for MPAs whose replenishment is contributed to by other MPAs.

Movement out of, into and between MPAs by juveniles, larvae or spores of marine species depends on their dispersal distance. Important determinants of dispersal distance are the length of the planktonic period, oceanography and current regimes, larval behavior, and environmental conditions (e.g., temperature and sources of entrainment). As with adult movement patterns, the dispersal of juveniles, larvae and eggs varies enormously among species. Some barely move from their natal site. Others disperse vast distances. MPAs will only be connected through the dispersal of young if they are close enough together to allow movement from one MPA to another. Any given spacing of MPAs will undoubtedly provide connectivity for some species and not for others. The challenge is minimizing the number of key or threatened species that are left isolated by widely spaced MPAs.

Based on emerging genetic data from species around the world, larval movement of 50-100 km appears common in marine invertebrates. For fishes, larval neighborhoods based on genetic data appear generally larger, ranging up to 100-200 km. For marine birds and mammals, dispersal of juveniles of hundreds of km is not unusual, but for some of these species, return of juveniles to natal areas can maintain fine-scale population structure. For MPAs to be within dispersal range for most commercial or recreational groundfish or invertebrate species, they will need to be on the order of no more that 50-100 km apart. Otherwise, a large fraction of coastal species will gain no benefits from connections between MPAs.

Current patterns, retention features such as fronts, eddies, bays, and the lees of headlands may create "recruitment sinks and sources". Such spatial variation in recruitment habitat may be predictable - dispersal distances will be shorter where retention is substantial (e.g., lees of headlands). As a result, MPAs may need to be more closely spaced in these settings. Although dispersal data appear to be valid for a wide range of species, there are only a small number of coastal marine species in California that allow these estimates of larval neighborhoods to be made with confidence. Nonetheless, it is the distribution of dispersal distances across species that really drives network design rather than the specific patterns for any particular species.

7. Minimal replication of MPAs

MPAs in a particular habitat type need to be replicated along the coast. Four major reasons for this are: to provide stepping-stones for dispersal of marine species; to insure against local environmental disaster (e.g. oil spills or other catastrophes) that can significantly impact an individual, small MPA; to provide independent experimental replicates for scientific study of MPA effects; and for the use of MPAs as reference sites to evaluate the effects of human influences on populations and communities outside MPAs. Ideally at least five replicates (but a minimum of three) containing sufficient representation or each habitat type, should be placed in the MPA network within each biogeographical region and for each habitat to serve these goals. For large biogeographical regions, fulfilling the critical stepping stone role may require even more MPA replicates. The spacing criteria discussed above will drive the number of replicates in this situation. To ensure that the effects of MPAs can be quantified, the network should be designed in a way that facilitates comparison of protected and unprotected habitats, and between different degrees of consumptive and non-consumptive uses.

8. Human activities ranges and MPA placement

The geographic extent of human activities is suggestive of size and placement of MPAs. Fishing fleets and other user groups typically have a finite home range from ports and access points along the coast. Many activities, especially in central California, are day-based and conducted from motor, sail or hand powered crafts with ranges between 1 and 29 miles (1 and 25 nautical miles). Historical patterns of fishing activity may have been concentrated much closer to ports than is true today because of declines in target species abundance from activities in the past. If MPAs are designed to limit consumptive uses, MPAs located farthest away from access points will tend to be associated with lower costs. However, MPAs often become magnets for fishing along their edges. These situations create a net benefit for consumptive users by locating MPAs close to ports and coastal access points. Similarly, MPAs designed to facilitate certain non-consumptive types of activities such as diving may be more effective closer to ports and coastal access points. As a general rule, locating MPAs at the outer reaches of the maximum range of any given user group will tend to minimize the impacts on that group, both negative (loss of opportunity) and positive (creation of opportunity). The balance between these influences must be evaluated for specific locations. In addition, if MPAs restrict transit they will carry higher social, economic and, potentially, safety costs for users seeking access to sites beyond the MPA.

9. Human activity patterns and portfolio effects

Human activities have distinct hotspots where effort is concentrated. For example, in the northern California urchin fishery, economists at the University of California at Davis have documented are-based fishing strategies around a dozen fishing locations. It is likely that there are a threshold number of these locations below which the fishery would not be feasible. Because an MPA larger than the typical harvest area could potentially eliminate a fishing location, these spatial use patterns should be part of design considerations, especially if establishing one particular MPA would spell the end of a particular activity along the entire coastline.

Consideration of Habitats in the Design of MPAs *(See additional references noted "F" in literature cited)*

The first step in assembling alternative proposals for MPAs in a region and in the context of a statewide MPA network is to use existing information to the extent possible to identify and to map the habitats that should be represented. The MLPA also calls for recommendations regarding the extent and types of habitats that should be represented.

The MLPA identifies the following habitat types: rocky reefs, intertidal zones, sandy or soft ocean bottoms, underwater pinnacles, seamounts, kelp forests, submarine canyons, and seagrass beds. The Master Plan Team convened in 2000 reduced this basic list by eliminating seamounts, since there are no seamounts in state waters. The team also identified four depth zones as follows: intertidal, intertidal to 30 meters, 30 meters to 200 meters, and beyond 200 meters. Several of the seven habitat types occur in only one zone, while others may occur in three or four zones.

The science team recommends expanding these habitat definitions in four ways:

1. Based on information about fish depth distributions provided in a new book on the ecology of California marine fishes (Allen et al. in press), the science team recommends dividing the 30-200 m depth zone into a 30-100 m and a 100-200 m zone. This establishes five depth zones for consideration:

    - Intertidal
    - Intertidal to 30 m (0 to 16 fm)
    - 30 to 100 m (16 to 55 fm)
    - 100 to 200 m (55 to 109 fm)
    - 200 m and deeper.

2. The habitats defined in the MLPA implicitly focus on open coast ecosystems and ignore the critical influence of estuaries. California's estuaries contain most of the State's remaining soft bottom and herbaceous wetlands such as salt marshes, sand and mud flats, and eelgrass beds. Ecological communities in estuaries experience unique physical gradients that differ greatly from those in more exposed coastal habitats. They harbor unique suites of species, are highly productive, provide sheltered areas for bird and fish feeding, and are nursery grounds for the young of a wide range of coastal species. Emergent plants filter sediments and nutrients from the watershed, stabilize shorelines, and serve as buffers for flood waters and ocean waves. Given these critical ecological roles and ecosystem functions, estuaries warrant special delineation as a critical California coastal habitat.

3. Three of the habitats defined in the MLPA – rocky reefs, intertidal zones, and kelp forests – are generic habitat descriptions that include distinct habitats that warrant specific consideration and protection. In the case of rocky reefs and intertidal zones, the type of rock that forms the reef greatly influences the species using the habitat. For example, granitic versus sedimentary rock reefs harbor substantially different ecological assemblages and should not be treated as a single habitat. Similarly, the term kelp

forest is a generic term that subsumes two distinct ecological assemblages dominated by different species of kelp. Kelp forests in the southern half of the state are dominated by the giant kelp, *Macrocystis pyrifera.* By contrast, kelp forests in the northern half of the state are dominated by the bull kelp, *Nereocystis luetkeana*. In central California, both types of kelp forests occur. These two types of kelp forests harbor distinct assemblages and should be treated as separate habitats.

4. Habitat definitions in the MLPA should be expanded to include ocean circulation features, because habitat is not simply defined by the substrate. Seawater characteristics are analogous to the climate of habitats on land, and play a critical role in determining the types of species that can thrive in any given setting. Just as features of both the soil and atmosphere characterize habitats on land, features of both the substrate (e.g., rock, sand, mud) and the water that bathes it (e.g., temperature, salinity, nutrients, current speed and direction) characterize habitats in the sea. No one would argue that a sand dune at the beach and a sand dune in the desert are the same habitat. Similarly, rocky reefs in distinct oceanographic settings are different habitats that can differ fundamentally in the species that use the reefs.

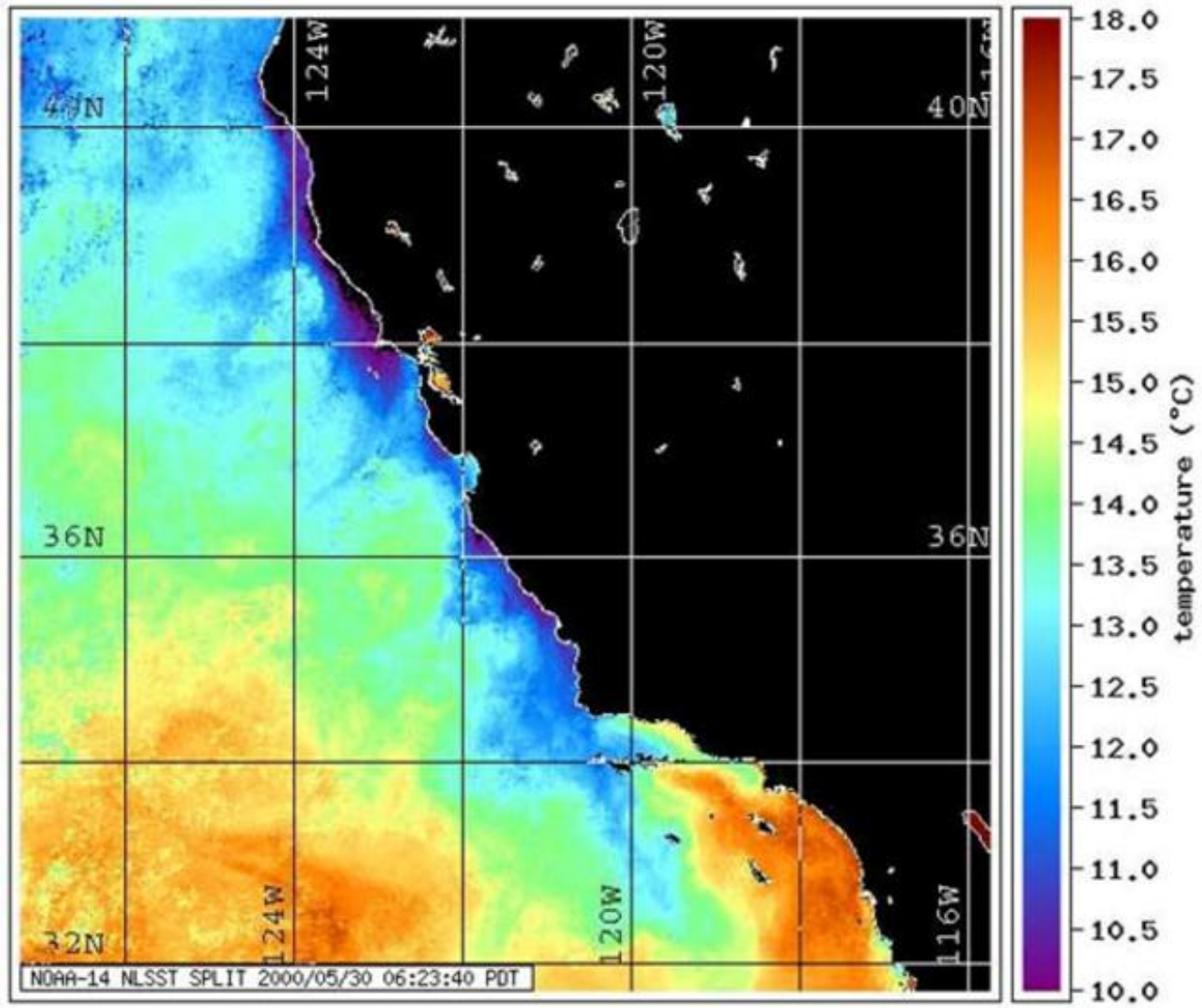
The oceanography of the California coastline is dominated by the influence of the California Current System. On the continental shelf and slope this system consists of two primary currents - the California Current, which flows toward the equator, and the California Undercurrent, which flows toward the North Pole (Hickey, 1979; 1998). When present, the undercurrent occurs beneath the southward flowing California Current. North of Pt. Conception, the undercurrent may reach the surface as a nearshore, poleward flowing current that is best developed in fall and winter (Collins et al., 2000; Pierce et al., 2000). These currents vary in intensity and location, both seasonally and from year to year.

Organisms will also be affected by the circulation induced by tidal currents. For those living in shallow water habitats very close to shore, inshore of the surf zone, the dominant influence on transport of planktonic eggs and larvae will be the circulation generated by breaking waves.

As can be seen in a satellite image of ocean temperature along the California coastline (Figure 4), the circulation and physical characteristics of the California Current System are exceedingly complex and variable. This is not the image one would expect if ocean currents were analogous to northward or southward flowing rivers in the sea. Rather, ocean flows are greatly modified by variation in the strength and direction of winds, ocean temperatures and salinity, tides, the topography of the coastline, and the shape of the ocean bottom, among several other factors. The end result is a constantly changing sea of conditions.

The patterns are not completely random, however. Many aspects of ocean climates vary somewhat predictably in space, especially ones that are tied to key features of the coastline – points and headlands, river mouths, etc. Locations that share similar ocean climates are typically more similar in the types of species they harbor. Therefore, defining habitats for the MLPA and MPA networks must include habitats defined by coastal oceanography as well as the composition of the seafloor.

Figure 4. An example of sea surface temperature in the California coastal waters, May 30, 2000.



Although a wide range of oceanographic habitats could be defined for the California coastline, the science team suggests that three prominent habitats stand out because of their demonstrated importance to different suites of coastal species:

- Upwelling centers
- Freshwater plumes
- Retention areas

Upwelling Centers

Upwelling is one of the most biologically important circulation features in the ocean. Upwelling occurs when deep water is brought to the surface. On average deep water is colder and more

nutrient rich than surface waters. When upwelling delivers nutrients to the sunlit waters near the surface, it provides the fuel for rapid growth of marine plants, both plankton and seaweeds. Ultimately the added nutrients can energize the productivity of entire marine food webs. Upwelling regions are the most productive ocean ecosystems. The west coast of North America is one of the few major coastal upwelling regions on the entire planet (Chavez and Collins, 2000; Hickey, 1998). The major driver of upwelling along the California coastline is wind. Winds that blow from the north and northwest parallel to California's generally north-south coastline drive currents at the surface. Because of the complicated effects of friction and the rotation of the earth, surface water is pushed to the right of the direction of the wind (the Coriolis Effect). With winds blowing from the north and northwest, this effect pushes surface waters away from shore. As water is pushed offshore, it is replaced by water that is upwelled from below.

The rate of upwelling depends on many features that vary spatially along the coastline – the strength and direction of the wind, the topography of the shoreline, and the shape of the continental shelf are three of the most important. Capes and headlands play a key feature in all of these drivers of upwelling. They accelerate alongshore winds, and they channel coastal currents in such a way that upwelling intensity can increase dramatically in their vicinity. As a result, major headlands and capes from Pt. Conception north are commonly centers of upwelling associated with strong rates of offshore transport of surface waters, greatly elevated nutrient concentrations, and enhanced productivity offshore (Pickett and Paduan, 2003). Since major capes and headlands tend to be fairly regularly spaced along the California coastline, with an average spacing between 150 and 200 km (93 and 124 m or 81 and 108 nm), these upwelling centers drive cells of ocean circulation with relatively predictable patterns of flow. Enhanced offshore flow and upwelling emanates from headlands, versus eddies and locations of more frequent alongshore flow in the regions between headlands. These filaments of upwelled water are readily identified emanating from key headlands in most satellite images of ocean temperature or biomass of phytoplankton. Because the upwelling centers are locations of more frequent and intense offshore flow near the surface, which moves larvae and other plankton away from shore, and elevated nutrients, which fuels much more rapid algal productivity, these locations represent a distinct oceanographically driven coastal habitat with substantially different species composition and dynamics compared to other coastal locations.

Freshwater Plumes

A second coastal habitat driven by features of the water column is generated by the influence of rivers. Freshwater emerging from watersheds alters the physical characteristics of coastal seawater (especially salinity), changes the pattern of circulation (by altering seawater density), and delivers a variety of particles and dissolved elements, such as sediments, nutrients, and microbes. These effects all arise from the land and can have a profound influence on the success of different marine species. The mouths of watersheds set the locations of low salinity plumes, and the size and shape of the plume vary over time as functions of the volume of flow from the watershed, the concentration of particles, and the nature of coastal circulation into which the water is released. The location of California's freshwater plume habitats can be defined by both satellite and ocean-based measurements.

Larval Retention Areas

Since connectivity and movement of larvae, plankton, and nutrients play such an important role in the impact of MPAs on different species, changes in the speed and direction of coastal currents can create very different ecological settings. A number of circulation features can greatly limit the coastal particles. In particular, features characterized by rotational flows, such as eddies, can greatly enhance the length of time that a particle or larval fish stays in a general region of the coastline. Such retentive features have been shown to significantly affect the species composition of coastal ecosystems (Largier, 2004). Since many retention areas are tied to fixed features of coastal topography (e.g., eddies in the lee of coastal headlands or driven by bottom topography), they define unique regions of coastal habitat that can be predictably defined.

Experience in California and elsewhere demonstrates that individual MPAs generally include several types of habitat in different depth zones, so that the overall number of MPAs required to cover the various habitat types can be smaller than the number of total habitats. The Master Plan Team convened in 2000 also called for considering adjacent lands and habitat types, including seabird and pinniped rookeries. Since marine birds and mammals are protected by federal regulations, they are not a primary focus of the MLPA. Nonetheless, these species can play important ecological roles and their success may be impacted by changes in other components of California's coastal ecosystems that are a primary focus of MLPA. Therefore, MPA planning needs to coordinate with other efforts focused on marine birds and mammals.

As noted regarding the design of MPAs, this guidance should be the starting point for regional discussions regarding representative habitats in a region. Although this guidance is not prescriptive, any significant deviation from it should be explained.

Species Likely to Benefit from MPAs

Recommending the extent of habitat that should be included in an MPA network will require careful analysis and consideration of alternatives. These recommendations may vary with habitat and region, but should be based on the best readily available science. One aspect of determining appropriate levels of habitat coverage is the habitat requirements of species likely to benefit from MPAs in a region. At Fish and Game Code subsection 2856(a)(2)(B), the MLPA requires that the master plan 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."

The Department prepared a master list of such species, which appears in Appendix G. This list may serve as a useful starting point for identifying such species in each region during the development of alternative MPA proposals. With the assistance of the science team, the Department should develop a list of species specific to each study region of the state, as they are determined, for use by the appropriate regional stakeholder group. The list will indicate which species are of critical concern and why. This regional list then can assist in evaluating desirable levels of habitat coverage in alternative MPA proposals. Although the statewide list

will be all inclusive, it is not likely that all species on the list will benefit from the establishment of new, or the expansion of existing, MPAs. For example, a species may be in naturally low abundance within this portion of its geographical range.

The Department, with the assistance of the science team, will develop scientifically based expectations of increases in abundance of focal species for each MPA. These expectations, while not hard targets or performance goals, will help managers determine the efficacy of MPAs. If expected increases are not realized, the process of adaptive management will allow for changes in the MPA design.

Biogeographical Regions

In calling for a statewide network of MPAs, to the extent possible, the MLPA recognizes that the state spans several biogeographical regions, and identified these, initially, as follows [FGC subsection 2852(b)]:

- The area extending south from Point Conception,
- The area between Point Conception and Point Arena, and
- The area extending north from Point Arena.

In the same provision, the MLPA provides authority for the master plan team required by FGC subsection 2855(b)(1) to establish an alternate set of boundaries. The Master Plan Team convened by the Department in 2000 determined that the three regions identified in the MLPA were not zoogeographic regions; scientists recognize only two zoogeographic regions between Baja California and British Columbia with a boundary at Pt. Conception. Instead of the term "biogeographical region," the team adopted the term "*marine region*" and identified four *marine regions*:

- North marine region: California-Oregon border to Point Arena (about 210 linear miles or 183 linear nautical miles of coastline);
- North-central marine region: Point Arena to Point Año Nuevo (about 180 linear miles or 156 linear nautical miles of coastline);
- South-central marine region: Point Año Nuevo to Point Conception (about 233 linear miles or 203 linear nautical miles of coastline); and
- South marine region: Point Conception to the California-Mexico border, including the islands of the southern California Bight (about 280 linear miles or 243 linear nautical miles of coastline).

Three of the above four regions (those north of Pt. Conception) fall within the larger zoogeographic region accepted by scientists. These sub-regions were used more or less as subdivisions of the greater zoogeographic region by the former Master Plan Team. Technically, the requirement of replicate state marine reserves encompassing a representative variety of habitat types and depths would only apply to the two recognized zoogeographic regions within the state. However, based on the concept of a network of MPAs, in whatever way it is defined, and the fact that it would likely require unusually and unacceptably large state marine reserves to incorporate a wide variety of habitat types if only two (the minimum

definition of “replicate”) state marine reserves were established in each zoogeographic region, it is likely that a statewide network will contain more than two state marine reserves in each biogeographical region.

MPAs in different biogeographical regions will affect different suites of species. Thus replication and network design may be considered separately for relatively distinct stretches of coastline. Biogeographical regions can be distinguished based upon data of two types: 1) the location of species’ borders along the coastline; and 2) surveys of species’ distribution and abundance. Historically, the locations of species’ borders, i.e., places where multiple species terminate their ranges, have been used to define biogeographical regions or provinces. However, regional boundaries typically are set by only small subset of the species distributed up and down coast from these “breakpoints”.

The abundances and diversity of species at locations along the coast are much more reflective of differences in biological communities and provide the best evidence of biologically distinct regions from both structural and functional standpoints. Historically, such data on abundance and biological diversity have not been available at enough locations along most coastlines for broad scale, geographic analyses. As a result, definitions of biogeographical regions have been forced to rely on a less meaningful measure of biological differences – the location of species’ borders.

Biogeographers have divided all major oceans into large *biogeographic provinces*. California’s coastline spans two of these large-scale provinces – the Oregonian and the Californian Provinces – with a boundary in the vicinity of Point Conception. This prominent biogeographical boundary has been recognized for more than half a century. More detailed analyses of species’ borders also have led to the identification of regional scale boundaries between biogeographical sub-provinces.

Biogeographers commonly have used distributional data for subgroups of taxonomically related species (e.g., snails, seaweeds, or fish) to set biogeographical boundaries; interestingly, the boundaries for sub-provinces often differ among taxonomic groups because different types of species respond to different physical and biological characteristics in different ways (Airamé et al. 2003). Two locations, however, emerge as prominent boundaries for key coastal species. Seaweeds, intertidal invertebrates, and nearshore fishes have comparable numbers of species’ borders in the vicinity of Monterey Bay as they do at Point Conception. In addition, coastal fishes have an important sub-province boundary at Cape Mendocino.

Scientific data do not support a significant biological break between biogeographical regions at Point Arena, as identified in earlier MLPA documents. Therefore, on the basis of the distribution of species’ borders for key coastal species groups, there are three biogeographical regional boundaries and four regions along the California coast:

1. The Mexican border to Pt. Conception,
2. Point Conception to Monterey Bay,
3. Monterey Bay to Cape Mendocino, and
4. Cape Mendocino to the Oregon border.

In the past decade, detailed data have become available on species abundances and diversity from a large number of locations along California's coast. This wealth of information on actual species assemblages now provides the opportunity to define biogeographical regions on the basis of actual ecosystem compositions, rather than the presumed composition of ecosystems inferred from species' borders. These ecosystem-based data are a better scientific fit with the goals of the MLPA. Summaries of species abundance and diversity data, especially for shallow water species (<30 m depth), suggest that there are four points of transition along the California coastline that demarcate distinct marine assemblages: Point Conception, Monterey Bay, San Francisco Bay, and Cape Mendocino.

Three of these locations are identical to those defined above solely on the basis of species' borders for prominent groups. The new boundary that emerges from abundance and biodiversity data is San Francisco Bay. The region between Monterey Bay and Cape Mendocino has two distinct biological assemblages on coastal reefs even though this is not a region characterized by large numbers of species' borders. The difference in assemblages on either side of San Francisco Bay appears to be caused by changes in the types of rock that form nearshore reefs. Since the type of rock is used to defined bottom habitats for MPA designation, this transition in species composition could be addressed in MPA designs using habitat considerations or, alternatively by designating the Monterey Bay to San Francisco Bay segment as a distinct biogeographical region.

Based on this review, there are four possible definitions of the biogeographical regions that will serve as the basic structure of the statewide network of MPAs. These options are as follows:

1) The three biogeographical regions defined in the MLPA;
2) The two *biogeographic provinces* recognized by many scientists with a boundary at Point Conception;
3) The four *marine regions* identified by the former Master Plan Team, with boundaries at Pt. Conception, Pt. Año Nuevo, and Pt. Arena; and
4) The biogeographical regions recognized by scientists who have identified borders based on species distributional patterns or on abundance and diversity data with boundaries at Pt. Conception, Monterey Bay and/or San Francisco Bay, and Cape Mendocino.

Accepting the strong scientific consensus of a major biogeographical break at Point Conception, the MLPA Blue Ribbon Task Force recommends that the Commission adopt the two biogeographic provinces as the biogeographical regions for purposes of implementation of the Marine Life Protection Act. The Task Force recommends that the more refined information on other breaks be used in designating study regions and in designing networks of MPAs.

Types of MPAs

The MLPA recognizes the role of different types of MPAs in achieving the objectives of the Marine Life Protection Program [FGC subsection 2853(c)]. While the MLPA does not define the different types, the Marine Managed Areas Improvement Act (MMAIA) does define state marine reserve, state marine park, and state marine conservation area. (See Appendix B for the text of the MMAIA as amended.)

Besides somewhat different purposes, which are described below, each type of MPA represents a different level of restriction on activities within MPA boundaries. These restrictions and purposes suggest how each designation can be used effectively in a network of MPAs.

State Marine Reserve

As defined in the MMAIA, a state marine reserve prohibits injuring, damaging, taking or possessing any living, geological, or cultural resources and must maintain the area "to the extent practicable in an undisturbed and unpolluted state" while allowing "managed enjoyment and study" by the public [PRC subsection 36710(a)]. The responsible agency may permit research, restoration, or monitoring. Such activities as boating, diving, research, and education may be allowed, to the extent feasible, so long as the area is maintained "to the extent practicable in an undisturbed and unpolluted state." Such activities may be restricted to protect marine resources. It specifically allows the agency to permit scientific activities. The definition of "marine life reserve" in the MLPA is consistent with this definition.

The MLPA and MMAIA thus require striking a balance between protection and access in marine reserves. The form that this balance takes in an individual marine reserve will depend upon the goals and objectives of that reserve. While the MLPA specifically precludes commercial and recreational fishing from marine reserves, it also authorizes restrictions on other activities, including non-extractive activities (e.g., diving, kayaking, snorkeling, etc.). Any such restrictions, however, must be based on specific objectives for an individual site and the best readily available science. It is important to note that this statement does not imply that navigation will necessarily be restricted though MPAs or that other non-extractive activities will be regulated, although in some instances the latter may be necessary. For example, it may be necessary to protect populations of sensitive marine birds or mammals in their nesting or breeding areas by prohibiting access to some areas.

The MLPA sets other requirements for the use of marine reserves. At FGC subsection 2857(c)(3), the MLPA requires "[s]imilar types of marine habitats and communities shall be replicated, to the extent possible, in more than one marine life reserve in each biogeographical region." Consistent with this approach, this Master Plan Framework foresees that in each biogeographical region described above, representative habitat across a range of depths should be represented in at least two marine reserves in order to assure the replication of habitats required by the MLPA. It should be noted that several of habitat types occur in only one depth zone, while others may occur in three or four depth zones. Experience demonstrates that individual MPAs generally include several types of habitat in different depth zones, so the overall number of marine reserves required to replicate the various habitat types may be less than the total combination of depth zones and habitats replicated across each region.

State Marine Park

As defined in the MMAIA, a state marine park prohibits injuring, damaging, taking or possessing for commercial use any living or nonliving marine resources. Other uses that would

compromise the protection of living resources, habitat, geological, cultural, or recreational features may be restricted. All other uses are allowed, consistent with protecting resources.

State marine parks, hereafter called “marine parks”, differ from marine reserves to different degrees in their purposes as well as the type of restrictions. Unlike marine reserves, marine parks allow some or all types of recreational fishing. The types of restrictions on fishing may vary with the focal species, habitats, and goals and objectives of an individual marine park within a region. Where the primary goal is biodiversity conservation, restrictions on fishing may be different from those in a marine park where the primary goal is enhancing recreational opportunities.

State Marine Conservation Area

In a state marine conservation area, activities that would compromise the protection of species of interest, the natural community[5], habitat, or geological features may be restricted. Research, education, and recreational activities, as well as commercial and recreational fishing may be permitted.

State marine conservation areas, hereafter called “marine conservation areas”, also differ from marine reserves in their purpose as well as the type of restrictions. This type of MPA allows some level of recreational and/or commercial fishing. The restrictions on fishing may vary with the focal species, habitats, and goals and objectives of an individual MPA within a region, and may, for instance, be in the form of restrictions on the catch of particular species or on the use of certain types of fishing gear. Marine conservation areas may be useful in protecting more sedentary, benthic species, while allowing the harvest of migratory or pelagic species. Another use of a marine conservation area would be to allow the continued use of traps (which typically have relatively low bycatch rates and are more efficient for harvesting invertebrates) while prohibiting the harvest of finfish species of concern by hook-and-line or by trawls (which typically have relatively high bycatch rates). At present the large fishery closures known as the Cowcod Conservation Areas and the Rockfish Conservation Area may function as *de facto* marine conservation areas in that bottom fishing for finfishes is prohibited but other types of fishing are allowed, though the specific regulations in these areas are subject to change dependent on stock assessments.

Combined use of marine reserves, marine parks and marine conservation areas

The combination of the use of marine reserves, marine parks and marine conservation areas has an especially valuable role to play in designing a network that accommodates a spectrum of uses (NRC 2001; Salm et al. 2000). In the design of MPAs, plans that use all three types of MPAs may allow separation of incompatible uses (NRC 2001). For instance, a marine reserve could be buffered with a marine park in which some types of recreational fishing are regulated but allowed or with a marine conservation area where limited recreation and commercial fishing are allowed. The buffer zone may allow the full benefit of spillover to be realized in the limited-take area.

[4] Natural community is defined in Fish and Game Code section 2702(d) as a distinct, identifiable, and recurring association of plants and animals that are ecologically interrelated.

This approach may, however, prove to be problematic relative to the enforcement and public understanding of different regulations within contiguous areas. Confusing differences in regulations in a small spatial area can lead to unintentional infractions and a degradation of the function of the MPA. Care must be taken to ensure that regulations are understandable and observed by the public and enforced as necessary.

Setting Goals and Objectives for MPAs

Whether MPAs within a region are reserves, parks, or conservation areas, or some combination of the above, the MLPA specifies that all MPAs have certain features. First, the MLPA requires that the Program and each MPA in the preferred alternative have specific identified objectives [FGC subsections 2853(c)(2) and 2857(c)(1)]. FGC subsection 2857(c)(1) states: "[I]ndividual MPAs may serve varied primary purposes while collectively achieving the overall goals and guidelines of this chapter." The MLPA provides some options for what these objectives are. At FGC subsection 2857(b), the MLPA states that the preferred alternative may include MPAs that will achieve either or both of the following objectives:

(1) Protection of habitat by prohibiting potentially damaging fishing practices or other activities that upset the natural ecological functions of the area.
(2) Enhancement of a particular species or group of species, by prohibiting or restricting fishing for that species or group within the MPA boundary.

It is important to note that it is potentially damaging fishing practices, not fishing per se, that is addressed in the first objective, and that both the first and second objectives may be achieved outside of the MPLA itself, as a result of other regulatory processes. The California Ocean Protection Act provides a framework for identifying opportunities to meet the objectives of the MLPA through the actions of other state agencies.

Setting goals and objectives for a region and for individual MPAs within a region will be a critical step in developing meaningful alternatives for a statewide MPA network and assembling a recommended network of MPAs, and in the design of monitoring and evaluation. Assembling and evaluating available information on the biological, oceanographic, socioeconomic and governance features of a region, including existing MPAs, and other closures implemented through fishery management regulations, and also including non-fishing impacts, should precede setting regional goals and objectives. Similarly, setting regional goals and objectives should precede setting goals and objectives for individual MPAs as well as designing boundaries and management measures for individual MPAs. Importantly, the process of establishing regional goals and objectives must include stakeholder involvement in the analysis and decision-making process.

Once set, goals and objectives will influence crucial design decisions regarding size, location, and boundaries. For instance, a marine reserve whose primary goal is protection of biological diversity may well have a different configuration than a marine reserve whose goal is enhancement of depleted fisheries (Nowlis and Friedlander 2004).

There are a variety of techniques for setting goals and objectives. No one technique is likely to suit the diverse situations in all regions. Deciding upon a process for setting goals and objectives should be an early focus for regional discussions. In fashioning goals, the following characteristics should be kept in mind (Pomeroy et al. 2004).

A goal is a broad statement of intent that is:

- Brief and clearly defines the desired long-term vision and/or condition that will result from effective management of the MPA;
- Typically phrased as a broad mission statement; and
- Simple to understand and communicate.

An objective is a more specific measurable statement of what must be accomplished to attain a goal. Usually, attaining a goal requires accomplishing two or more objectives. Useful objectives have the following features:

- Specific and easily understood;
- Written in terms of what will be accomplished, not how to go about it;
- Realistically achievable;
- Defined within a limited time period; and
- Can be measured and validated.

In developing regional goals and objectives, attention should be paid to other complementary programs. For instance, like the MLPA, the Marine Life Management Act (MLMA) takes an ecosystem-based approach to management. The Nearshore Fishery Management Plan (NFMP) required by the MLMA identified MPAs as an important tool in achieving its goals and objectives. Similarly, the Abalone Recovery and Management Plan (ARMP) recommends the use of MPAs as additional protection to assist with the recovery of abalone populations and help support populations in fished areas. While the NFMP and ARMP defer to the MLPA process in designing and establishing networks of MPAs, the plans also identify key features of MPA networks that would contribute to the goals and objectives of the NFMP, MLMA, and ARMP. Other fishery management plans should be reviewed for similar linkages. The features that MPAs should include in order to fulfill the goals of the NFMP are (from NFMP, Section 1, and Chapter 3):

- Restrict take in any MPA [intended to meet the NFMP goals] so that the directed fishing or significant bycatch of the 19 NFMP species is prohibited
- Include some areas that have been productive fishing grounds for the 19 NFMP species in the past but are no longer heavily used by the fishery
- Include some areas known to enhance distribution or retain larvae of NFMP species
- Consist of an area large enough to address biological characteristics such as movement patterns and home range. There is an expectation that some portion of NFMP stocks will spend the majority of their life cycle within the boundaries of the MPA
- Consist of areas that replicate various habitat types within each region including areas that exhibit representative productivity

The features that MPAs should include in order to fulfill the goals of the ARMP include the following (from ARMP, Section 7.1.1.3). The ARMP recommends that at least four of the following criteria should be met:

- Suitable rocky habitat containing abundant kelp and/or foliose algae
- Presence of sufficient populations to facilitate reproduction. The reproductive biology of abalone suggests that fertilization success is reliant on close proximity, thus high densities of breeding animals could promote reproduction.
- Suitable nursery areas. Nursery grounds have been identified for juvenile abalone: crustose coralline rock habitats in shallow waters which include microhabitats of moveable rock, rock crevices, urchin spine canopy, and kelp holdfasts. Protection of areas with this cryptic habitat may promote juvenile growth and survival until emergence at 50-100 mm in shell diameter. Areas where invasive surveys find high densities of small abalone (less than 50 mm) can be classified as potential nursery areas.
- Oceanographic regimes. The protected lee of major headlands may act as collection points for water and larvae. These areas (for example, the northwest portion of Drakes Bay) may promote the settlement of planktonic larvae, and act as natural nurseries (Ebert *et. al.* 1988).
- Size. Existing MPAs do not provide enough area for large numbers of abalone, nor are they ideal for research regarding population dynamics.
- Accessibility. MPAs need to be accessible to researchers, enforcement personnel, and others with a legitimate interest in resource protection.

Once developed, regional goals and objectives can be matched with the goals of the different types of MPAs, as defined by the Marine Managed Areas Improvement Act (MMAIA) at PRC Section 36700 and in the MLPA. The MMAIA defines the goals for the three types of MPAs as shown in Table 2.

Table 2: Comparison of Marine Protected Area Goals

Purpose	State Marine Reserve	State Marine Park	State Marine Conservation Area
Protect or restore rare, threatened, or endangered native plants, animals, or habitats in marine areas.	X		X
Protect or restore outstanding, representative, or imperiled marine species, communities, habitats, and ecosystems.	X	X	X
Protect or restore diverse marine gene pools.	X		X
Contribute to the understanding and management of marine resources and ecosystems by providing the opportunity for scientific research in outstanding, representative, or imperiled marine habitats or ecosystems.	X	X	X
Provide opportunities for spiritual, scientific, educational, and recreational opportunities		X	
Preserve cultural objects of historical, archaeological, and scientific interest in marine areas.		X	
Preserve outstanding or unique geological features.		X	X
Provide for sustainable living marine resource harvest.			X

Although the MLPA does not identify specific goals and objectives for marine parks and marine conservation areas, it does identify possible functions, which may be considered as goals, for marine reserves. At FGC subsection 2851(f), the MLPA says that marine reserves:

- protect habitat and ecosystems,
- conserve biological diversity,
- provide a sanctuary for fish and other sea life,
- enhance recreational and educational opportunities,
- provide a reference point against which scientists can measure changes elsewhere in the marine environment, and
- may help rebuild depleted fisheries.

Some or all of these functions may apply to any particular marine park or marine conservation area. For example, a conservation area which allows fishing for salmon and pelagic species could address bullets 1-3 and 5-6 by protecting all benthic species. A marine park could address bullet 4 as well as bullet 5.

As mentioned above, the MLPA recognizes that individual MPAs may have several goals and objectives, such as protection of biological diversity and enhancement of recreational opportunities. In these instances, special care should be taken in designing management measures, such as restrictions as well as data collection and monitoring, which will maximize the different objectives and quantify whether different objectives are being met.

Enforcement and Public Awareness Considerations in Setting Boundaries

Regardless of the amount of enforcement funding, personnel, or equipment available, the enforceability and public acceptance and understanding of marine protected areas will be enhanced if a number of criteria are considered during design and siting. While the complexities of the California coastline and locations and distributions of protected habitats and resources make using the same criteria at each location difficult, an effort should be made to include as many of these considerations as possible.

Marine protected area boundaries should be clear, well-marked where possible, recognizable, measurable, and enforceable. Selecting known, easily recognizable landmarks or shoreline features, where possible, as starting points for marine protected area boundaries will provide a common, easily referenced understanding of those boundaries. In general, marine protected area boundaries should be straight lines that follow whole number North-South longitude and East-West latitude coordinates wherever possible. Likewise, any offshore corners or boundary lines should be located at easily determined coordinates. This is especially true if installation and maintenance of boundary marker buoys is not cost effective or feasible. Using depth contours or distances from shore as boundary designations should be avoided, if possible, due to ambiguities in determining exact depths and distances. However, in some cases, depth boundaries may be not only unavoidable but desirable. Many of California's existing MPAs in ocean waters use depth as the offshore boundary. This is a practical concession based on the use by divers who possess depth gauges but no other navigational aids. In the case of a

proposed intertidal MPA, for example, depth would be the only practical alternative for an offshore boundary.

There are benefits and disadvantages to siting marine protected areas in locations that are accessible and/or observable, either from the shore or the water. On one hand they can increase the likelihood that potential illegal activities will be observed and reported, thereby discouraging such activities because they might be observed and increase public awareness of the MPA.

Conversely, MPAs sited in areas that are very easily accessed will naturally have higher potential for illegal activities to occur. Additionally, these areas will have the highest level of conflict with existing uses. Siting MPAs in areas close to harbors may raise issues of safety and convenience by requiring extractive users to travel farther to areas open to fishing could be problematic. Siting must be balanced between the ease of enforcement and monitoring and the potential for infractions to occur. If enforceable alternative areas are available farther from easy access points, they should be considered.

Siting marine protected areas within, or near, locations under special management (national marine sanctuaries and parks, state and local parks and beaches, research facilities, museums and aquaria, etc) may provide an added layer of enforcement, observation and public awareness. This is especially true if there are shore-side facilities and personnel based at the site.

Information Supporting the Design of MPAs

Throughout the development of alternative proposals for MPAs, an emphasis must be placed upon using the best readily available science, as required at FGC subsection 2855(a). The MLPA does not require complete or comprehensive science, but rather the level of science that is practicable.

Baseline data needs for MPAs should be drafted for inclusion in the regional profile and MPA management plan described elsewhere in this document. Examples of such needs are:

- Status of recreational, commercial, and other marine resources in the region;
- Status of species in need of restoration;
- Analysis of consumptive and non-consumptive activities affecting living marine resources in the region, including commercial and recreational fishing, diving, point and non-point discharges, among others;
- Analysis of existing management and regulations;
- Geographical patterns of extractive and non-extractive uses;
- Economic contribution of ocean-dependent activities to local and regional economies.

This process should also draw upon the knowledge, values, and expertise of local communities and other interested parties. At FGC subsection 2855(c)(1)-(2), the MLPA specifically requires that local communities and interested parties be consulted regarding:

(1) Practical information on the marine environment and the relevant history of fishing and other resources use, areas where fishing is currently prohibited, and water pollution in the state's coastal waters.
(2) Socioeconomic and environmental impacts of various alternatives.

Understanding the distribution, magnitude, and spatial extent of economic activities and values is important in the design of marine protected areas. Marine protection can both positively and negatively impact the level and sustainability of economic values, taxes and employment. Within each region a varying level of data exist for determining these values. Additionally, stakeholder groups in each region will help provide informal data on the value of resources in their area. More information on social science tools and methods can be found in Appendix E. The regional MPA process should make every effort to assemble socioeconomic information early and to apply it in the design and evaluation of MPAs.

Other Programs and Activities Other Than Fishing

Regional profiles and profiles of potential MPAs should describe current and anticipated human activities that may affect representative habitats and focal species. Water quality and marine habitats, especially in estuarine areas, may be degraded by any of a wide range of activities (Sheehan and Tasto 2001). For instance, water quality may be undermined by point source discharges from pulp mills, sewage treatment plants, manufacturing facilities, as well as by nonpoint source discharges from agriculture, urban areas, forestry, marinas and boating, mine drainage, on-site sewage systems, and by modification of river flows. Water quality and habitats may be directly affected by dredging and the disposal of dredge spoil, and by catastrophic spills of oil or other substances.

A profile should discuss whether any such non-fishing activities are significantly affecting wildlife or habitats of concern in a potential MPA site. Where the effects of any such activities present a clear threat to resources of concern, a profile should identify current efforts to mitigate those threats. Federal, state, county, and local government agencies carry out a diverse array of programs to manage such activities (Sheehan and Tasto 2001). The Governor’s ocean action plan includes a useful survey of such programs (CRA and CEPA 2004). If warranted, a proposal for an MPA may include recommendations to appropriate agencies for reducing impacts of activities that are likely to prevent an MPA from achieving its goals and objectives. Generally, such recommendations should also be referred to California Ocean Protection Council since the California Ocean Protection Act of 2004 created that body to promote coordination of ocean protection efforts across agencies. The council is ideally positioned to insure that MPAs established under the MLPA benefit from the programs and capabilities of agencies with responsibilities beyond those of the Department.

One significant aspect of the MLPA is its intent to comprehensively identify:

- areas in the ocean uniquely worthy of being reserved for their specific or intrinsic value,
- areas that need the additional protections and attention that may come with being designated as an MPA,
- habitats and species that should be protected within MPAs in each region of the state, and

- areas of the ocean that should be reserved for specific uses.

The MLPA depicts the legislature's intent to make California's existing array of MPAs function as a network. It focuses on sustaining healthy marine ecosystems for their long-term values.

One purpose of the council established by the California Ocean Protection Act of 2004 (COPA) is to coordinate the activities of state agencies related to the protection and conservation of the coastal waters and ocean ecosystems to improve effectiveness of all these efforts within limited resources. COPA and the Council may serve as the vehicle for addressing non-fishing impacts that are not under the regulatory authority of the Commission.

Efforts are being undertaken by many state and federal agencies that contribute to and support the overall goals of the MLPA. These efforts include the following:

- the Department's work to implement the Marine Life Management Act with its broader ecosystem considerations in fishery management;
- the State Water Resources Control Board recent updates to its California Ocean Plan to ensure that it establishes appropriate water quality standards and lays out a workable implementation plan;
- the work of the California Coastal Commission in monitoring local coastal programs, establishing a Critical Coastal Areas Program, permitting coastal development, and ensuring coastal zone access;
- the Resource Agency and California Environmental Protection Agency in their agreement to strengthen an MOU regarding watershed planning to give renewed support to collaborative efforts to ensure land-based activities avoid harming the marine environment in general, and bays and estuaries in particular;
- the National Marine Sanctuary Program's sponsorship of research and community discussions regarding special marine protected areas in the Monterey Bay National Marine Sanctuary.

Likewise, there are numerous similar efforts being undertaken by federal agencies including the Water Quality Protection Program of the Monterey Bay National Marine Sanctuary; the Army Corps of Engineers' Coastal Sediment Management Master Plan; and the continuing efforts of NOAA Fisheries to confront ocean impacts derived from upstream pollution, sand and gravel mining, over-drafting water rights, and invasive species.

While not all of these programs will have a significant effect on regional implementation of the MLPA and the designation of MPAs, coordination of the regional planning efforts will help identify ways that various efforts can be integrated and made supplementary to each other to avoid overlap and conflict. Identifying goals for individual MPAs and a network of MPAs in the context of the goals and objectives of these other agencies and programs will help ensure consistency. Management, research, and monitoring plans for MPAs should also be coordinated with these other agencies and programs to increase the likelihood that MPAs will successfully meet the MLPA goals with the least cost and disruption to the public benefits derived from the ocean.

Section 4. Management

Without effective management, MPAs and MPA networks become “paper parks,” and their goals, objectives, and benefits are not achieved (Kelleher et al. 1995). As a result, the array of MPAs creates the illusion of protection while falling far short of its potential to protect and conserve living marine life and habitat “[FGC Section 2851(a)]. In several passages, the MLPA requires that California's MPAs have effective management measures [FGC subsection 2853(b)(5); 2853(c)(2); 2856(a)(2)(H) and (K)].

The initial focus for meeting the management requirements of the MLPA should be the preparation of a management plan for MPAs in each region. An outline that may serve as the basis for a regional MPA management plan may be found in Appendix K. Besides generally guiding day-to-day management, research, education, enforcement, monitoring, and budgeting, a management plan also distills the reasoning for key elements of the network that should be monitored, evaluated, and revised in response to new information and experience. Much of the material required to complete a management plan will be developed in the course of designing, evaluating, and establishing a regional proposal. Some elements of management, such as monitoring and evaluation, enforcement, and financing, are described in more detail in other areas of this document.

Management plans should not dwell upon detail, but should provide a foundation for developing more specific action plans, as necessary, and for adapting management measures to new information. Management plans should include a schedule for review and possible revision at least every five years, and a mechanism for revisions in the interim in response to significant events, such as unexpected monitoring results, budget shifts, or changes in the status of the populations of focal species or of habitats or in the character or effectiveness of management outside individual MPAs.

A management plan should describe the allocation of responsibility to various government agencies and non-government organizations and industry groups for carrying out specific management activities including those partnerships that could result in more effective and economical management of the MPA. While the Department, and in some circumstances the California Department of Parks and Recreation, exercise primary authority for the management of California’s MPAs, these agencies can draw upon the capacity of other agencies and organizations in carrying out critical management activities. MPAs located adjacent to facilities such as marine labs, onshore protected areas, or similar such institutions may be effectively co-managed by those entities.

In meeting needs for research, monitoring, enforcement, and public education activities, MPA proposals should look to collaboration with other agencies and non-governmental groups. An example is the Department’s collaboration with the Channel Island’s National Marine Sanctuary and the National Park Service at the MPAs established in 2003 around the Channel Islands. In some cases, such collaboration will benefit from a formal memorandum of understanding, while in other cases collaboration can be most effectively pursued at more informal levels.

Another example of government partnerships is the California Coastal Commission's and State Water Resources Control Board's critical coastal areas partnership (for more information, see http://www.coastal.ca.gov/nps/cca-nps.html). California's Critical Coastal Areas (CCA) Program is an innovative program to foster collaboration among local stakeholders and government agencies, to better coordinate resources and focus efforts on coastal-zone watershed areas in critical need of protection from polluted runoff. A CCA Committee is focusing its efforts on preventing runoff into sensitive and important marine habitats, in particular areas of special biological significance. This program is a good example of a coordinated effort to link land and sea.

In addition, collaboration with non-governmental organizations, including non-profit conservation and education organizations, yacht clubs, and fishermen's or recreational divers' groups, can enhance implementation of important management activities, such as education, research, and monitoring. At the Monterey Bay National Marine Sanctuary, for instance, the Citizen Watershed Monitoring Network, a volunteer-based group, conducts monitoring according to U.S. Environmental Protection Agency standards. While this data is voluntarily collected and therefore may not be used for enforcement purposes, it does provide several benefits to the sanctuary, which would otherwise not have the staff or funding to support such data collection.

Stakeholder advisory committees should continue to play a role in the management of MPAs in a region after completion of the design process, although other methods for engaging the public may be used. The management plan for a regional MPA proposal should provide for continuing engagement of stakeholders through a regional advisory committee or other means (Salm et al. 2000). Some form of state-wide MPA advisory committee may also serve a valuable function to help ensure a continuing linkage between public and governmental participants as the MLPA is implemented throughout the state. Such committees can fulfill a number of important roles, such as those stated in the recent National Report of the National Marine Sanctuary Program's Advisory Councils (NMSP 2004):

- Serve as a link between an MPA and its community, disseminating information about the MPA to the various constituencies of members and bringing the concerns of constituents and the public to sanctuary staff;
- Assist in creating a dialogue to examine various sides of an issue and a place for mediation;
- Identify potential partners and constituent groups with which the MPA should be working and forge relationships;
- Review and provide input on plans, proposals, and products, including prioritizing issues;
- Provide technical and background information on issues facing the MPA; and
- Validate the accuracy and quality of information used for decision making.

Key issues in convening an effective advisory committee include size and structure, such as whether to convene an overall committee within which sub-groups of the committee or working groups of non-committee members operate. As is the case with stakeholder committees advising on the design and evaluation of proposed MPAs, the charter of the

stakeholder committees convened after establishment of MPAs must be clear. The role of such committees may range from simply advising the Department to conducting specific management tasks under the general guidance of the Department (Pomeroy and Goetze 2003). In any event, the establishment and possible roles of such standing committees should be discussed in a draft management plan, so that they can be considered by the Department and Commission.

Section 5. Enforcement

Existing Enforcement Assets

As indicated in the MLPA [FGC Section 2851(a)], a lack of enforcement resources is one of the reasons California's existing MPAs create the illusion of protection while falling short of their potential to protect resources. This lack of resources is not unique to MPA enforcement and is true across all fisheries enforcement in California. To remedy this, the MLPA requires that the Marine Life Protection Program provide for adequate enforcement [FGC Section 2853(b)(5)] and include appropriate enforcement measures for all MPAs in the system [FGC Section 2853(c)(2)]. The MLPA includes in this the use, to the extent practicable, of advanced technology and surveillance systems. Because of the added emphasis on MPAs established by the MLPA and the clear need for increased enforcement resources, additional assets will be required.

The Department of Fish and Game's enforcement staff is charged with enforcing marine resource management laws and regulations over an area encompassing approximately 1,100 miles of coastline and out to sea. Department staff also provide enforcement of federal laws and regulations within State waters and in federal waters. Enforcement duties include all commercial and sport fishing statutes and regulations, all Fish and Game Code and Title 14, California Code of Regulations restrictions, marine water pollution incidents, homeland security, and general public safety. General fishing regulations and other restrictions apply within MPAs as well as specific MPA restrictions.

The Department shares jurisdiction for federal regulations including the Magnuson Stevens Fishery Conservation and Management Act, the Endangered Species Act, and the Lacey Act. Department enforcement patrols regularly extend into federal waters between three and 12 nautical miles from shore as well as into the Exclusive Economic Zone beyond 12 nautical miles. A significant portion of both commercial and recreational fishing effort, and subsequently enforcement effort, occurs in federal waters and the EEZ. The existing patrol effort beyond state waters and outside MPAs must also be considered in the plan. How effectively state and federal regulations are enforced within and around the MPAs will affect the success of MPAs in conserving and protecting marine resources.

The Department of Fish and Game maintains a fleet of seven large patrol boats in the 54- to 65-foot class stationed at major ports throughout the state. These patrol boats are staffed by a cadre of 22 officers, and five support personnel. The Department also has eight patrol boats in the 24- to 30-foot range, and another 15 patrol skiffs stationed at ports and harbors throughout the state. Overall the Department has approximately 230 wardens in the field, responsible for a combination of both inland and marine patrol. A portion of these wardens have a "marine emphasis" focusing primarily on ocean enforcement but also enforcing inland regulations. The Department has a fleet of single- and twin-engine fixed wing aircraft that work in conjunction with both marine and land based wardens to help identify and investigate violations. Though seemingly impressive, when compared to the more than 5,000 square miles of California State

waters and the federal waters beyond, as well as California's vast inland area, these numbers are quite small.

In the central California coast, for example, there are presently 30 to 40 wardens in the field. Of these, only about 15 have a marine emphasis and are responsible for enforcing regulations over more than 1,100 square miles of state waters within the study region (See table 3).

Table 3. Central coast enforcement personnel with marine emphasis (2005).

Pigeon Point to Big Sur		**Big Sur to Point Conception**		**Total**
Land Based	Patrol Boat	Land Based	Patrol Boat	
1 Lt. / 2 Wardens (1 vacant position)	1 Lt. / 2 Wardens 1 patrol boat	3 Wardens	2 Lt. / 4 Wardens 2 patrol boats	4 Lt. / 11 Wardens

The Department of Fish and Game's Special Operations Unit (SOU) consists of ten enforcement officers who are tasked with conducting statewide covert investigations primarily dealing with the commercialization of fish and /or wildlife. SOU investigations allow a team of well trained Department wardens to take the time and effort, usually not available to field wardens, to thoroughly investigate these large poaching operations that are severely impacting California's fish and wildlife resources. The SOU reports directly to the Marine Assistant Chief out of Sacramento Headquarters. The unit has no uniform patrol responsibility anywhere in the state. The unit is directed to specific investigations using information gathered from a variety of sources throughout the state.

The investigations conducted by SOU are varied, and include commercialization of recreationally caught or illegally taken bear, deer, turkey, abalone, lobster, sturgeon, salmon and steelhead, and a variety of other marine and inland fish as well as many other wildlife species. Covert investigations are very time consuming and expensive to conduct. The investigations can last anywhere from a few days to several years to complete. The SOU supervisor works closely with a local District Attorney during all investigations, which helps facilitate aggressive prosecution of most SOU cases. SOU may be used to assist with major MPA violations.

The Department's enforcement program also works closely with the enforcement programs of a number of other agencies including the California Department of Parks and Recreation, NOAA Fisheries, National Marine Sanctuary Program, National Park Service, and United States Coast Guard on matters of mutual enforcement interest (See Table 4). Though these programs often provide financial or logistical support, they do not provide significant staff resources statewide, especially for offshore patrols or patrols of areas not adjacent to their own facilities. As part of seeking new cooperative agreements, the Department will make efforts to acquire more direct assistance from appropriate agencies.

Table 4. Natural Resource Enforcement Assets in California

Agency	**Assets and Activities**
U.S. Coast Guard	The U.S. Coast Guard has a primary role in protecting natural resources under the Oil Pollution Act of 1990, the Rivers and Harbors Act of 1899, and the Marine Plastic Pollution and Control Act. The U.S. Coast Guard works directly with the Department's Office of Spill Prevention and Response (OSPR) on oil pollution incidents. They also provide limited support for State and Federal fisheries regulation enforcement.
U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service agents and officers have the statutory authority to enforce the Marine Mammal Protection Act, Endangered Species Act and Lacey Act.
NOAA Fisheries	The Department has a Joint Enforcement Agreement with NOAA Fisheries. NOAA Fisheries provides funding to the state to enforce federal regulations in state waters, federal offshore waters and in bays, estuaries, rivers and streams.
National Marine Sanctuaries	Currently, there are several sanctuary officers within the central coast area, patrolling the Monterey Bay National Marine Sanctuary. Boats and aircraft available for law enforcement patrols in all California Sanctuaries. Law enforcement agreements coordinate enforcement efforts, share physical resources, cross deputize state officers and provide federal funds for state operations.
National Park Service	The National Park Service has enforcement personnel stationed at various federal parks along the California coast and at some of the off-shore islands.
California Department of Fish and Game	Seven large patrol boats and over twenty smaller craft are dedicated to marine patrol efforts. One large patrol boat is primarily responsible for the Channel Islands marine protected areas law enforcement patrols. Two large patrol boats are within the central coast area.
California Department of Parks and Recreation	The Department of Parks and Recreation manages approximately one third of the California coastline and has law enforcement personnel stationed in park units throughout California, many with on water patrol capability. These officers have the authority to enforce Fish and Game statutes.
Harbor Police, City Police, and Sheriffs	Local harbor districts, sheriff and police Departments often employ peace officers to conduct on-water patrols within their jurisdictions.

The MLPA places an increased importance and focus on MPAs as a tool to enhance marine resources and requires that the existing array of MPAs be improved and managed to the extent possible as a network. In order to adequately enforce MPA regulations, the Department will prioritize areas of particular concern or at particular risk and emphasize patrol of these areas. Given the Department's other broad mandates to enforce both state and federal marine resource regulations current assets are not adequate to redirect to MPA specific patrols. The increased focus on MPAs suggested by the MLPA and the comprehensive network the act mandates will require not only a detailed enforcement plan, but additional enforcement assets.

MPA Enforcement Considerations

The level and type of enforcement activity in an individual MPA depends upon several factors. In particular, the goals and objectives of the individual MPA and its accompanying regulations dictate the enforcement needs. Specific MPA regulations and the need for or desired level of enforcement within an MPA also impact enforcement needs. In some cases, MPAs may be enforced without direct contact of individual vessels, such as in a no-take MPA where a vessel

is obviously not engaged in fishing. In limited-take areas, the specific regulations may require close examination of individual vessels to determine whether fishing activities comply with the regulations. However, while enforcement in no-take areas may consist of visual observation from a distance if the desired level of enforcement is high, they may also require careful examination of individual vessels.

Beyond the MPA classification, other elements of MPA design have implications for an effective enforcement plan. The following factors facilitate enforcement of MPAs:

- Straight line offshore boundaries which follow lines of latitude and longitude - more easily recognized by users and enforcement is simplified
- Larger shoreline lengths - provide a buffer against unintentional boundary infractions

- Proximity to cities - enhances the ability to enforce as more assets are readily available and deployment of staff and equipment is easier, however may pose problems for level of use (see below)
- Distant from heavily used areas - areas near urban development are often more heavily visited and require more enforcement effort to ensure compliance
- Fewer points of public access - Increased numbers of access points to an MPA (e.g., multiple shoreside access points versus only offshore access) require increased monitoring efforts and increased staffing
- Adjacent to the shoreline - enforceable using smaller vessels and shoreside patrol when compared to offshore MPAs with no shoreline connection
- Adjacent to onshore facilities - existing staff (e.g., state park rangers) can assist in enforcement and monitoring

The number of and distance between MPAs impacts the ability to enforce the MPA regulations. If MPAs are too far from one another, individual patrols are not able to enforce multiple areas. If MPAs are too numerous, individual patrols are not able to reach all areas. Each case would require additional enforcement personnel to cover the entire network of MPAs.

Finally, the enforcement plan must consider natural barriers to enforcement. MPAs established in areas with normally rough conditions may be difficult to patrol or access. As noted above, offshore MPAs require larger vessels and dedicated at-sea patrol. MPAs located farther offshore or more distant from ports have higher patrol costs in both time and expenses. MPAs adjacent to shore, however, may also have natural barriers to their enforceability. This would include distance from patrol bases as noted above, along with physical inaccessibility. Though MPAs in very remote and difficult-to-access areas will naturally have fewer visitors and a decreased chance of unintentional infractions, they are also uniquely suited for unobserved intentional infractions.

Enforcement Plan Objectives

The primary objective of an MPA enforcement plan is to ensure compliance with regulations designed to achieve the individual MPAs objectives. Compliance is enhanced through visible and consistent patrol and through adequate outreach to ensure public knowledge of regulations and areas. As noted above, additional enforcement personnel and assets will be required to achieve this primary objective. Increased use of cooperative agreements with other

agencies may be a partial solution, but additional funding for enforcement is required for any of the solutions.

The objectives of the enforcement plan can be split into four primary categories:

1. Provide an effective and comprehensive operational ability
2. Maintain and enhance cooperative efforts with other agencies
3. Ensure public awareness of regulations and rationale
4. Provide outreach and education

The activities and funding required to implement these objectives are detailed in appendix L. In summary, the activities include:

Effective and comprehensive operational ability

- Identify areas of high priority, biological sensitivity, or enforcement need
- Determine MPA Network enforcement needs
- Hire additional enforcement officers
- Explore and acquire remote observation technology and techniques

Priorities are developed based on the potential for resource impact, level of use, and potential for infractions. High priority areas include habitats that are particularly vulnerable to damage, areas with high aggregations of critical species or species at low abundance, and areas where infractions are likely to occur or have occurred at high rates in the past.

Seek additional cooperative agreements

- Develop standard operating procedures
- Develop a standardized training program
- Seek and support ongoing and enhanced memoranda of understanding

Ensure public awareness of regulations and rationale and provide enhanced outreach and education

- Establish a Department MPA outreach program
- Develop outreach materials for enforcement staff to distribute
- Establish an education advisory board
- Hold public forums to educate specific groups
- Develop standardized signage protocols

The Department already conducts significant outreach and educational activities. In order to ensure public awareness of MPA regulations and rationale, the Department would create specific curricula and materials dedicated to MPAs. The Department would create standards for statewide signage and information to make outreach materials consistent. Additional funding would be required for any outreach and educational activities.

Section 6: Monitoring and Adaptive Management of MPAs

In the last several decades, monitoring and evaluation have become important features of management approaches to living marine resources and the environment (NRC 1990, NRC 2001). More recently, they have become central elements in management programs intended to adapt as understanding of the managed ecosystems – both the biophysical and social systems – improves and circumstances change. In California, the legislature incorporated this adaptive approach into the Marine Life Management Act (MLMA) in 1998. Besides defining adaptive management, the MLMA requires the development of research and monitoring activities within fishery management plans [FGC Sections 90.1, 7073(b)(3), and 7081].

A year later, the legislature incorporated the principle of adaptive management as well as monitoring and evaluation of MPAs and a statewide MPA network into the MLPA in several passages. At FGC Section 2856(a)2(H), for instance, the MLPA requires that the master plan include "[R]ecommendations for monitoring, research, and evaluation in selected areas of the preferred alternative, including existing and long-established MPAs, to assist in adaptive management of the MPA network, taking into account existing and planned research and evaluation efforts."

In these and other ways, the MLPA emphasizes the role of monitoring and evaluation in adapting individual MPAs and the MPA network in response to new knowledge and circumstances. The adaptive management approach of the MLPA provides for future proposals to add, modify, or eliminate MPAs based on information gained from monitoring and evaluation activities, the development of new scientific information, and input from interested parties.

It is worth noting that the MLPA calls for monitoring and evaluation of selected areas within the preferred alternative to assist with adaptive management of the MPA network. This does not mean that other MPAs should not also be monitored and evaluated in accordance with their own goals and objectives, but that the performance of selected MPAs might be used to guide future decisions over a wider area.

Monitoring and evaluation should not be done for their own sake, but to gauge the performance of an MPA in relation to its goals and objectives. A cost effective approach in many areas may be to link these activities to other ongoing monitoring activities. Similarly there may be many opportunities to involve members of the general public in monitoring and evaluation activities as well, thus leveraging further the resources available.

Since MPAs will be implemented in a phased approach in individual regions through 2011 rather than adopted all at once statewide, the initial focus must be on developing effective monitoring programs in individual regions, including monitoring in areas both inside and outside MPAs. The final phase in developing monitoring and evaluation programs will be to evaluate and adjust these programs in individual regions to reflect a coherent program statewide.

Clear and measurable objectives should, in turn, form the basis for the design of systems to monitor and evaluate the impacts of management actions. Monitoring and evaluation systems should explicitly address five principles (Pomeroy et al. 2004). Such programs should be:

- Useful to managers and stakeholders for improving MPA management;
- Practical in use and cost;
- Balanced to seek and include scientific input and public participation;
- Flexible for use at different sites and in varying conditions; and
- Holistic through a focus on both natural and human perspectives.

Developing a Monitoring and Evaluation Program for MPAs and Network Components

To promote consistency among monitoring and evaluation programs in different regions, a consistent process should be followed. Many of the recommendations below come from a 2004 guidebook to natural and social indicators for evaluating MPA management effectiveness (Pomeroy et al. 2004). This discussion relies heavily on the guidebook because it is comprehensive, reflects the experience of MPAs around the world, has been field tested, and relies principally upon techniques that are simple rather than complex, and therefore more likely to be implemented and sustained over the long-term.

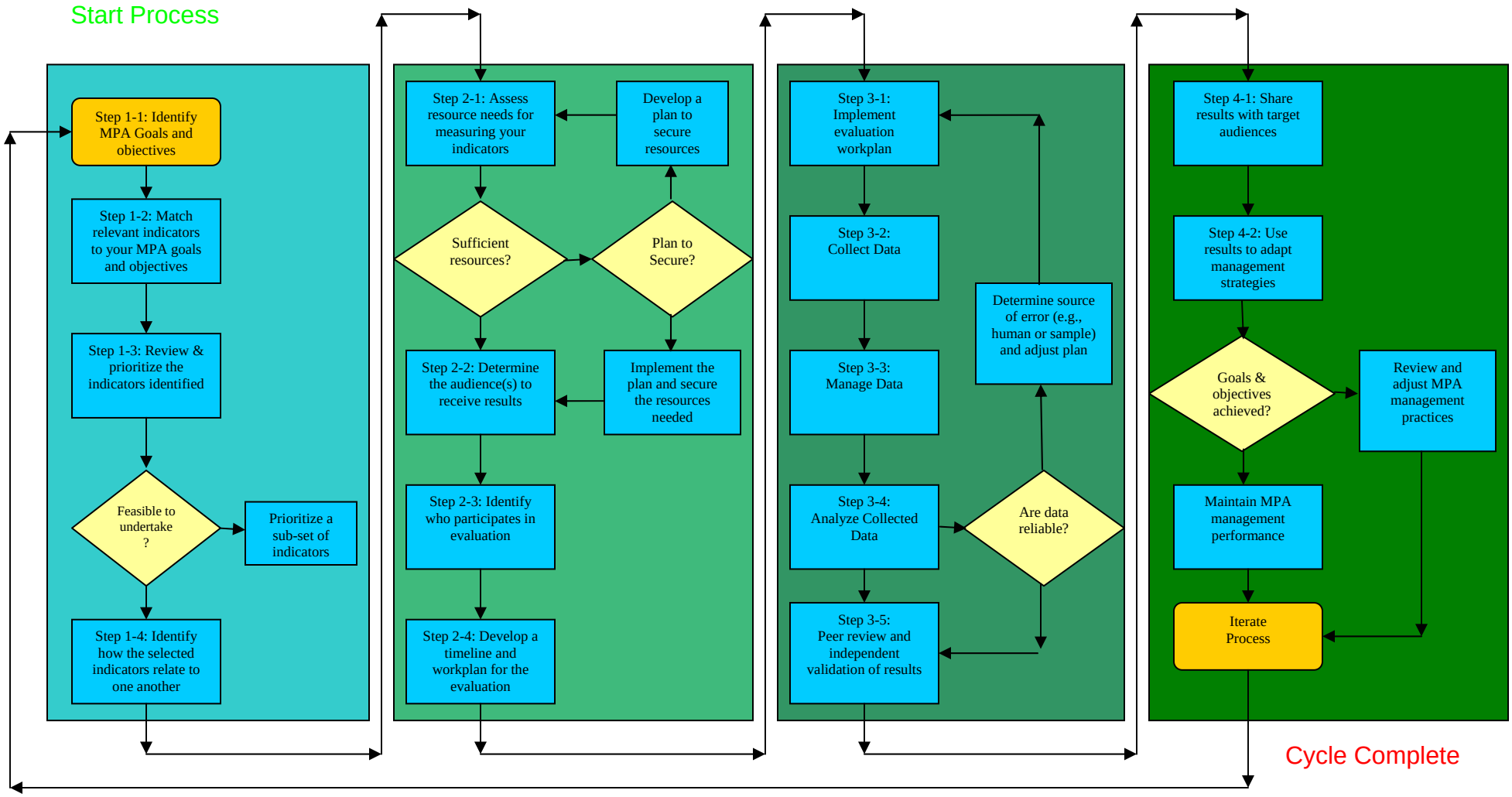
The process below presents only the more general features of the approach presented by Pomeroy et al.; much more detail is available in the guidebook itself. In addition, monitoring and evaluation programs should reflect local conditions, constraints and opportunities. The basic steps for establishing a monitoring program are listed below and displayed in a flowchart in figure 5.

- Identify MPA goals and objectives.
    - Identify any overlapping goals and objectives.
- Select indicators to evaluate biophysical, socioeconomic and governance patterns and processes
    - Review and prioritize indicators,
    - Develop quantifiable benchmarks of progress on indicators that will measure progress toward goals and objectives, and
    - Identify how selected indicators and benchmarks relate to one another.
- Plan the evaluation.
    - Assess existing data;
    - Assess resource needs for measuring selected indicators;
    - Determine the audiences to receive the evaluation results;
    - Review relevant monitoring and evaluation programs at existing MPAs, such as at the Channel Islands;
    - Identify participants in the evaluation; and
    - Develop a timeline and work plan for the evaluation.
- Review and revise planned monitoring and evaluation program.
    - Conduct structured peer and public review processes, and
    - Make modifications in response to review.
- Implement the evaluation work plan.

    - Select methods and approach and collect data;
    - Manage collected data, includes identifying the data manager, providing for the long-term archiving and access to the data, and making the data available for analysis and sharing;
    - Analyze collected data; and
    - Conduct peer review and independent evaluation to ensure robustness and credibility of results.
- Communicate results and adapt management.
    - Share results with target audiences, and
    - Use results to adapt management strategies.

Indicators of success include those pertaining to biophysical goals and objectives, socioeconomic goals and objectives, and governance (management) goals and objectives. Examples include, among many others, focal species abundance to determine whether resources are being sustained, household income to determine whether livelihoods are being enhanced or maintained, and level of enforcement coverage to determine if effective management strategies are in place. Pomeroy et al. list a total of 42 indicators (10 biophysical, 16 socioeconomic, and 16 governance) that cover combinations of 21 commonly used MPA goals and 68 commonly used objectives. The guidebook essentially provides a “toolbox” of indicators and a starting point for developing a plan. It also provides some detail on survey methods used to measure the indicators, though is not a comprehensive listing of all survey methodologies. Once regional goals and objectives are selected and individual MPA goals and objectives determined the guidebook and following flowchart (figure 5) will provide a method to establish monitoring programs.

Figure 5. Flowchart of process to establish and conduct a monitoring program[6].



[6] From Pomeroy, et al., 2004.

To achieve the purpose of informing adaptive management, the results of monitoring and evaluation must be communicated to decision makers and the public in terms that they can understand and act upon (NRC 1990). Moreover, in addition to aiding in MPA management, measuring, analyzing and communicating indicators can promote learning, sharing of knowledge and better understanding of MPA natural and social systems among scientists, resource managers, stakeholders, members of the public, and other interested parties (Pomeroy et al. 2004). To these ends, monitoring and evaluation programs for MPAs should include a communications plan that identifies the target audiences and specifies the timing, methods, and resources to regularly synthesize and present monitoring and evaluation results.

Though the results from ongoing monitoring and evaluation should be reviewed periodically, a comprehensive analysis of monitoring results should be conducted every three to five years. The longer time-frame for review takes into account the fact that biological changes are slow to occur and trends are more likely to become apparent on this time scale. These reviews should be transparent, include peer review, and make results available to the public. Besides evaluating monitoring methods and results, the review should evaluate whether or not the monitoring results are consistent with the goals and objectives of the individual MPA, the region, and the MLPA. If the results are not consistent, the review should develop recommendations for adjustments in the management of the MPA network.

Within the above set of required components, specific monitoring methods are not prescribed. For example, monitoring and evaluation programs may be effective within a range of levels in intensity and sampling frequencies. They also may rely on different indicators, depending on the MPA goals and objectives.

General Considerations in Identifying Indicators

An indicator measures the success of a management action, such as the specific design of an MPA. It is a unit of information measured over time that will make it possible to document changes in specific attributes of the MPA (Pomeroy et al. 2004). General considerations in selecting or designing an indicator include:

- Measurable - able to be recorded and analyzed in quantitative or qualitative terms.
- Precise - clear meaning, with any differences in meaning well understood OR measured the same way by different people.
- Consistent - not changing over time, but always measuring the same thing.
- Sensitive - changing proportionately in response to actual changes in the variables measured.
- Simple - rather than complex.
- Independence defined - correlation with other indicators examined.

In selecting indicators, a monitoring and evaluation plan for an MPA or portion of the MPA network should (Pomeroy et al. 2004):

- Define and provide a brief description of the indicator;
- Explain the purpose and rationale for measuring the indicator;

- Consider difficulty and utility—that is, how difficult it is to measure and the relative usefulness of information provided by the indicator;
- Evaluate the required resources including people, equipment, and funding;
- Specify the method and approach to collecting, analyzing, and presenting information on the indicator, including sample size, spatial and temporal variation;
- Identify reference points or benchmarks against which results will be measured and timelines within which changes are expected;
- Explain how results from measuring the indicator can be used to better understand and adaptively manage the MPA;
- Provide references on methods and previous uses of the indicator.

Prior knowledge of the variability in the indicators selected should be incorporated into the monitoring and evaluation design where possible. If no prior knowledge exists variation in indicators must be identified within the monitoring and evaluation program. Multiple independent indicators are required for complex systems such as in the marine environment. Consideration also should be given to the timescale within which changes in an indicator might reasonably be expected. For instance, recovery of populations of long-lived species, such as some rockfishes, may require many years; performance measures or other types of benchmarks for such indicators should reflect this longer timescale.

MPA monitoring and evaluation programs should measure biophysical, socioeconomic, and governance indicators, since these dimensions of marine ecosystems are inextricably linked (Pomeroy et al. 2004). Possible indicators are described below.

Biophysical. One common focus of MPAs is the conservation of living marine resources and habitats of California's coastal waters. Likely biophysical goals of individual MPAs and MPA networks established under the MLPA include sustaining the abundance and diversity of marine wildlife, protecting vulnerable species and habitats, and restoring depleted populations and degraded habitats. Thus, potential biophysical indicators might include (Pomeroy et al. 2004):

- Abundance and population structure of species of high ecological or human use value;
- Composition and structure of a community of organisms;
- Survival of young;
- Measures of ecosystem condition;
- Type and level of return on fishing effort;
- Water quality; and
- Areas whose habitat or wildlife populations are showing signs of recovery.

Socioeconomic. Socioeconomic indicators make it possible to understand and incorporate the concerns and interests of stakeholders, to determine the impacts of management measures on stakeholders, and to document the value of an MPA to the public and to decision makers (Pomeroy et al. 2004).

Possible socioeconomic indicators include (Pomeroy et al. 2004):

- Use data (and values of those uses) for consumptive and non-consumptive purposes, including:
    - Numbers of participants
    - Economic effects on local communities and to supporting industry
    - Measures of perceived value and level of satisfaction derived from consumptive and non-consumptive activities
    - Changes in geographic and other patterns of use in and around MPAs within the region;
- Level of understanding of human impacts on resources;
- Perceptions of non-market and non-use value;
- Community infrastructure and business;
- Number and nature of markets; and
- Shareholder knowledge of natural history and current use patterns and intensity.

All of these indicators would be tailored and specifically defined to reflect the conditions, resources present, use patterns and goals and objectives of each MPA or region.

Governance. By definition, MPAs are a governance tool since they limit, forbid, or otherwise control how people use marine areas and wildlife through rights and rules (Pomeroy and others 2004). Governance may include enforcement, use rights, and regulations. Goals for governance of MPAs include the following (Pomeroy et al. 2004):

- Legal certainty as indicated by legal challenges or reported failure to act because of legal uncertainty;
- Effective management structures and strategies maintained;
- Effective legal structures and strategies for management maintained;
- Effective public participation and representation ensured;
- Management plan compliance by resource users enhanced; and
- Resource use conflicts managed and reduced.

Possible governance indicators include the following:

- Local understanding of MPA rules and regulations;
- Availability of MPA administrative resources;
- Existence and activity level of community organizations;
- Level of public involvement; and
- Clearly defined enforcement procedures.

In addition, it is important to recognize the role that volunteer monitoring activities can play in evaluation. As mentioned earlier, there may be many opportunities to leverage with existing monitoring activities in the region and to make very productive use of stakeholder, other members of the public and educational and research entities to form partnerships in conducting monitoring and management programs. For example, the Citizen Watershed Monitoring Network in the Monterey Bay National Marine Sanctuary has used a monitoring

protocol developed by the U.S. Environmental Protection Agency in collecting information on water quality in the sanctuary. Information from this program has helped in determining where education and outreach efforts should be targeted how successful specific pollution reduction activities have been, and in identifying problem areas for further investigation.

Finally, monitoring and evaluation programs can benefit from engaging commercial and recreational fishermen. At the Channel Islands, in Morro Bay, Fort Bragg, and elsewhere along the California coast, fishermen, research scientists, and federal and state biologists are carrying out field projects of mutual interest, including tag-and-recapture studies that provide critical information on the movement of fish and growth rates. Similarly, recreational fishermen have recently participated in collecting information on their catches as part of the Coastside Fishing Club's Recreational Catch Estimation Project. The Channel Islands National Marine Sanctuary supports a Cooperative Marine Research Program which helps coordinate and fund fisheries/science cooperative monitoring projects. These initiatives are in the early stages of development, and offer important opportunities for collaboration.

Section 7. Financing

Achieving the goals and objectives of individual MPAs, the statewide system of MPAs, and of the MLPA itself will depend upon sufficient short and long-term funding for carrying out key management activities, including public education, research, monitoring and evaluation, and enforcement. At FGC Section 2856(a)2(K), the MLPA requires that the master plan include "[R]ecommendations for funding sources to ensure all MPA management activities are carried out and the Marine Life Protection Program is implemented." One of the products of the MLPA Initiative will be the development of a comprehensive funding strategy by December 2005, which will address these needs.

For many types of management activity, including monitoring, public education, and enforcement, estimates of costs will vary depending on the intensity of the activity, which may range between essential or critical levels to optimal levels. As a result, overall costs for carrying out management activities will be a range of estimates for any one year. Estimates and actual costs will also vary from year to year, particularly in the early years as initial start-up costs are absorbed. An effective management plan will map these potential costs over several years.

Although some funds for management may be raised from local fees or from the private sector profit and non-profit communities, the primary source of funding for the management of MPAs will be state government and perhaps the federal government (Salm et al. 2000). It is also possible to reduce the need for government funding through effective partnerships in carrying out management or research activities.

Other sources of funds may indirectly contribute to achieving the goals and objectives of MPAs in a region by mitigating threats to species and habitats of concern from pollution and poor water quality. For instance, the State Water Resources Control Board has the authority to designate an area of state ocean waters as an "area of special biological significance" or a "state water quality protection area"; if the area is also an MPA there would be overlapping designations. Recent legislation places a high priority on using available pollution control funds on improving water quality in such areas.

Funding the management of a statewide MPA network should also be viewed within a broader context that includes the funding of other new and continuing efforts to maintain and enhance the living marine heritage of California, including legislation such as the Marine Life Management Act and other, older legislation on fisheries, coastal and marine habitat, and water quality.

Because available state funds fluctuate with changes in the overall economic health and priorities of California and the nation, marine and coastal programs of all types have to constantly adjust to these changes.[7] Management plans are an important tool for protecting

[7] Currently, the state budget includes little funding explicitly devoted to implementation of the MLPA and additional funds are clearly needed to ensure success.

MPAs and their benefits during times of limited funding. Sound management plans can help ensure that realistic cost estimates are taken into account when such features as boundaries are decided. They also can help prioritize the most vital activities at times of low financial resources, and allocate funds efficiently and effectively when more generous funding is available.

Financing an effective system of MPAs in California will depend upon this good planning as well as tapping into a diverse array of non-governmental and governmental funding sources. A detailed approach to doing so awaits adoption of a long-term funding strategy that is being prepared by the MLPA Initiative, as well as the development of management plans for the regional components of the MPA network.

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Dear subscriber:

This issue of MPA News covers the months of December 2002 and January 2003, allowing our staff a year-end holiday. In February, our regular monthly delivery will resume.

On behalf of the staff and editorial board of MPA News, I thank you for your interest in our publication. We are pleased to serve the field of MPA practitioners and stakeholders, and look forward to continuing our work for years to come. Please let us know about projects on which you are working - we want to hear from our subscribers. Our e-mail address is mpanews@u.washington.edu. Thank you.

John B. Davis
Editor

BALANCING ECOLOGY AND ECONOMICS: LESSONS LEARNED FROM THE PLANNING OF A MARINE RESERVE NETWORK IN THE CHANNEL ISLANDS (US)

In the past year, milestones were reached in two high-profile processes to create representative systems of marine protected areas. In the Australian state of Victoria and in the Channel Islands of the US state of California, government officials approved plans for networks of new MPAs, concluding lengthy and contentious planning efforts in both cases. Both processes offer lessons to practitioners and stakeholders

elsewhere who face similar challenges in planning MPA networks.

In a two-part series, MPA News distills lessons learned from each process by examining the obstacles encountered and how participants might have improved the processes in retrospect. Part one of the series, focusing on the Channel Islands, appears in this issue.

> In the February 2003 issue, the conclusion of MPA News's two-part series will examine lessons learned from the process to designate an MPA network in Victoria.

Background on Channel Islands planning process

The unique mix of marine life surrounding the Channel Islands archipelago exists due to the convergence there of warm- and cold-water currents, flowing up and down the Pacific coast of North America. In 1980, the US federal government designated the 4,292-km^2 Channel Islands National Marine Sanctuary (CINMS) to protect these waters, principally from the threat of increased oil drilling in the area. In the late 1990s, responding to calls from local stakeholders to protect dwindling fish stocks, the sanctuary and the California Department of Fish and Game instituted a joint process to consider no-take marine reserves in the sanctuary. (The sanctuary straddles state and federal waters.)

The multistakeholder Sanctuary Advisory Council for CINMS, which provides advice to the sanctuary's management, was assigned oversight of the reserve-planning process in 1999. To examine the issue of reserves in greater detail, the council formed a marine reserves working group (MRWG) of managers, fishermen, conservationists, and other stakeholders. The MRWG was responsible for recommending a plan to the council, which would then evaluate and forward the plan to the manager of the sanctuary. Final implementation would come upon approval from state and federal resource-management agencies (MPA News 2:10).

Notably, the MRWG established that all of its decisions on reserves would be made through a consensus-based process - i.e., all members must agree. The working group set a number of goals for the process, among them:

- Protection of representative and unique habitats;
- Achievement of sustainable fisheries in the Channel Islands; and
- Minimization of short-term economic losses to all resource users.

To inform its decisionmaking, the MRWG created two advisory panels, on science and socioeconomics. The science panel, directed by the working group to propose size and location criteria for reserves, recommended that at least 30% of each habitat type in the sanctuary be set aside to conserve biodiversity and sustain fisheries. The socioeconomic panel analyzed the potential impacts on fishing and other activities in the case of such closures.

In early 2001, the MRWG failed to achieve full consensus by deadline on a network plan, hindered primarily by dissent from recreational fishing representatives. Stuck without an agreed-upon option from stakeholders, the Sanctuary Advisory Council advised the CINMS manager and California Department of Fish and Game to develop a plan themselves, based on the findings of the working group. The result was a preferred option

that, if implemented, would set aside 25% of the sanctuary as no-take through a series of reserves, with 10% of the closures in state waters and 15% in federal waters. In October 2002, a state commission ratified that plan, effectively designating 10% of the sanctuary as off-limits to fishing, to take effect January 1, 2003 (MPA News 4:5). The process to consider designation of the remaining federal portion of the network, which will require approval from federal fisheries managers, is now getting started.

Lessons learned

MPA News interviewed eight individuals who participated directly in the MRWG process. Ranging across government, NGOs, and the commercial and recreational fishing sectors, these participants described a variety of challenges faced by practitioners and stakeholders in the planning effort. Through these discussions, MPA News gathered the following lessons:

1. **Maximizing conservation while minimizing short-term economic impacts is difficult.**

Although each of the surveyed participants concluded that the MRWG's goal of protecting biodiversity had likely been met, there was disagreement over whether the working group's socioeconomic goals had achieved similar success.

"The process failed to minimize the short-term economic impacts on fishermen," said Harry Liquornik, president of a local port association of commercial fishermen. According to a report of reserve-network impacts by the socioeconomic advisory panel, fishermen could see the ex-vessel value of their catches decline by 8%-19% depending on gear type, assuming they were unable to recoup the losses elsewhere. Liquornik said it was a major challenge for planners to find areas with good habitat to set aside that would not disproportionately affect any particular sector of the industry.

"Don't get me wrong - I fully support reserves," said Liquornik. "The goals that we developed, although pretty lofty, were excellent." However, he said, the MRWG erred in not setting criteria for measuring achievement of the socioeconomic goals. Like the science advisory panel's 30% target for closures, perhaps the working group should have set a maximum target for economic impacts and worked down from there, he said. He added that no plans for effort reduction were agreed upon, raising the likelihood of environmental impacts due to effort displacement from the new reserves.

Another MRWG member, Greg Helms of The Ocean Conservancy, an NGO, agreed that allocating economic impacts was a continual challenge. "The traditional struggle between commercial and recreational fishermen was a strong undercurrent in the process," he said. "This added to the struggle between conservation considerations and economic ones."

Helms says the process was outstanding - and fortunate - in its ability to incorporate high-quality information, gathered by teams of scientists, in both ecological and socioeconomic decisionmaking. By applying natural and social features to a cell grid of the planning area, planners had a sophisticated and organized way to discuss and conceptualize various reserve alternatives. "There was a clear depiction of costs and benefits among alternatives," he said.

Linda Krop, executive director of the Environmental Defense Center, another NGO, said the working group satisfactorily met its goals. "Given the internal conflicts, it was virtually impossible to meet all objectives for both the short and long term," she said. "However, the [state-ratified plan] made great progress in meeting

the agreed-upon goals and objectives. To some degree, the scientific input was ignored to elevate consumptive socioeconomic interests, but the end result was still an improvement over pre-existing regulations."

2. Full consensus is not always achievable.

The MRWG process was built on a foundation of consensus-based decisionmaking. When the sanctuary and state officials moved forward to prepare a plan despite the MRWG's failure to reach full agreement, some participants felt that they and the process had been wronged. There was particular outrage from the recreational fishing community, whose MRWG representatives had favored smaller closures.

Sean Hastings of CINMS, who staffed the working group, said that although striving for full consensus was admirable, "It should not impede the necessity to fulfill the mandate of the law." He said that if the process were hypothetically to be done again, he would suggest not to repeat the full-consensus goal, and instead focus on generating the best advice possible.

Helms of The Ocean Conservancy agreed. "Consensus is not an achievable goal for stakeholder processes dealing with issues of this magnitude," he said. "A first reason is that it is unfair to expect stakeholder representatives to both represent their constituency and honor a negotiated compromise at the same time. Also, the goal of consensus poses the problem of giving each participant a veto power over any potential outcome. Thus stakeholder processes should be viewed as an outstanding method of identifying common ground, identifying and processing data, defining the contours of conflict, and potentially creating novel alternatives for their resolution.

"Participants should have been given more specific parameters about what to provide the ultimate decisionmakers and more clarity that a decision was going to be made using the information generated by the process," said Helms. "Perhaps the goals and objectives should have been provided to the MRWG so that its task would have been one of finding 'how', and not 'whether' or 'how much' to agree upon."

John Ugoretz, senior biologist with the California Department of Fish and Game, pointed out that although the Channel Islands process did not ultimately achieve full consensus on a reserve network, MRWG members were able to agree on many other things, including the fundamental goals for what they intended to do. "All the working group members agreed that there was a problem in the area noted by declining [fish] populations," said Ugoretz. "They also agreed that there are multiple causes for this problem and that marine reserves are one way to address it." He said that these basic agreements were all used by state and federal officials in developing the final proposal. Therefore, to suggest that consensus-based decisionmaking should play no role in MPA planning would be wrong, he said. "Highly diverse groups of representatives can reach agreements," he said.

Steve Roberson, an attorney and recreational fisherman, was part of a group of anglers who first recommended creation of reserves in CINMS in 1996. A MRWG member, he says that although final agreement on a reserve plan was not achieved, the goal itself likely brought people to the negotiating table. "Maybe people wouldn't have participated at all if there hadn't been the unanimity requirement," he said.

3. Remain committed to the goals of the process.

The MRWG planning process lasted two years, with dozens of meetings. Many of these consisted of long

discussions on the precise wording of goals so that everyone would be in agreement before moving ahead. Without the commitment of MRWG members to the process, the group would not have reached the agreements that it did on goals and objectives. "The endless wordsmithing was driving me crazy, but I realized later that it was probably necessary for the later negotiations," said Roberson.

Tom Raftican of the United Anglers of Southern California said, however, that the process could have benefited from a time extension at the end, allowing the process one more chance to reach unanimity on a plan. "If consensus is the goal that you start with, then it needs to be the goal that you finish with, too," he said. With no extension of the deadline for a decision, he said, the result of the process was fundamentally unfair. He added that in the final days of the process, the MRWG was close to a solution that could have found agreement from all sides, but the deadline put an end to it.

Krop of the Environmental Defense Center said commitment to the process carried the responsibility of keeping constituents - often diverse and decentralized - informed. She suggested that MRWG representatives from the fishing community did not always do a sufficient job of educating their constituents of the issues at stake. "Rather than present objective information and try to develop options based thereon, the fishing community continued to take an 'all or nothing' approach," she said. "Fishers and harbor business people would show up at meeting after meeting, afraid that they would lose their jobs and livelihood. They did not have the benefit of the information that had been generated through the process." She recommended that for such planning boards to be effective, they should include stakeholders who are truly interested in achieving full- or near-consensus, and who are not there simply to exercise their veto power.

4. Setting percentage-based targets can alter a planning process.

When the MRWG asked the science advisory panel to provide size and location criteria for potential reserves, the panel took the initiative of delivering its advice with a percentage-based target: that at least 30%, and as much as 50%, of each sanctuary habitat be set aside as no-take. The figures were reported in the media, and fishing interests voiced strong objection to the idea of closing up to half of their fishing grounds. MRWG discussions, which had formerly focused on how to meet the group's general goals of balancing ecology and economics, now veered toward how the group could set aside 30% of the sanctuary.

Ugoretz of the California Department of Fish and Game says the 30% target was never viewed as a firm goal by the federal and state officials, including himself, who drew up the eventual network plan. "The agencies, when developing the proposed project, took into account the science advisory panel's advice, along with other science and goals such as limiting socioeconomic impacts," he said. "We also considered the fact that MPAs would not be the only type of management used [in the region], and that many ongoing processes are reducing fishing effort. Thus we determined that representing habitats at a level of 20% or more was adequate."

Although the sanctuary, as host of the planning process, worked hard to separate politics from the fact-finding and science processes, some participants felt the science panel had overstepped its bounds in picking and publicizing a percentage-based target. Bruce Steele, a commercial urchin diver, accused the science panel of being political. "If the scientists are going to take a political stance, then they should be prepared to go the whole way and participate in all the community meetings, too," he said. He said one assumption that underlay the panel's target - that all fisheries management outside the sanctuary was ineffective - was flawed. "Fishermen went into this process hoping it would produce a better interface

between science and community stakeholders but, with some exceptions, that didn't transpire," he said.

Liquornik, representing the local port association of commercial fishermen, said the MRWG discussions in the end consisted of seeing how far the fishermen could go in setting aside fishing grounds. "The fishing community should have stopped and said, 'This is as far as we can go, percentage-wise, with the consensus of the industry,'" he said. Absent such a limit, the fishing representatives on the MRWG were left to consider each proposal on an ad hoc basis, weakening their negotiating position.

5. External factors can affect planning.

As noted above by Ugoretz, the Channel Islands process did not operate in a vacuum. Other fisheries management actions along the US Pacific coast have placed increasingly strict limits on fishing effort in recent years, including a ruling in 2002 by the Pacific Fisheries Management Council (PFMC) that fishing for rockfish would be off-limits in waters deeper than 120 feet (MPA News 4:3). The PFMC ruling, which came after the MRWG discussions but prior to state ratification of the Channel Islands network plan, has made the concept of closing shallow rockfish habitat in the sanctuary - particularly around the islands nearest to mainland harbors - that much more difficult for the recreational fishing sector.

"The PFMC essentially closed down the rockfish fishery beyond 120 feet," said Raftican of United Anglers. "There are an awful lot of moving parameters out there in fisheries management. It's extremely difficult in planning to take a static look at the situation."

Said Roberson, "The recreational fishing people had too many closures hitting them from other processes to allow them much flexibility. With the Channel Islands reserves and the rockfish closures, I think some of the [recreational fishing guides] will go out of business."

6. Clarification of roles may be necessary.

When a government agency is both a host and participant in a planning process, as the sanctuary was, there can be confusion among stakeholders as to where the agency's allegiance lies: to the process or to its own interests. "On a general scale, there was and still is confusion on the sanctuary's interest and involvement in the process," said Hastings of CINMS. "The public needs to recognize that agencies must operate within the scope of the law and their mandate. Certain constituencies appeared not to fully understand the sanctuary's role in protecting resources and providing a very open public process to better inform the sanctuary and other resource management agencies."

Liquornik said the decision by the sanctuary and state officials (on advice from the Sanctuary Advisory Council) to develop a plan themselves without full consensus from the MRWG was indicative of where their interests lay. "We learned that agencies are stakeholders, too," he said.

Outcomes of the process

Roberson says that although many in the recreational fishing community view the Channel Islands planning process as having been a negative one, it had one positive result: the community is now more organized and galvanized to take action on issues. "Hopefully that will be a positive thing environmentally," said Roberson. He said recreational fishermen might now be able to effect greater change, such as by working for better water quality and other issues impacting their target species.

Others in the fishing sector are not satisfied with the Channel Islands process. A coalition of several recreational and commercial fishing associations filed a lawsuit on December 3 to stop implementation of the Channel Islands reserve network and reopen the process by which state officials approved it. The lawsuit claims the state failed to consider the effects of the closures on adjacent areas or respond to public comments, among a range of other violations of state law.

In the meantime, the state of California is moving ahead with a process under the state's Marine Life Protection Act to design a network of MPAs throughout state waters (MPA News 3:9).

Helms of The Ocean Conservancy summarized the lessons he had taken from the Channel Islands. "The process was challenged by valid questions from many stakeholder sectors about whether a negotiated stakeholder process is a viable and proper means to resolve resource conflicts," he said. "Essentially, the willingness to pursue common ground and compromise challenged the process, and I believe these challenges will persist as MPA planning efforts move forward. 'End run' opportunities will continue to exist; that is, methods to secure superior outcomes outside the process will be available to each constituency and these have the potential to undermine stakeholder processes.

"The management of the ocean is becoming more contentious and the estimates of its status more bleak," he said. "How will future planning processes be affected by this context?"

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Editor's note: William Alevizon, author of the following perspective piece, is a senior marine ecologist with the marine conservation program of the Wildlife Conservation Society, a US-based NGO. A specialist in population and community ecology of reef fishes, Alevizon has conducted ecological investigations of Caribbean and Florida reef habitats and fisheries since 1973, and has authored or co-authored numerous scientific papers and technical reports. He has participated in MPA planning efforts in several Caribbean nations, including Antigua, the Dominican Republic, Honduras, and Nicaragua. For the past two years, Alevizon has worked closely with the Bahamas Department of Fisheries to develop a planning framework for the nation's proposed marine reserve network and conduct preliminary site surveys of prospective reserve sites.

A list of the literature cited in this piece is available online at http://depts.washington.edu/mpanews/Alevizon-cited.htm.

MPA PERSPECTIVE

CONSERVING ECOLOGICAL INTEGRITY OF MARINE RESERVES: "NO-TAKE" IS NOT NECESSARILY "FULLY PROTECTED"

By William Alevizon, Wildlife Conservation Society

A troubling trend has emerged in recent years among many MPA scientists, planners, and advocates: namely, the interchanging use of the terms "fully protected" and "no-take". Such usage suggests that extractive use per se is the only resource-use issue relevant to the protection of marine resources within marine reserves. The logical outcome of such a paradigm is that managers/planners are led to believe that simply making these areas off-limits to fishing might adequately protect the ecological integrity of such areas.

Such a view, however, is inconsistent with best-available science and common sense. Today, many biologists concur that on a worldwide basis, the greatest threat to wildlife, biodiversity, and ecosystem health is the widespread degradation, loss and fragmentation of natural habitats (Ehrlich and Wilson 1991; Soule 1991). While "extractive use" may frequently contribute to habitat degradation in marine ecosystems, it is far from the only factor or form of resource use so involved.

It has been well documented, for example, that unregulated numbers and/or activities of recreational divers and snorkelers can cause substantial damage to sensitive marine habitats. Such problems become evident even at levels of diving intensity far less than those presently experienced at many popular dive sites (CIDE 1997). Coral reefs are particularly sensitive to diver damage, with documented impacts typically including reduction of live coral cover, reduced abundance and diversity of corals and other benthic invertebrates, and increased turbidity and sedimentation at reef sites (Hawkins and Roberts 1992, 1993; Chiappone and Sullivan 1996; Harriot et al. 1997; CIDE 1997; Roberts and Hawkins 2000; Jensen 2001). Problematic impacts from unregulated recreational diving have also been documented on temperate rocky-reef habitats in both the Mediterranean (Zabala 1997; Badalamente et al. 2000) and in California kelp forests (Schaeffer et

al.1999).

Similarly, feeding and other forms of harassment of marine wildlife have been shown to cause ecological disruption in the forms of altered behaviors and/or unnatural distribution/abundance patterns in sharks (Burgess 1998), reef fishes (Perrine 1989; Quinn and Kojis 1990; Cole 1994; Hawaii DLNR 1993,1999) and marine mammals (NOAA 1994). Marine mammals have been most thoroughly studied with regard to the impacts of inappropriate human interactions (feeding, touching, etc.). Here, the problems documented were of sufficient concern (NOAA 1994) that such activities are now classified a form of "take" and prohibited under provisions of the U.S. Marine Mammal Protection Act.

Despite such well-documented problems, the referenced activities remain unregulated at most so-called "fully protected" marine reserves. While the long-term impacts of chronic overfishing on reef communities are not to be taken lightly, neither should substantive documented "non-consumptive" impacts. In fact, given the problems documented from the referred activities within some established marine reserves, one could argue credibly that the latter should be of at least equal concern as the former in the development of management schemes designed to "fully protect" the long-term ecological integrity (or fisheries) of sensitive tropical and temperate reef habitats.

Roberts and Hawkins (2000) pointed out the need to regulate diving intensity on coral reefs, suggesting that a sizable portion (10-20%) of reef areas in "fully protected" marine reserves be completely closed to scuba diving. Badalamente et al. (2000) reported that newly established marine reserves in the Mediterranean quickly became magnets for increased dive tourism, and the resulting impacts on benthic communities and disturbance of reef fish assemblages (through rampant fish feeding) forced authorities to either ban divers completely, or strictly regulate their numbers in some areas. A focused study of the impacts of recreational diving impacts on kelp forests of central California (Schaeffer and Foster 1998) led authors to conclude that, "Marine reserves not based upon empirical data and allowing unmonitored levels of diving can be counterproductive to the conservation ideals they are supposedly based upon." Davis and Tisdell (1995) reached a similar conclusion: "The environment of heavily used dive sites...may be impacted by SCUBA diving and these impacts may conflict with conservation goals."

These lessons and admonitions should not remain unheeded. In an era of ecosystem-level approaches to conservation and management, it must be acknowledged that extractive use is but one of any number of ways in which the ecological integrity of marine ecosystems may be compromised by human impacts. Even when fisheries protection/restoration is the primary goal in establishing a marine reserve, it should be recognized that protecting the integrity of supporting habitats and biological assemblages is as necessary to that goal as the regulation of extractive use. Full protection for MPAs designed to conserve biodiversity, protect wildlife, and/or maintain natural ecosystem attributes must go beyond the simple concept of no-take. Regulatory schemes designed to provide "full protection" for sensitive marine ecosystems should invoke the precautionary principle as the management standard, and thereby encompass, to the degree practical, protections from the full spectrum of all known and readily controlled negative human impacts.

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NOTES & NEWS

More information on women and MPAs

Readers who want to learn more about the subject of women and MPAs - featured in last month's MPA News - may refer to the *Women in Fisheries* bulletin, published by the Secretariat of the Pacific Community. The November 2002 edition features several articles on women's roles in community-based management and conservation in Pacific island nations. The issue is available online at http://www.spc.int/coastfish/News/WIF/WIF11/WIF11.htm.

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Insurer ruled liable for damages from Galapagos spill

A court in Ecuador has ruled that Terra Nova, a British insurance underwriter, must pay a total of US$10 million to the Galapagos National Park as compensation for a fuel spill that occurred in the park's waters in January 2001. The spill occurred when the tanker Jessica - insured by Terra Nova and carrying a cargo of 240,000 gallons (605,000 liters) of fuel - ran aground off San Cristobal Island. Two-thirds of the vessel's cargo was released directly into park waters (MPA News 3:11). Terra Nova has appealed the court's decision, arguing that the case falls under British jurisdiction rather than Ecuadorian. If upheld, the compensation would help reimburse the park for its spill-response and monitoring efforts. In addition, US$600,000 would go to biologist Martin Wikelski of Princeton University (US), whose long-term study of marine iguanas in the park ended when 62% of them died at a study site affected by the spill. For more information: Eliecer Cruz, Director, Galapagos National Park, Puerto Ayora, Santa Cruz, Galapagos, Ecuador. E-mail: ecruz@spng.org.ec.

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Designation expected soon: Antarctica's first wholly marine protected area

A marine area encompassing 30km^2 in Terra Nova Bay, Ross Sea region, is expected in mid-2003 to become the first entirely marine protected area in Antarctica to be developed under the Madrid Protocol, which regulates environmental protection on the continent. A proposal by Italy to designate the site as an Antarctic Specially Protected Area (ASPA) was approved in October 2002 by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR); the proposal now heads to the Antarctic Treaty Consultative Meeting in June 2003 in Madrid for final approval. The Terra Nova Bay site is an important littoral area for well-established and long-term scientific investigations, and its proposed regulations would strictly limit any activities that could jeopardize the area's ecology. No marine resource harvesting has been conducted historically in the immediate vicinity. In addition to considering the Terra Nova Bay designation, the June 2003 meeting will consider revised management plans for three existing protected areas with partial marine components. The proposed management plan for the Terra Nova Bay ASPA is available online in PDF format at http://cep.npolar.no/docArchive/documents/CEPV/English/wp036e.pdf. For more information on the Madrid Protocol and its system for designating protected areas, go to http://cep.npolar.no/Content/about_cep/env_prot.htm.

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Designation expected soon: UK's first no-take zone for biodiversity

The waters of Lundy Island, 12 nautical miles off the southwest coast of the United Kingdom, are set to feature the UK's first statutory no-take zone for nature conservation purposes, pending approval by EU fisheries officials in early 2003. The 3.3-km^2 zone, banning all consumptive activities, would protect subtidal reefs on the island's eastern side. The reefs support fragile benthic species, including seafans and cup corals, and are regularly fished for crab and lobster. Although several closures already exist in UK waters for fisheries management and other purposes, the Lundy Island no-take zone would be the first enacted specifically to protect marine biodiversity. According to English Nature, the UK government agency responsible for wildlife conservation, the protection should enhance populations of fish and shellfish inside and outside the reserve, which could provide benefits to the local diving industry and fishermen. For more information: Chris Davis, English Nature (Devon), Level 2, Renslade House, Bonhay Road, Exeter, Devon EX4 3AW, United Kingdom. Tel: +44 01392 889; E-mail: chris.davis@english-nature.org.uk.

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Best-practice guidelines released for diving, other coral reef activities

The Coral Reef Alliance, a US-based NGO, has released a series of best-practice guidelines to provide a template for educating visitors and regulating activities at coral-based MPAs around the world. Designed to be adapted to specific local situations, the guidelines cover diving, snorkeling, turtle watching, underwater cleanups, and whale and dolphin watching. "The guidelines embrace the most commonly held management tenets for each activity covered," said Kalli De Meyer, former manager of Bonaire Marine Park and director of the guideline project. An international peer review body of experts in the field, including industry and MPA interests, approved each guideline. The guidelines are available online at http://www.coralreefalliance.org/parks/guidelines.html.

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CD-ROM provides data for MPA planning on Pacific coast of North America

As part of an intergovernmental effort to encourage creation of an MPA network along the Pacific coast of North America, a new CD-ROM is available to provide baseline physical, biological, and social data on the region. Produced by the Marine Conservation Biology Institute (MCBI), a US-based NGO, the CD-ROM covers the Pacific exclusive economic zones of Mexico, the US, and Canada, and includes such data as bathymetry, chlorophyll_a (a measure of primary productivity), and location of federal MPAs and ports. The tool is intended to inspire analyses and cooperation among conservation planners using ESRI ArcView 3.x and ArcGIS 8.x products. Development of the CD-ROM arose from an expressed need by the Baja California to Bering Sea Marine Conservation Initiative (B2B), coordinated by the trinational Commission for Environmental Cooperation of North America. To order the B2B 1.0 CD-ROM, available for US$25, contact Sara Maxwell, MCBI, 15805 NE 47th Court, Redmond WA 98052, USA. Tel: +1 425 883 8914; Fax: +1 425 883 3017; E-mail: sara@mcbi.org.

MPA News

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