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MONITORING
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MPA MONITORING PLAN

AUGUST 2011

About this Document

This document was developed to guide monitoring of marine protected areas (MPAs) in California's South Coast region. Through a regional MPA planning effort, thirty-six MPAs have been designated in this region, which includes state waters from Point Conception to the California/Mexico border, including the Channel Islands. In addition to the thirty-six new MPAs, an additional twelve pre-existing MPAs and two special closures were incorporated in the South Coast regional MPA network. The plan was developed by the MPA Monitoring Enterprise, in collaboration with the California Department of Fish and Game, and through consultations with stakeholders and scientists. It was adopted by the Fish and Game Commission on August 3, 2011.

The MPA Monitoring Enterprise has developed a new framework for MPA monitoring that meets MLPA requirements. The South Coast MPA Monitoring Plan applies the monitoring framework to the South Coast, taking account of the unique ecological and socioeconomic aspects of the region. The South Coast MPA Monitoring Plan is not a monitoring workplan or a monitoring implementation plan. Rather, it presents a framework and approach to monitoring that includes key metrics and monitoring questions, guidance for setting monitoring priorities, and guidance for designing a cost-effective, efficient and cohesive monitoring program for the South Coast region.

Citation: *South Coast MPA Monitoring Plan.* MPA Monitoring Enterprise, California Ocean Science Trust, Oakland, California, USA. August 2011.

About the MPA Monitoring Enterprise

The MPA Monitoring Enterprise was created in 2007 to lead the design and implementation of scientifically rigorous, impartial and cost-effective monitoring of the network of marine protected areas established in California under the Marine Life Protection Act. We develop monitoring that assesses and tracks the condition of ocean ecosystems and evaluates the effects of marine protected area design and management in order to measure the performance of marine protected areas in meeting policy goals and inform future management decisions. We work closely with the California Department of Fish and Game and the California Ocean Protection Council and engage scientists and stakeholders to ensure monitoring is based on the best available science, reflects public interests and meets management needs.

The MPA Monitoring Enterprise is housed within the California Ocean Science Trust, a non-profit organization established pursuant to the Coastal Ocean Resources Stewardship Act of 2000 to provide scientific guidance to the state on ocean policy issues. More information about the MPA Monitoring Enterprise can be found at www.monitoringenterprise.org.

South Coast
MPA Monitoring Plan

Developed to meet requirements of California's Marine Life Protection Act

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- Department of Fish & Game
- Fish & Game Commission
- Marine Life Protection Act Initiative
- Natural Resources Agency
- Ocean Protection Council
- State Coastal Conservancy

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EXECUTIVE SUMMARY

ROLE OF THIS PLAN

On December 15, 2010, the California Fish and Game Commission adopted a MPA network for the South Coast region. This region extends from Point Conception to the California/Mexico border, including the Channel Islands. The regional MPA network includes 36 new MPAs, and 12 pre-existing MPAs and 2 special closures at the Channel Islands that were incorporated unchanged into the regional network. The establishment of a regional MPA network is a step towards implementation of the 1999 California Marine Life Protection Act (MLPA, Chapter 10.5 of the California Fish & Game Code, §2850-2963). The Act directs the state to complete a statewide network of marine protected areas (MPAs). The MLPA also requires monitoring of MPAs to facilitate adaptive management of MPAs and ensure that the MPA network meets the goals of the Act.

This plan has been developed to guide monitoring of MPAs in the South Coast region that will meet MLPA requirements. It presents a framework for MPA monitoring and provides a flexible, scalable approach for implementing MPA monitoring, to make best use of available resources and potential partners. This plan has been developed by the MPA Monitoring Enterprise, in close collaboration with the California Department of Fish and Game, and through consultations with stakeholders and scientists. It was adopted by the California Fish and Game Commission on August 3, 2011 for inclusion in the MLPA Master Plan for Marine Protected Areas, thus formally establishing it as part of the policy guiding MLPA implementation.

The plan is not a monitoring workplan or a monitoring implementation plan. Rather, it presents a framework and approach to monitoring that includes guidance for setting monitoring priorities, selecting the scale at which monitoring will be implemented, and designing the sampling or data collection plan appropriately. The primary intended audiences for this plan are the Department of Fish and Game and the Fish and Game Commission, as well as MPA stakeholders, existing and potential partners in conducting MPA monitoring, and existing and potential funders of MPA monitoring.

This plan is intended to be a living document. Just as the MPAs will be managed adaptively, so should monitoring be evaluated and refined to ensure it continues to meet management needs, and this plan updated accordingly.

SETTING THE SCOPE OF MPA MONITORING

The scope of monitoring in each MLPA region is guided by the MLPA and the MLPA Master Plan. Under the MLPA, regional MPA networks must meet six goals, which include both ecological and socioeconomic goals. The broad scope of the MLPA goals leads to an ecosystem-based focus to MPA monitoring, which allows assessment of effectiveness of the MPAs in protecting populations, species, habitats, and ecosystems and explicitly includes humans.

The MLPA Master Plan, the principal policy document guiding implementation of the MLPA, recommends reviews of the MPAs at five-year intervals following their establishment, and calls for monitoring designed to support these reviews, so that monitoring is useful to managers and stakeholders for improving MPA management. This monitoring plan has been designed to result in clear and understandable reports that will be provided in advance of the recommended five-year reviews of the MPAs.

The South Coast MPA planning process included development of regional goals and objectives, as well as objectives for each individual MPA. Further, guidelines were developed for MPA size, spacing and other aspects of site and network design. Guidelines were also developed to consider water and sediment quality when siting or designing MPAs; because water quality evaluations are not mandated by the MLPA, these guidelines were considered secondary to other MLPA network design guidelines. This monitoring plan includes approaches to evaluating these different design guidelines and decisions.

To reflect these various policy elements and considerations, MPA monitoring should incorporate several design characteristics. It should be hierarchical, efficient, designed to generate interpretable and synthesizable data, and adaptable to reflect available resources and evolving management priorities. These design requirements, coupled with the policy guidance described above, guided the selection and construction of the basic monitoring elements that comprise the MPA monitoring framework. The MPA monitoring framework is designed to meet MLPA requirements in each MLPA region. Consistent application of the framework to each region will facilitate future comparisons among regions and contribute to assessment of the statewide MPA network, once complete.

In brief, the top level of the monitoring framework is the set of Ecosystem Features chosen to collectively represent and encompass an MLPA region, and human uses, for the purposes of focusing MPA monitoring. The Ecosystem Features provide the focus for two core monitoring elements: 1) Assessing Ecosystem Condition & Trends; and 2) Evaluating MPA Design & Management Decisions.

ADOPTING AN ECOSYSTEMS APPROACH

Ten 'Ecosystem Features' have been selected to collectively represent and encompass the South Coast region's ecosystems, for the purposes of MPA monitoring. The Ecosystem Features provide the overarching structure for MPA monitoring, and are:

- Rocky Intertidal Ecosystems
- Kelp & Shallow Rock Ecosystems (0-30m)
- Mid-depth Rock Ecosystems (30-100m)
- Estuarine & Wetland Ecosystems
- Soft-bottom Intertidal & Beach Ecosystems
- Soft-bottom Subtidal Ecosystems (0-100m)
- Deep Ecosystems, including Canyons (>100m)
- Nearshore Pelagic Ecosystems (i.e., the water column habitat within state waters, in depths >30m)
- Consumptive Uses
- Non-consumptive Uses

The Ecosystem Features provide the basis for assessing the condition of South Coast ecosystems, and how conditions change over time. They also guide the evaluation of MPA design and management decisions.

By reducing fishing, MPAs can lead to increases in the abundance and size of some fish and invertebrates within their boundaries; this initial effect of MPA implementation is one of the most widely demonstrated worldwide. The rates and magnitudes of population changes are likely to be influenced by historical levels of fishing in areas subsequently designated as MPAs as well as ongoing fishing activities inside MPAs that allow fishing and outside MPA boundaries. Such effects are detected by examining population trends before and after MPA implementation inside and outside MPAs and taking into account historical and current information on fishing activities. These methods allow, for example, examination of the extent to which the MPAs (as compared to other factors such as fisheries management measures) may or may not be contributing to any observed increases in fish size or numbers.

Ecological and socioeconomic changes following MPA implementation will occur in the context of variation in natural and anthropogenic influences. Therefore, in order to understand the effects of MPAs on these ecosystems, the analysis and interpretation of monitoring results will need to consider additional information from other monitoring programs and data sources. This information, referred to as contextual information, will include consideration of the natural influences of the physical environment, such as oceanographic conditions or substrate types, as well as human influences, such as economic conditions or land-use patterns.

The ecosystems approach and the specific ecosystem features selected have been designed to meet the requirements of MLPA, but may also directly benefit other programs, including fisheries management. For example, MPA monitoring will generate new, detailed data on relative abundances and size distributions of fishery species, which may be useful as inputs for population modeling by fishery scientists. The MPA monitoring approaches described in this plan are amenable to the addition of possible supplemental monitoring modules to provide additional, detailed information to support management and research priorities beyond the immediate requirements of the MLPA, such as supplemental fisheries, water quality or invasive species monitoring.

ASSESSING ECOSYSTEM CONDITION & TRENDS

Tracking ecosystem conditions over time will employ a 'status and trends' monitoring approach focused on the ten Ecosystem Features. For each Ecosystem Feature, two possible implementation options have been developed. Ecosystem Feature Assessments require technically demanding or otherwise comparatively resource-intensive monitoring methods. This monitoring option relies on the identification of key attributes, which are important aspects of the structure or functioning of the Ecosystem Feature, and indicators that provide insight into the condition of each key attribute. A second implementation option, which may be used instead of or in combination with Ecosystem Feature Assessment, is Ecosystem Feature Checkup. The Checkup option has been developed to take best advantage of potential community-based or citizen-scientist monitoring partnerships, and uses comparatively simpler sampling protocols and methods to monitor a set of vital signs.

These approaches are designed to build on the foundation of knowledge to be generated through the South Coast MPA Baseline Program. The Baseline Program will begin in 2011 and will extend through 2014, and has two complementary purposes: (1) to provide a summary assessment and understanding of ecological and socioeconomic conditions in the region at or near the time of MPA implementation and (2) to measure initial ecological changes and the short-run net benefits or costs to consumptive and non-consumptive user groups following MPA implementation.

The monitoring metrics have been chosen first and foremost to best meet the requirements of the MLPA. However, consideration has also been given to providing potential benefit to other programs without compromising the ability to meet MLPA monitoring requirements. For example, some fishery species have been chosen as metrics both because they will inform assessment of MPA effectiveness, and because information on these species may benefit fisheries management.

EVALUATING MPA DESIGN & MANAGEMENT DECISIONS

The establishment and on-going management of MPAs involve a number of decisions, ranging from design decisions made during the MPA planning process, such as MPA size and spacing, to day-to-day management decisions made to address ongoing and emerging issues, such as those related to managing visitors to MPAs. Monitoring includes evaluating the effects of selected design and management decisions on ecosystems and their components. These evaluations, together with assessments of ecosystem condition and trends, will be used to inform future management decisions, thus facilitating adaptive MPA management as required under the MLPA.

Evaluation of design and management decisions will employ a 'management effectiveness' monitoring approach that uses structured evaluations of the effects of specific MPA and MPA network design and management decisions on Ecosystem Features or Feature components. These evaluations must be carefully structured to ensure they generate conclusive results that can be used with reasonable confidence to inform management. Potential evaluations should be tested against this standard, and also ranked according to management urgency, direct relevance or applicability to management decisions, feasibility, time required for producing actionable results, and cost-effectiveness.

This monitoring element consists of two monitoring modules: short-term and long-term MPA design & management evaluations. Short-term evaluations are those expected to generate conclusive findings to inform MPA management decisions within four years (i.e. within the 5-year review cycles recommended in the MLPA Master Plan). Short-term evaluations are likely to focus on day-to-day MPA management decisions, such as those relating to visitor management, or on tightly focused evaluations of a particular MPA design decision on a specific and readily measured ecosystem component, such as the bycatch rates of a particular fishery that is allowed within an MPA. Long-term evaluations are those expected to take more than four years to generate conclusive findings, and are likely to include evaluations of fundamental site and network design decisions, such as those relating to MPA size and network connectivity. These evaluations will span multiple five-year review periods, and may need to be managed differently as a result.

Initial inventories of short-term and long-term evaluation questions have been developed, including many that are based on input from stakeholders during the development of the monitoring plan. These should be further refined at the time of monitoring implementation.

REPORTING MONITORING RESULTS

To facilitate adaptive MPA management, monitoring reports should include highly synthesized and interpretable results, presented as key conclusions or findings that clearly pertain to MLPA requirements, including assessing the regional MPA network's effectiveness in meeting MLPA goals and facilitating adaptive MPA management. Monitoring reporting should present key findings in intuitive ways, appropriately incorporate expert judgment needed to interpret complex and multidisciplinary data, and be timely relative to MPA management decisions and processes, such as the five-year reviews recommended in the MLPA Master Plan. Analysis and reporting of monitoring results should be transparent, with analytical methods and assumptions, as well as supporting data, made available for independent analysis.

Example 'mock-ups' showing possible pages of future monitoring reports are included in the monitoring plan to illustrate how a subset of monitoring results and findings may be presented. They depict an approach to reporting on ecosystem condition and trends, including a specific example of the Kelp & Shallow Rock Ecosystem Feature, as well as illustrating a way in which evaluations of MPA design and management decisions could be communicated, with both potential short- and long-term questions illustrated. Pages such as these would be accompanied by detailed supporting and technical information and analytical results.

Online technology solutions offer significant opportunity to maintain and share information about the MPAs and monitoring, including data, results, reports, etc. The Monitoring Enterprise is currently designing and building the first version of an online monitoring hub that will be an adaptable platform that can house, aggregate, analyze and present monitoring data and other information.

DEVELOPING MONITORING PARTNERSHIPS

This monitoring plan has been designed to facilitate development of partnerships to conduct and support monitoring of the South Coast regional MPA network. Potential partners are many, and include state and federal agencies, research

institutions, and citizen-science and community programs and organizations, among others. Partnerships may greatly assist with conducting MPA monitoring, interpreting monitoring results, and disseminating monitoring information, but must be carefully developed and maintained to be effective. This will require the development of monitoring partnership agreements, to clearly document the roles and responsibilities of each partner. As appropriate, partnership agreements should specify the monitoring data to be collected, methods to be employed, standards and formats for information to be provided, content and timing of reports, training of data collectors, and other details necessary to protect information quality.

The plan outlines further considerations for partnerships, focusing on those established to collect monitoring data, which are likely to be initial top priorities for implementation.

ESTIMATING COSTS OF MONITORING COMPONENTS

A key consideration for the implementation of this monitoring plan is financial cost. Existing monitoring programs provide a basis for estimating some of the potential costs of monitoring South Coast MPAs. Many of the MPA monitoring activities conducted in the Channel Islands, North Central and Central Coast MPAs are similar to some that are included in this monitoring plan. Other MPA and non-MPA programs in California also conduct activities that are similar to some of those included in this plan.

The financial costs of implementing many of the potential monitoring components have been estimated based on information from these existing programs, adjusted as needed to apply to the South Coast region or to the specific array of adopted MPAs. These estimates include costs to collect, analyze, and report monitoring results for potential individual monitoring components. Cost estimates include standard components of funded projects such as overhead costs but do not include leveraged or matched funds. Leveraging resources and taking advantage of existing expertise and capacity in the region will be important in implementing monitoring cost-effectively. The cost estimates assume that leveraged funds will be available to provide additional support for monitoring activities, using existing programs and cost-sharing arrangements as a model.

These cost estimates for potential monitoring components are used to develop recommended monitoring priorities and guide development of an effective and coherent MPA monitoring program that will meet MLPA requirements in an efficient, cost-effective fashion.

BUILDING AN EFFECTIVE MPA MONITORING PROGRAM

Each of the two core elements of the monitoring framework (i.e., Assessing Ecosystem Condition & Trends and Evaluating MPA design & Management Decisions), is implemented through selection of modules from within each element. The modules for assessing ecosystem condition and trends are the Ecosystem Features that have been identified for a region. The modules for evaluating MPA design and management decisions are the short-term and long-term evaluation categories. All modules have been designed to be stand-alone components of monitoring and may be scaled to reflect available resources.

Two example monitoring programs have been developed, illustrating the selection and scaling of monitoring modules. The programs have been designed to reflect two hypothetical regional MPA monitoring budget scenarios, of $1,000,000 and $2,000,000 annually. A spending plan has been developed for each scenario, depicting the monitoring activities to be conducted in each of four data collection years, leading to analysis and reporting in the fifth year, in order to inform the five-year reviews recommended by the MLPA Master Plan.

The spending plans reflect all guidance provided in this monitoring plan, and also reflect priorities identified during consultations with stakeholders in the region. The spending plans assume implementation of MPA monitoring using the partnerships approach and reflecting the cost estimates developed from existing monitoring programs. The spending plans allocate the available budget ($1,000,000 or $2,000,000 annually) to collect, analyze and report monitoring results, but do not include all possible costs of monitoring implementation. As noted earlier, the cost estimates for individual components of monitoring assume leveraging of funds comparable to MPA monitoring programs conducted to date, such as in the Channel Islands, the North Central and Central Coast regions. Additionally, Department of Fish and Game core costs, such as for staff, are not included. Nonetheless, the spending plans include the majority of anticipated new costs of MPA monitoring in the South Coast region, tailored to take best advantage of the two hypothetical budget scenarios.

Both spending plans implement only strategically selected portions of the full scope of MPA monitoring included in this monitoring plan. Nonetheless, both include assessment of priority Ecosystem Features and provide for select short- and long-term evaluations of MPA design and management decisions. Thus, both spending plans meet MLPA requirements, as they will enable assessment of the MPA network's effectiveness in meeting MLPA goals and facilitate adaptive MPA management.

FREQUENTLY ASKED QUESTIONS

1. What is the role of this document?

This document provides a scientifically based framework and approach to guide monitoring of MPAs in the South Coast region, along with options and recommendations for implementation. The approach and framework form the basis of the South Coast MPA Baseline Program and are designed to guide implementation of long-term MPA monitoring in the region.

This document is not a monitoring workplan or a monitoring implementation plan. Rather, it presents a framework and approach to monitoring that includes guidance for setting monitoring priorities, selecting the scale at which monitoring will be implemented and designing the sampling or data collection plan appropriately.

2. Who are the intended audiences for this document?

This document has been developed to provide guidance to the Department of Fish and Game, as the agency with statutory authority for implementing the Marine Life Protection Act (MLPA), and for the Fish and Game Commission, as the decision-making entity designated under MLPA. Other key audiences for this document include MPA stakeholders, existing and potential partners in conducting MPA monitoring, and existing and potential funders of MPA monitoring.

3. How and when will this plan be implemented?

The approach and framework forming the core of this monitoring plan are being implemented initially though the South Coast MPA Baseline Program, which will begin in 2011 and will continue through 2014. Long-term monitoring will follow, building on the foundation established by the Baseline Program (see Question 5), and will be implemented when resources become available.

4. Who will oversee and manage MPA monitoring?

Under the MLPA, the Department of Fish and Game has statutory authority for implementing MPAs. The Department has an existing infrastructure in place within its Marine Region MPA Project that will be a source for the oversight and management of MPA monitoring. Additionally, through partnerships, the Department can augment its existing resources for MPA monitoring.

5. Is this monitoring plan related to the South Coast MPA Baseline Program?

Yes. This plan describes the approach and framework for monitoring that underpins both the Baseline Program and long-term monitoring. Long-term monitoring will build on the foundation of information and knowledge to be developed through the Baseline Program, which will begin in 2011 and continue through 2014.

The Baseline Program was developed to address the most time-sensitive aspects of MPA monitoring, specifically: (1) to provide a summary assessment and understanding of ecological and socioeconomic conditions in the region at or near the time of MPA implementation; and (2) to measure initial ecological changes and the short-run net benefits or costs to consumptive and non-consumptive user groups following MPA implementation. Findings from the Baseline Program will be used to refine the long-term monitoring metrics and inform implementation of long-term monitoring.

The Ocean Protection Council has authorized $4M to support the South Coast MPA Baseline Program. A Request for Proposals (RFP) to implement the program was released by California Sea Grant in February, 2011 and proposals were due April 7, 2011. Proposals received in response to the RFP are undergoing review of their scientific and technical merits, alignment with the purposes of the Baseline Program, and cost. More information is available on the California Sea Grant website at www.csgc.ucsd.edu.

6. What are the core elements of MPA monitoring?

The MPA monitoring framework is organized around Ecosystem Features, which are selected in consultation with stakeholders and scientists to collectively represent and encompass the marine ecosystems and human uses in an MLPA region. The Ecosystem Features provide the top level of the monitoring framework, which includes two core monitoring elements: 1) Assessing Ecosystem Condition & Trends; and 2) Evaluating MPA Design & Management Decisions.

Assessment of ecosystem condition and trends will be used to track the state of marine ecosystems, including human activities, in the South Coast region, and how they change over time inside and outside the MPAs. Evaluations of specific MPA design and management decisions, such as MPA size and spacing, will examine the effects of these decisions on Ecosystem Features or ecosystem components. Collectively, these monitoring elements will provide information to assess progress in achieving MLPA goals, and support future adaptive management decisions.

Each core element is designed to be adaptable to best fit with available resources and capacity at the time it is implemented. For example, two options have been included for monitoring ecosystem condition through time: Ecosystem Feature Checkups are designed to be implemented through partnerships with citizen-science groups and community organizations, while Ecosystem Feature Assessments are designed to take advantage of technically robust monitoring partnerships such as among state agencies and with federal agencies and research institutions.

In order to correctly interpret monitoring results from these two core elements, it will be important to consider other types of information, referred to as contextual information. This includes, for example, oceanographic, water quality, and economic information. Linkages and information exchanges with programs collecting contextual information are explicitly provided for in the plan.

7. Does this plan include monitoring of MPA enforcement and compliance?

No, not directly. However, information about MPA compliance will be essential for correctly interpreting monitoring results. MPA enforcement and compliance monitoring is the responsibility of the Department of Fish and Game and will be conducted by the Department and its potential partners. All available compliance information will be used during analysis and interpretation of monitoring results.

8. Does this plan include fisheries monitoring as part of MPA monitoring?

Yes. Fisheries monitoring is required to assess the effectiveness of the MPAs and to meet the requirements of the MLPA. The MPA monitoring plan incorporates monitoring of socioeconomic and ecological aspects of consumptive human activities, including commercial and recreational fishing. For example, monitoring of the spatial distribution, landings, catch per unit effort (CPUE), and economic value of commercial and recreational fisheries is included, focusing on economically and ecologically important species in the region. This information can be obtained through use of existing fisheries data as well as collection of new data at the spatial resolution necessary to detect potential MPA effects. In addition, monitoring of ecological characteristics, such as density and size structure, of selected fishery

species is also included. MPA monitoring thus overlaps with but does not encompass all monitoring required for fisheries management purposes.

9. Will information collected through MPA monitoring also inform fisheries management?

Yes. MPA monitoring metrics have been chosen to benefit fisheries management as much as possible without compromising the ability to meet MLPA requirements. For example, many of the focal species selected for MPA monitoring are fished species, including some unassessed species. Both the South Coast MPA Baseline Program and long-term monitoring will collect ecological data, including abundances and size distributions for important fishery species, as well as socioeconomic data, such as the status of and changes in commercial and recreational fisheries. The plan also includes monitoring of key aspects of commercial and recreational fisheries that can inform fisheries management. However, MPA monitoring alone is not intended to be sufficient to support fisheries management.

10. Does this plan consider water quality?

Yes. Some species that are sensitive to water quality are included in the monitoring plan. Direct measurement of pollutant or contaminant levels and other more comprehensive water quality monitoring is beyond the scope of this monitoring plan. However, water quality information will be essential for correctly interpreting monitoring results. Linkages with programs monitoring water quality in the South Coast region are provided for in the plan to ensure exchange of information and inform analysis of MPA monitoring data.

11. Does this plan consider climate change?

Yes. Some species that are expected to be sensitive to possible climate change effects (e.g., changes in sea surface temperatures or ocean acidification) are included in the monitoring plan. Direct monitoring of possible climate change effects, such as ocean acidification and changes in the strength or timing of upwelling events, is beyond the scope of MPA monitoring. However, such information will be important for correctly interpreting monitoring results, and available information will be used during the analysis of monitoring data.

12. Does this plan consider the dynamic nature of marine ecosystems?

Yes. The monitoring plan recognizes the natural spatial and temporal variation in ecosystems and ecosystem components, and this has been considered in the design of monitoring and the selection of monitoring metrics. Collection and analysis of time series data will be essential to reveal trajectories of ecosystem change inside and outside MPAs, and to assess potential MPA effects in a naturally variable system. In addition, analysis of monitoring data will take into account contextual information on oceanographic conditions and trends.

13. How many MPAs will be monitored and how often?

The number of MPAs that will be monitored and the frequency of monitoring will depend on available resources, management priorities at the time of implementation and the specific monitoring methods employed. The Baseline Program (see Question 5) will encompass as many MPAs as possible to provide a robust foundation to inform and support long-term monitoring. For long-term monitoring, specific MPAs to be monitored will be selected when long-term monitoring is implemented.

14. What is the cost of MPA monitoring?

The monitoring framework and approach are designed to be scalable to fit available resources, and to be cost-efficient through development of monitoring partnerships, all while meeting MLPA requirements. The Ocean Protection Council has provided $4M to help support collection and analysis of baseline data (see Question 5). Baseline program monitoring is augmented through matching funds and other cost-sharing arrangements, which are required of all funded projects.

This plan includes two example long-term monitoring programs. The programs have been designed to reflect two hypothetical regional MPA monitoring budget scenarios, of $1,000,000 and $2,000,000 annually. A spending plan has been developed for each scenario, depicting the monitoring activities to be conducted in each of four data collection years, leading to analysis and reporting in the fifth year, in order to inform the five-year reviews recommended by the MLPA Master Plan. The spending plans include the majority of anticipated new costs of MPA monitoring in the South Coast region, using existing programs and cost-sharing arrangements as a model for assuming that leveraged funds will be available to provide additional support. Both spending plans implement only strategically selected portions of the full scope of MPA monitoring included in the monitoring plan. Nonetheless, both include assessment of priority Ecosystem Features and provide for select short- and long-term evaluations of MPA design and management decisions. Thus, both spending plans meet MLPA requirements, as they will enable assessment of the MPA network's effectiveness in meeting MLPA goals and facilitate adaptive MPA management.

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1. Introduction

- Role of this plan
- Scope of this plan
- How this plan was developed

The Marine Life Protection Act (MLPA), passed by the California legislature in 1999 (Chapter 10.5 of the California Fish and Game Code, §2850-2963), directs the state to reevaluate and redesign California's system of marine protected areas (MPAs). The MLPA also requires monitoring of MPAs, specifically "monitoring, research, and evaluation at selected sites to facilitate adaptive management of MPAs and ensure that the [MPA] system meets the goals [of the MLPA]".[1] The MLPA Master Plan for Marine Protected Areas (the MLPA Master Plan), the principal policy document guiding implementation of the MLPA, directs that MPA monitoring programs be developed sequentially as planning is completed for each region.[2] The regional MPA network for the South Coast region was adopted by the California Fish and Game Commission on December 15, 2010. Accordingly, this plan has been developed for monitoring MPAs in the South Coast region to meet MLPA requirements.

ROLE OF THIS PLAN

This plan has been prepared by the MPA Monitoring Enterprise, a program of the non-profit California Ocean Science Trust, in close collaboration with the California Department of Fish and Game, scientists, and stakeholders. It is intended as guidance for the Department of Fish and Game and others involved in conducting or supporting MPA monitoring in the South Coast region.

Under the MLPA, monitoring must facilitate adaptive management of MPAs, which means it must lead to the development of monitoring results and reports that are timely and useful for policy-makers, resource managers, stakeholders, scientists, and other participants in MPA management decisions and processes. In particular, monitoring should be designed to provide useful information to support the five-year reviews of the MPAs that are recommended in the MLPA Master Plan. This monitoring plan has been designed to meet these requirements.

The South Coast MPA Monitoring Plan is not a monitoring workplan or a monitoring implementation plan. Rather, it presents a framework and approach to monitoring that includes guidance for setting monitoring priorities, including prioritizing the elements of monitoring to be implemented, selecting the scale at which prioritized elements will be implemented and designing the sampling or monitoring data collection plan appropriately.

This plan is being implemented in two stages: 1) the South Coast MPA Baseline Program which began in 2011 and will continue through 2014 and was implemented through a Request for Proposals (RFP) process (see below); and 2) long-term monitoring. To implement long-term monitoring, this plan may be used to develop an 'implementation plan'. An implementation plan should consider the resources available to implement monitoring, timescales for monitoring implementation, management priorities and the technical guidance in this plan to build a coherent monitoring program. Chapter 9 of this document provides specific recommendations for building and implementing an effective monitoring program. It also provides more specific guidance on the potential content of an implementation plan and recommendations for approaches to develop an implementation plan using the guidance in this document.

[1] Fish and Game Code section 2853(c)(3). See also sections 2852(a) and 2856(a)(2)(H).
[2] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 73.

The primary intended audiences for this plan are the California Department of Fish and Game and the California Fish and Game Commission, as well as MPA stakeholders, existing and potential partners in MPA monitoring, and existing and potential funders of MPA monitoring.

This plan is intended to be a living document. Just as the MPAs will be managed adaptively, so should monitoring be evaluated and refined to ensure it continues to meet management needs. Monitoring priorities, approaches, and methods should evolve as appropriate to reflect increasing knowledge and respond to changes in the environment or management priorities. Each recommended five-year review will provide a good opportunity to not only adapt monitoring to reflect these changes in knowledge and priorities, but also to critically evaluate the effectiveness of monitoring itself. Following these evaluations, and reflecting on lessons learned, updates can be made to this plan and associated implementation plans.

SCOPE OF THIS PLAN

This plan has been designed for the monitoring of MPAs in the South Coast region, which includes all state waters from Point Conception in Santa Barbara County to the California/Mexico border in San Diego County, including the Channel Islands (see map in Appendix C-1). The regional MPA network, adopted by the Fish and Game Commission on December 15, 2010, includes 36 new MPAs covering a total of 8% of the state waters in the region, plus an additional 12 pre-existing MPAs and two special closures in the northern Channel Islands, encompassing a further 7% of the state waters in the region. The pre-existing MPAs at the northern Channel Islands, which were not altered during the MPA planning process, were incorporated into the South Coast regional MPA network.

This plan considers all MPAs and special closures in the region, providing for monitoring inside and outside MPAs. The MPA network adopted by the Fish and Game Commission is comprised of MPAs of two different types (state marine reserves (SMRs) and state marine conservation areas (SMCAs)), plus additional special closures.[3] SMRs prohibit fishing and other extractive uses, while allowing research, education and non-consumptive uses consistent with the protection of marine resources**.** SMCAs allow a range of uses, including specified fishing and other extractive activities. A number of SMCAs may later be converted into State Marine Parks (SMPs). Finally, special closures are year-round or seasonal closures to human access designed to help protect sea bird nesting, breeding, and roosting areas and/or pinniped rookeries and haul-outs.

There are also several military use areas and federal Safety Zones in the region, which are managed by the Department of Defense. While falling outside of the direct purview of the MLPA, these areas may be monitored using the approaches and recommendations within this plan through partnerships and agreements with the Department of Defense.

APPLYING THE MONITORING FRAMEWORK TO THE SOUTH COAST REGION

The MPA Monitoring Enterprise, in collaboration with the Department of Fish and Game, has developed a framework for MPA monitoring that meets MLPA requirements. This framework was first applied in the North Central Coast region and was adopted by the Fish and Game Commission as part of the monitoring plan for that region. This South Coast MPA Monitoring Plan applies the monitoring framework to the South Coast, taking account of the unique aspects of the region.

A schematic diagram of the monitoring framework is provided in Figure 1-1. Each element of the framework is further described and applied to the South Coast region in the subsequent chapters of this plan. In brief, the top level of the monitoring framework is the set of Ecosystem Features chosen to collectively represent and encompass an MLPA region, and human uses, for the purposes of focusing MPA monitoring. The Ecosystem Features provide the focus for two core

[3] Definitions of each MPA classification are available in the Public Resources Code (PRC) Section 36700 and 36710.

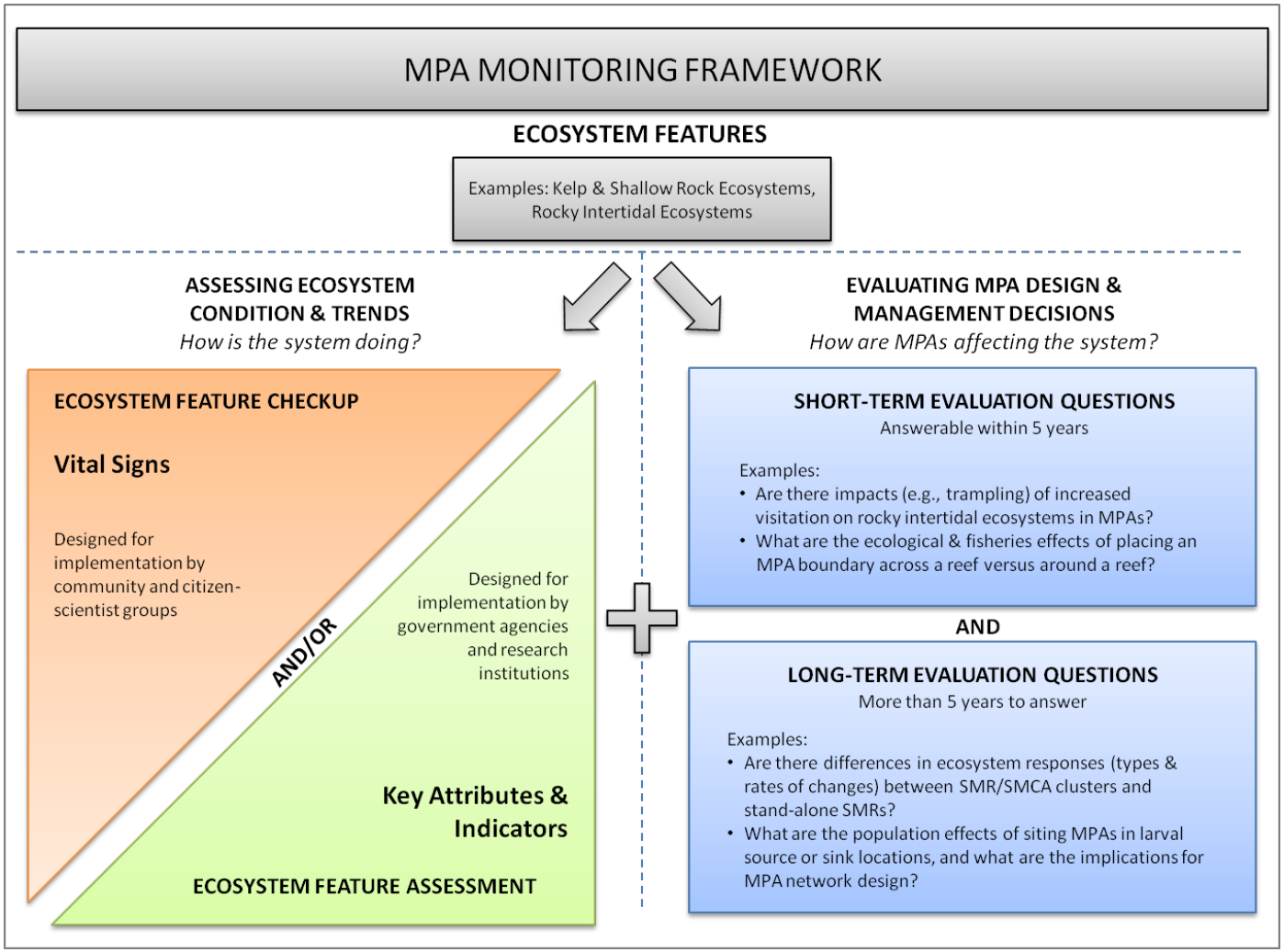


Figure 1-1. *Schematic diagram of the MPA Monitoring Framework showing the two principal monitoring elements: 1) Assessing Ecosystem Condition & Trends; and 2) Evaluating MPA Design & Management Decisions. Ecosystem condition and trends may be monitored using Ecosystem Feature Checkups, which employ monitoring metrics called vital signs, or through Ecosystem Feature Assessments, which employ key attributes and indicators or focal species as monitoring metrics. MPA design and management decisions are evaluated through answering targeted questions, including both short-term questions, expected to be answered within four years (one monitoring and reporting cycle), and long-term questions, expected to take longer than four years to answer. Monitoring is focused using ten Ecosystem Features, which collectively represent and encompass the South Coast region's ecosystems, including humans, and is designed to deliver useful results in advance of the five-year MPA reviews recommended by the MLPA Master Plan.*

MPA monitoring elements: 1) assessment of ecosystem condition and trends; and 2) evaluation of specific MPA design and management decisions. Assessment of ecosystem condition and trends will track the state of marine ecosystems, including human activities, in the South Coast region, and how they change over time inside and outside the MPAs. Evaluations of specific MPA design and management decisions, such as MPA size and spacing, will examine the effects of these decisions on Ecosystem Features or Ecosystem Feature components. Collectively, the two core monitoring elements will provide information to assess progress in achieving MLPA goals, and facilitate future adaptive management decisions.

The monitoring framework as applied through this plan has been designed to reflect the scope of the MLPA. This plan includes fisheries monitoring components that will allow assessment of the regional MPA network's effectiveness in meeting MLPA goals. It considers water quality, invasive species, and climate change through inclusion of some monitoring metrics expected to be sensitive to these influences. However, this plan is intended to complement, and not duplicate, monitoring capacities and responsibilities that are beyond the remit of the MLPA and are resident in other programs. Linkages and information exchanges with other programs will nonetheless be essential for effective MPA monitoring and assessment. During analysis of monitoring results, information from other monitoring programs, such as fisheries and water quality monitoring, will be critical for correctly interpreting MPA information. MPA monitoring findings may also provide useful information for those programs. Two-way information exchanges with these programs will be developed to ensure the best use of information collected.

BUILDING ON THE SOUTH COAST MPA BASELINE PROGRAM

This plan provides the framework for both the South Coast MPA Baseline Program and for subsequent, long-term monitoring of the regional network. Much of the detailed guidance in this plan focuses on providing options for long-term monitoring, building on the foundations of information and knowledge to be developed through the Baseline Program. The Baseline Program began in 2011 and will extend through 2014. Additional details are provided in Chapter 4 and in the Request for Proposals (Appendix C-2), but, in brief, the Baseline Program was developed to address the most time-sensitive aspects of MPA monitoring, which are:

1. To provide a summary description, assessment and understanding of ecological and socioeconomic conditions in the South Coast region, inside and outside MPAs to be designated under MLPA, at or near the time of MPA implementation; and
2. To measure initial ecological changes and the short-run net benefits or costs to consumptive and non-consumptive user groups following MPA implementation.

Findings from the baseline projects, once complete, will contribute to the evaluation and refinement of this plan, which is anticipated to occur in association with the first of the five-year reviews of the South Coast MPAs recommended in the MLPA Master Plan, currently expected to take place in 2016.

BUILDING ON ESTABLISHED FOUNDATIONS, KNOWLEDGE & EXPERIENCE

California is home to long-standing MPA monitoring programs that include university, local, state, and federal government programs, as well as citizen science programs. For example, an MPA monitoring program was developed in the northern Channel Islands following implementation of an MPA network there in 2003. The Channel Islands MPA monitoring program was designed to address the goals of the Channel Islands MPAs, which were not established under the MLPA and so have different goals from MPAs designated under the Act. Additionally, the design of the Channel Islands MPA monitoring program was focused on expanding pre-existing monitoring projects to include the new MPAs. The knowledge and experience gathered through Channel Islands MPA monitoring has helped shape the recommendations in this plan. In

particular the data collected through the Channel Islands MPA monitoring will be used to contribute to, and strengthen, a baseline characterization of the South Coast region as part of the South Coast MPA Baseline Program.

This plan has also built upon experience with monitoring in support of the Baseline Programs in the North Central and Central Coast regions. The Central Coast regional MPA network, implemented under the MLPA, was established in 2007. Baseline monitoring was conducted in this region, including a socioeconomic assessment and collection of ecological data, primarily in 2007 and 2008. The North Central Coast MPA Baseline Program is currently in progress. MPAs in the North Central Coast were implemented in 2010 and the Baseline Program extends from 2010 to 2013. Programs in both of these regions have provided valuable information and experience, helping to shape monitoring planning in the South Coast region.

In addition, numerous on-going monitoring programs, as well as extensive historical data sets, exist in the South Coast region, including programs and data sets associated with fisheries and water quality programs (see Appendix C-7). The framework and approaches to monitoring described in this plan are designed to take best advantage of the opportunities for building partnerships with existing monitoring programs. More information and guidance for establishing partnerships is provided in Chapter 7 of this plan.

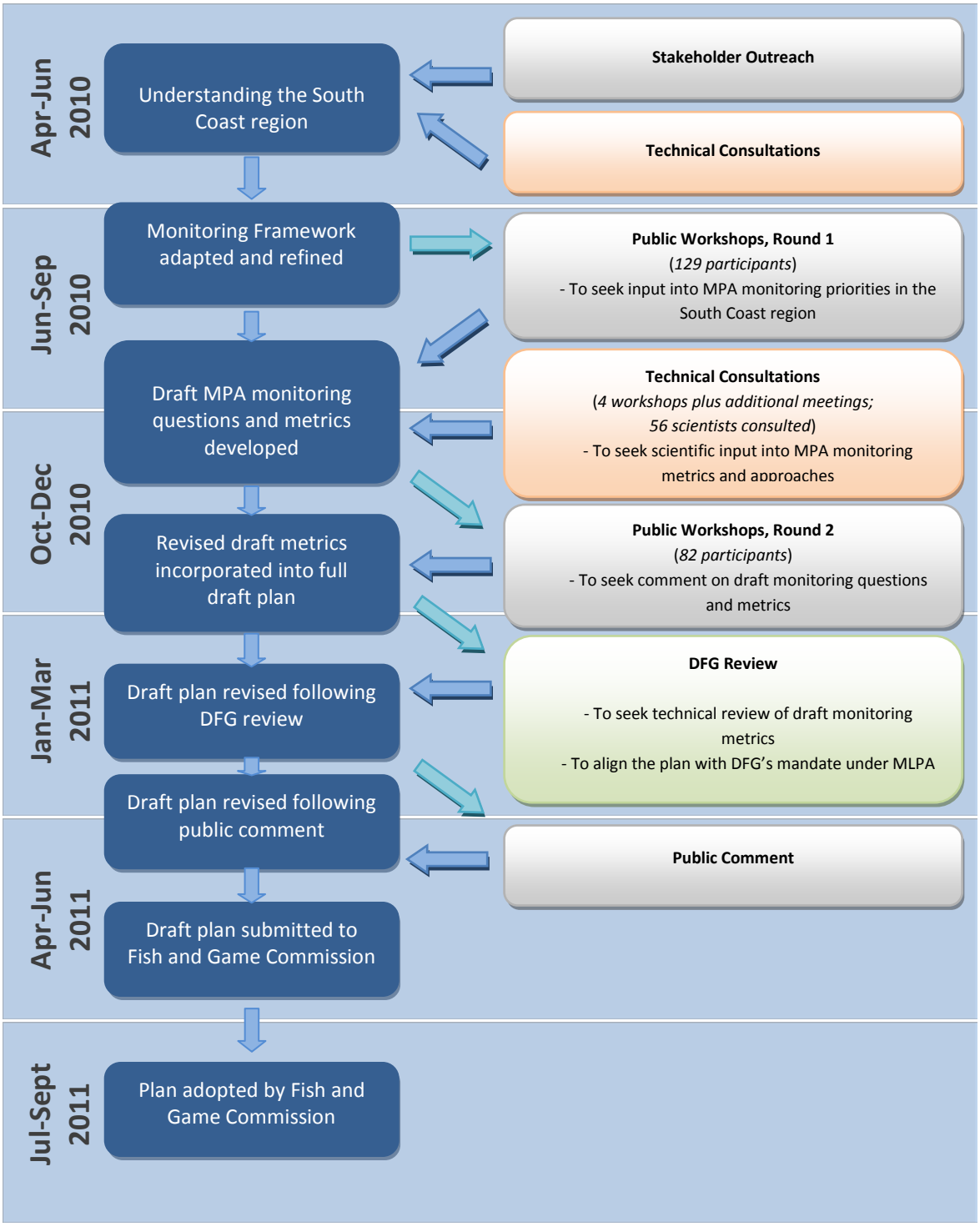
HOW THIS PLAN WAS DEVELOPED

In April 2010, the Monitoring Enterprise began a consultative process to develop this monitoring plan. As a first step in understanding stakeholder perspectives on MPA monitoring in the region, interviews were conducted with former members of the South Coast Regional Stakeholder Group and developers of external MPA arrays during the South Coast MLPA planning process. To better understand the existing expertise, programs, and data in the region, the region's ecology and socioeconomics, and implications of the South Coast MPA planning process, we also consulted academic and agency scientists working in the South Coast region.

In July 2010, the Monitoring Enterprise, in collaboration with the Department of Fish and Game, convened a first round of public workshops in the South Coast region. In order to facilitate participation by stakeholders living in different parts of the South Coast region, three workshops were held, all of which were open to the public and followed the same agenda and format. The objectives of the first round of workshops were to understand stakeholder perspectives on and priorities for MPA monitoring (see Appendix C-3 for locations, agenda and workshop summary). Following this round of workshops, and in consideration of the input received, the Monitoring Enterprise consulted with scientists and other technical experts to develop preliminary monitoring metrics that incorporated the best available science and reflected stakeholder priorities. In November 2010, a second round of public workshops was held to present, discuss and receive written comments on the draft monitoring metrics (see Appendix C-4 for locations, agenda and workshop summary). Following this workshop, the draft metrics were revised in consideration of comments received.

In early 2011, a first draft of the South Coast MPA Monitoring Plan was reviewed by the California Department of Fish and Game. This review encompassed both a technical review of the monitoring metrics, as well as review of the plan's alignment with the Department's management priorities and policy mandates. Following revision in response to Department of Fish and Game review, the draft South Coast MPA Monitoring Plan was released for public comment from April 27 – May 27, 2011. The Monitoring Enterprise carefully considered all comments received in revising the draft plan, which was presented to the Fish and game Commission on June 29, 2011. This plan was adopted by the California Fish and Game Commission on August 3, 2011, and approved for inclusion in the MLPA Master Plan for Marine Protected Areas, thus formally establishing it as part of the policy guiding MLPA implementation.

Figure 1-2. *Major steps in the development of the South Coast MPA Monitoring Plan.*



2. Setting the Scope of MPA Monitoring

- Policy guidance for MPA monitoring
- Design requrements for the MPA monitoring framework
- Key elements of the MPA monitoring framework
- Applying the framework to the South Coast region

The scope of monitoring in each MLPA region is guided by the MLPA and the MLPA Master Plan. This chapter describes how these overarching policy documents were used to develop key characteristics of the MPA monitoring framework. Application of the framework to the South Coast region also means taking account of the guidance developed and decisions made during the MPA planning process for this region. This information is used to refine the framework as needed to reflect the key and unique aspects of the South Coast region.

POLICY GUIDANCE FOR MPA MONITORING

MPA MONITORING WITHIN AN ADAPTIVE MANAGEMENT FRAMEWORK

MPA monitoring is one step in a larger cycle of MPA implementation and management. Monitoring follows MPA establishment and provides feedback on the effects of MPA management. Thus, as management actions are evaluated, the results are used to improve management over time. Attention to this context ensures that monitoring is deliberately designed and timed to feed into the adaptive management loop. An example of an adaptive management cycle is shown in Figure 2-1, annotated to indicate application to the context of the MLPA.

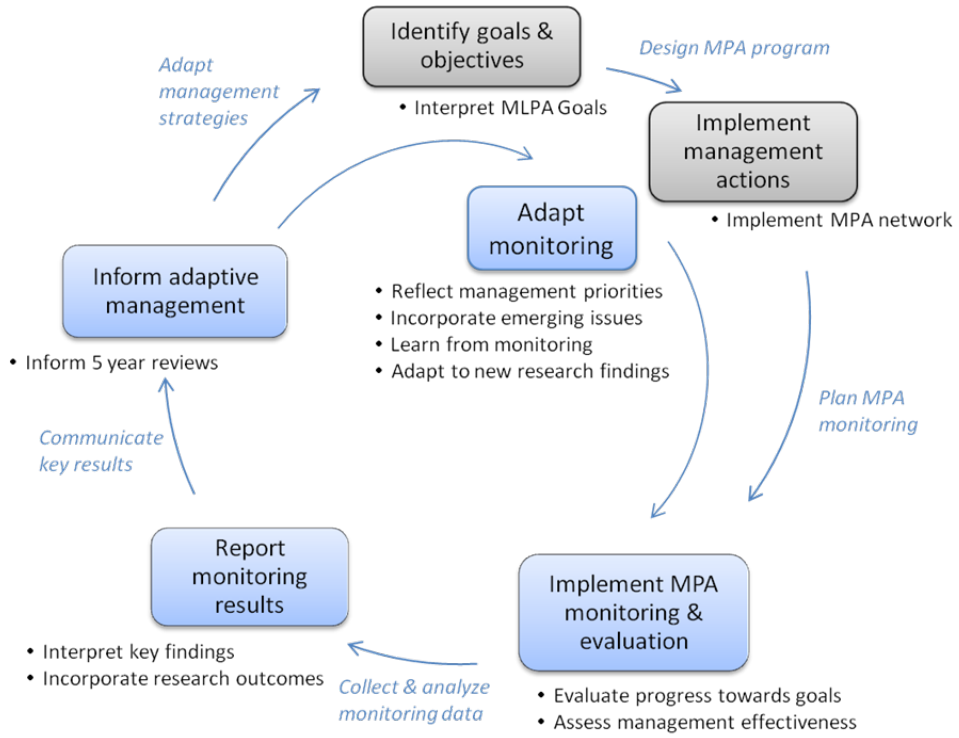


***Figure 2-1**. An illustration of the adaptive management process, annotated to show application to the MLPA context. Monitoring must be designed to evaluate management actions in order to inform management review and adaptation. In addition, monitoring itself must be adapted periodically to remain relevant and useful.*

THE MARINE LIFE PROTECTION ACT (MLPA)

The MLPA requires "…monitoring, research, and evaluation at selected sites to facilitate adaptive management of MPAs and ensure that the [MPA] system meets the goals stated in this chapter". [4] The specific MLPA goals and their implications for monitoring are discussed below.

MLPA Goal 1: Protect the natural diversity and abundance of marine life, and the structure, function and integrity of marine ecosystems.

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

Goals 1 and 2 clearly require ecological monitoring using indicators and other metrics chosen to provide information about populations, species, and ecosystems. Of these, ecosystems provide the overarching umbrella, as the highest level of organization of the system, and thus provide the top level of the monitoring hierarchy.

MLPA Goal 3: 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.

Goal 3 requires a type of socioeconomic monitoring to determine whether and to what extent opportunities have improved, with a linkage to ecological monitoring to assess the effectiveness of management in protecting biodiversity.

MLPA Goal 4: Protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic values.

Goal 4, as interpreted through the MPA planning process, requires that habitats be monitored. This will be achieved through selecting indicators and other metrics to assess habitats identified for protection in MPAs by the South Coast Science Advisory Team during the planning process for the region.

MLPA Goal 5: Ensure California's MPAs have clearly defined objectives, effective management measures and adequate enforcement and are based on sound scientific guidelines.

The MPA planning process included definition of rationales for each MPA, and development of scientific guidance for the design of individual MPAs and the South Coast regional network. The effectiveness of management measures will be evaluated through assessment of the performance of the regional MPA network in meeting its goals. Enforcement will be implemented by the Department of Fish and Game with assistance from appropriate partners. Information on MPA compliance will be used to help evaluate and assess monitoring results.

MLPA Goal 6: Ensure the State's MPAs are designed and managed, to the extent possible, as a network.

The MPA planning process explicitly focused on designing a South Coast regional MPA network, as a step in establishing the statewide MPA network required under MLPA. The monitoring approaches recommended in this plan have been designed to allow assessments of the performance of the regional network as a whole, as well as of the individual

[4] California Marine Life Protection Act, Statutes 1999, Chapter 1015, Fish and Game Code section 2853(c)(3). See also sections 2852(a), and 2856(a)(2)(H).

MPAs that will be monitored. Approaches for assessing specific network functions, such as connectivity, are also included in this plan.

THE MLPA MASTER PLAN FOR MPAS

The MLPA Master Plan states that MPA monitoring and evaluation 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
- holistic through a focus on both natural and human perspectives.[5]

This monitoring plan meets these requirements by:

- enabling assessment of the effectiveness of the South Coast regional MPA network in meeting its goals, thus providing essential information to managers and stakeholders for future management decisions
- providing recommended monitoring priorities that can be tailored to make best use of available resources, including through development of monitoring partnerships
- reflecting stakeholder input gathered through workshops (see Workshop 1 Overview and Workshop 2 Overview, Appendices C-3 and C-4, respectively)
- including assessments of individual MPAs throughout the region and of the regional network as a whole, which will ultimately contribute to assessment of the statewide MPA network, when complete
- including both ecological and socioeconomic monitoring, and by explicitly considering humans as part of the ecosystem

The MLPA Master Plan also states "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", and that "a comprehensive analysis of monitoring results should be conducted approximately every five years".[6] This monitoring plan has been designed to result in clear and understandable reports that will be provided in advance of the five-year reviews of the MPAs recommended in the MLPA Master Plan.

THE SOUTH COAST MPA PLANNING PROCESS

During the MPA planning process, goals and objectives for the South Coast regional MPA network were developed, based on the statewide goals expressed in the MLPA (see Appendix C-5). These regional goals and objectives, together with the associated design and implementation considerations, have helped guide the development of this monitoring plan, and led to several specific planning steps and monitoring elements, including:

- stakeholder workshops and public comments on the draft monitoring plan (see for example Goal 5, Objective 2)
- inclusion of socioeconomic monitoring of consumptive and non-consumptive human uses inside and outside MPAs (see for example Goal 3, Objective 1)
- specific provisions for potential citizen-science or community-based contributions to monitoring (see for example Goal 3, Objective 3).

[5] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 74.
[6] Ibid. p. 75.

In addition, site-specific objectives were developed for each individual MPA, linked to the regional goals and objectives. As monitoring activities and programs are being carried out in specific MPAs, measurable site-level objectives will be cross-referenced with monitoring protocols to ensure maximum feasible coverage of the objectives in monitored sites.

This monitoring plan was also informed by the list of species 'likely to benefit' from the MPAs (Appendix C-6). The South Coast Science Advisory Team (SCSAT) identified these species as likely to show a detectable change in local population as a result of MPA implementation. This list was used to identify and select species for monitoring that contribute to assessment of ecosystem condition and trends.

During the planning process, scientific guidelines were developed to shape design of the regional network, including guidelines for the size of individual MPAs, the distance between adjacent MPAs, and levels of protection of MPAs (Appendix C-8) that reflect the allowed activities in a given site[7]. In addition, the SCSAT developed guidelines to consider water and sediment quality concerns within proposed MPAs. Water quality evaluations are not mandated by the MLPA and were considered secondary to other MLPA network design guidelines. This monitoring plan includes approaches to evaluating these different design guidelines and decisions. Such assessments will take time and careful design to generate results that are sufficiently robust to guide future management decisions. Additional background information on the best readily available science and information used in the MPA planning process, including information on beach manipulation, wetland and eelgrass restoration activities and military use areas and activities can be found in the South Coast recommendations transmitted from the Blue Ribbon Task Force to the Fish and Game Commission[8]

ADDITIONAL POLICY CONSIDERATIONS

This monitoring plan has been designed to meet the requirements of the MLPA and associated policies and guidance. However, it also reflects consideration of other policies and programs that are closely related to the MLPA, and these should be considered again during monitoring implementation. For example, in addition to the Fish and Game Commission, the State Park and Recreation Commission and the State Water Resources Control Board also have the authority to designate specified state marine managed areas.[9] Marine managed areas include a variety of different designations, including not only MPAs designated under MLPA but also, for example, state marine cultural preservation areas and state water quality protection areas. While these designations serve different mandates, they are all intended to protect, conserve, or otherwise manage a variety of resources and their uses.[10] During implementation of MPA monitoring, the selection of specific sites to be monitored should consider the locations of such sites within the South Coast region, and opportunities to maximize information exchange and resource sharing among various programs should be explored, while ensuring the ability to meet MLPA requirements is not compromised.

MPAS AND THE RELATIONSHIP BETWEEN THE MLPA AND THE MARINE LIFE MANAGEMENT ACT

During the design of the monitoring framework, particular consideration has been given to the relationship between the MLPA and the Marine Life Management Act (MLMA). The California Marine Life Management Act (MLMA, Statutes 1998, Chapter 1052) became law on January 1, 1999. The MLMA mandated several significant changes in the way California's

[7] Draft Methods Used to Evaluate Marine Protected Area Proposals in the MLPA South Coast Study Region. California Marine Life Protection Act Initiative. Updated October 6, 2009

[8] See South Coast Recommendations Transmission Binder 2 accompanying the Memorandum from the MLPA Blue Ribbon Task Force to the California Fish and Game Commission, December 8, 2009 (available at: www.dfg.ca.gov/mlpa/recommendations_sc.asp)

[9] California Marine Managed Areas Improvement Act, Public Resources Code sections 36600-36900. See §36602(b).

[10] Ibid. PRC §36602(d).

marine fisheries are managed and regulated.[11] The MLMA sets sustainability as an overall goal for the fishery management system (FGC §7056). Within the definition of sustainability, the MLMA includes not only the maintenance of fishery populations, but also the fullest possible range of present and long-term benefits, ecological benefits, and biological diversity (FGC §99.5). The MLMA calls for achieving its primary goal of sustainability by meeting several objectives:

- preventing overfishing
- rebuilding depressed stocks
- ensuring conservation
- promoting habitat protection and restoration.

MPAs are recognized as playing a potential role in contributing to achieving the goals of the MLMA. For example, the Nearshore Fishery Management Plan, developed under the MLMA and completed in August 2002, "uses marine protected areas (MPAs) to ensure that the MLMA's objectives for protection of habitat and ecosystem integrity as well as sustainable fisheries are met" and "recognizes the authority of the Marine Life Protection Act (MLPA) to design a Master Plan for MPAs in California".[12]

The MLMA, like the MLPA, also specifically requires monitoring (e.g., FGC §7081) and adaptive management (FGC §7056(g)). The MLMA includes an emphasis on collecting essential fisheries information (EFI) and recommends the use of monitoring to provide this information.

Thus, although there is clear overlap, the primary purposes of the MLMA and MLPA differ, and monitoring to meet the goals of MLPA is necessarily designed and implemented differently from monitoring conducted to meet the goals of MLMA. Nevertheless, monitoring to meet MLPA requirements necessarily will include some fisheries monitoring, including both ecological and socioeconomic elements of fisheries. Moreover, given the close relationship between the two acts, MPA monitoring can and should benefit fisheries monitoring. For example, many species important to fisheries are also important components of marine ecosystems, such as many groundfish species. Thus, monitoring of select fisheries species is essential to effective monitoring of MPAs. Similarly, the South Coast Regional Goals and Objectives developed during the MPA planning process include "minimiz[ing] negative socio-economic impacts and optimize positive socio-economic impacts for all users including coastal dependent entities, communities and interests, to the extent possible, and if consistent with the Marine Life Protection Act and its goals and guidelines" (see Appendix C-6, Goal 5, Objective 1).

The monitoring approaches described in this plan therefore include ecological and socioeconomic elements of fisheries monitoring in order to assess the effectiveness of the regional MPA network in meeting MLPA goals and to support adaptive MPA management. This information may inform fisheries management and may contribute to meeting the goals of the MLMA. Similarly, monitoring conducted to support fisheries management may provide information that is useful to augment and interpret MPA monitoring information. During implementation of MPA monitoring, there are likely to be valuable opportunities to seek efficiencies and leverage resources by integrating some aspects of MPA and fisheries monitoring activities.

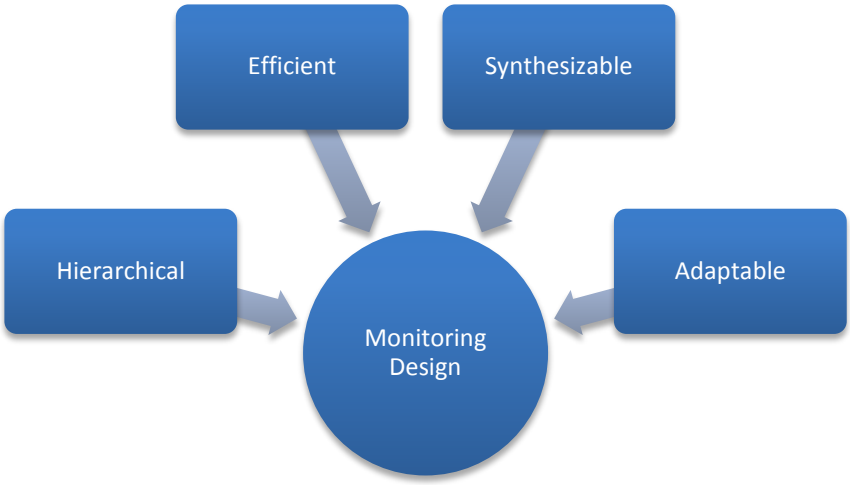
However, it is important to recognize that the fisheries monitoring elements included in this plan are not intended to be sufficient for fisheries management purposes, because the monitoring goals are those of the MLPA, rather than the MLMA. Nonetheless, the MPA monitoring metrics described in this plan have been selected to benefit fisheries management to the extent possible without compromising the ability to best meet MLPA requirements. If desired, it is also possible to

[11] The Master Plan: A Guide for the Development of Fishery Management Plans, as Directed by the Marine Life Management Act of 1998. December 2001, p. i.
[12] Nearshore Fishery Management Plan. August 2002, p. iii.

supplement MPA monitoring with additional monitoring to further explore the overlap between MPAs and fisheries management (see Appendix A-1).

DESIGN REQUIREMENTS FOR THE MPA MONITORING FRAMEWORK

A wide range of ecological and socioeconomic information is required to assess the effectiveness of each regional MPA network in meeting policy goals. This information must allow assessments of effectiveness at a variety of scales, for example from selected individual MPAs through the entire regional network, and from selected habitats and species through entire ecosystems. Yet to be useful for informing future management decisions, all this information must lead to monitoring results that are interpreted and presented in a way that is clear and informative for diverse audiences including decision-makers, managers, and stakeholders. These various needs have been addressed in the development of the MPA monitoring framework through identifying and meeting key monitoring design requirements.



A HIERARCHICAL FRAMEWORK

The first design requirement is that monitoring must fit a hierarchical framework, to allow collection and reporting of results at various scales, including the MLPA region as a whole, individual ecosystem types (such as kelp forests), individual MPAs (that are monitored, as not all sites may be monitored), and individual ecosystem components, such as selected species. Implementation of a hierarchical approach means that monitoring indicators and other metrics at each level of the hierarchy are chosen so that they collectively allow assessment of the next higher level of the hierarchy, which contains metrics that collectively allow assessment of the next higher level, and so forth.

EFFICIENT DESIGN & IMPLEMENTATION

The second design requirement is that monitoring is as efficient as possible, both in design and in implementation. Thus, at each level in the hierarchy and for each monitoring question or approach, a key design criterion is identifying the most important and useful information that should be collected. Throughout this monitoring plan, priority is placed on identifying information that is sufficient to allow specific assessments, rather than on identifying all information that could possibly be collected. This approach allows clear prioritization of information to be collected through monitoring, but does not preclude collection of additional information when feasible and desirable.

INTERPRETABLE & SYNTHESIZABLE DATA

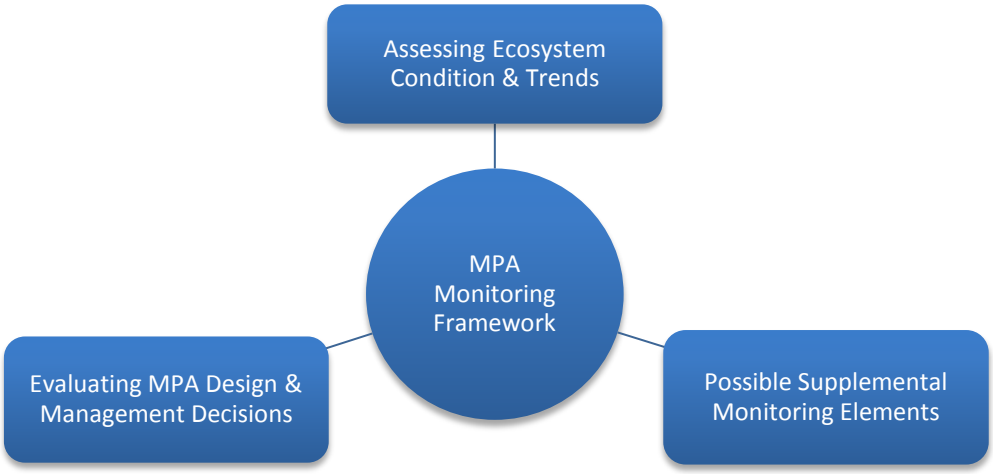
To be useful to policy makers, resource managers, stakeholders, and others involved in future MPA management decisions, monitoring data must facilitate development of overarching conclusions about network performance and of key, "take home" messages, which can be presented in clear, intuitive reports (see Chapter 6 for illustrative examples). At the same time, the full range of technical information underpinning the information syntheses must be made readily available to support further analyses, review or uses of the data at any level of detail desired.

ADAPTABLE DESIGN & PRIORITIES

The final design requirement is that monitoring must be adaptable, so that it can be adjusted as needed to reflect changing management needs and make best use of available resources, and can evolve over time to take advantage of scientific advances, new or improved monitoring methods and approaches, and other opportunities to increase monitoring accuracy and effectiveness. Accordingly, the monitoring framework has been developed as a series of nested modules. Each module is designed as a stand-alone unit focused on monitoring aspects of ecosystems, resources, resource use, or management decisions. Monitoring can thus be adapted by choosing the desired modules to implement. In addition, each module can be scaled, or adjusted in magnitude or intensity. Guidelines for choosing and scaling modules are provided in this monitoring plan to ensure a coherent monitoring program that appropriately reflects the South Coast region. To encourage evolution and refinement of monitoring, the modules include research and development components to identify and prioritize opportunities to improve monitoring through research collaborations.

Additionally, this entire plan should be considered a living document, subject to regular review so that monitoring itself can be managed adaptively. The five-year reviews of the South Coast MPAs that are recommended in the MLPA Master Plan would provide excellent opportunities to periodically evaluate and refine monitoring, and update this plan as needed.

KEY ELEMENTS OF THE MPA MONITORING FRAMEWORK



These design requirements, coupled with the policy guidance described above, guided the selection and construction of the basic monitoring elements that comprise the MPA monitoring framework. These basic MPA monitoring elements are briefly described below, and are discussed in detail in subsequent chapters. The MPA monitoring framework is designed to meet MLPA requirements in each MLPA region. Consistent application of the framework to each region will facilitate future comparisons among regions and contribute to assessment of the statewide MPA network, once complete.

ASSESSING ECOSYSTEM CONDITION & TRENDS

Monitoring of the regional MPA networks must reflect many different ecological and socioeconomic aspects in order to meet the requirements of the policy guidance discussed above. Habitats, marine life populations, marine life diversity and abundance, socioeconomic trends, and recreational uses are just a few of the aspects specifically referenced in the various policy elements. The MPA monitoring framework adopts an ecosystems focus to provide a sufficiently broad umbrella to encompass these diverse aspects, to promote cohesion of different monitoring elements within an ecosystems framework, to facilitate integration of different types of monitoring results, and to enable assessment of the performance of the MPA network against the full range of MLPA goals. The central focus of the approach is to collect monitoring information that can be interpreted at an ecosystem level, and that can provide information about the condition of, and trends within, ecosystems over long time scales. One of the elements of this monitoring framework is designed to allow long-term tracking of the condition of, and trends in, key aspects of marine ecosystems, including ecological and human elements of ecosystems and resource use. This monitoring element and its application to the South Coast region is described in detail in Chapter 4.

EVALUATING MPA DESIGN & MANAGEMENT DECISIONS

Each regional MPA network is designed using the best readily available scientific information, which is used to guide key design decisions such as the siting of individual MPAs, the size of MPAs, and the distance between MPAs. In addition, the MPAs are designed to meet specific objectives. For example, special closures were designed by stakeholder participants in the planning process to reduce or prevent disturbance to wildlife, such as seals or seabirds. One of the elements of the monitoring framework provides for evaluation of these design decisions. Better understanding of the effects of MPA size, for example, would be valuable for making future management decisions, although, as noted earlier, such questions can be notoriously difficult to answer. This monitoring element and application to the South Coast region is described in detail in Chapter 5.

SUPPLEMENTAL MONITORING MODULES

The monitoring modules focused on assessing ecosystem condition and trends and evaluating MPA design and management decisions have been developed to work together to meet the requirements of the MLPA. They incorporate the best available science and reflect the interests of stakeholders. However, because the goals of the MLPA are broad, these modules necessarily provide broad coverage of many aspects of ecosystems, resources, resource uses, or management impacts, rather than comprehensive monitoring of any single element. Thus it may be desirable to supplement this MPA monitoring with additional, intensive monitoring of specific ecosystem elements, human activities, or pressures on the system, even if such additions are not necessary to meet MLPA requirements. Currently, scalable supplemental fisheries monitoring and water quality monitoring modules have been developed as possible monitoring additions. This approach may also be extended to develop supplemental modules addressing other possible management priorities such as those related to climate change or invasive species. This is discussed further in Appendix A.

APPLYING THE FRAMEWORK TO THE SOUTH COAST REGION

SPATIAL SCOPE OF MONITORING

As noted in Chapter 1, this monitoring plan considers all South Coast MPAs and special closures. However, because MPA assessment relies in part on comparing conditions inside and outside MPAs, and at varying distances from MPAs, this plan

applies to the entire South Coast region, and not just the MPAs. However, this still leaves the question of where within the region, and in which MPAs, monitoring should occur. From a scientific perspective, this depends largely on the questions monitoring is seeking to answer, for example on which monitoring modules are implemented and at what scale.

The MLPA specifically references "…monitoring, research, and evaluation at selected sites."[13] The MLPA Master Plan notes that "this does not mean that other MPAs should not also be monitored and evaluated in accordance with their own objectives and regional goals, but that the performance of selected MPAs might be used to guide future decisions over a wider area."[14] This is the approach taken within this monitoring plan, consistent with the design requirement to ensure monitoring efficiency while meeting MLPA requirements.

A key tool in MPA monitoring and evaluation is comparing selected indicators and other metrics inside MPAs and outside, and at varying distances from MPA boundaries. It is also important to provide adequate spatial distribution of monitoring efforts to draw conclusions about the effects of the regional network as a whole, and across the South Coast region. The spatial distribution of monitoring is likely to be refined over time, reflecting changing management needs and environmental conditions, and increasing experience with monitoring that is likely to lead to opportunities to improve monitoring efficiency and possibly reduce monitoring intensity.

Considerations and guidance for selecting the MPAs and other sites for monitoring are discussed in Chapter 8. These guidelines may be applied when data collection begins through development of a monitoring implementation plan. This is discussed further in Chapter 9.

TEMPORAL SCOPE OF MONITORING

The temporal scope of monitoring describes both the anticipated longevity of monitoring and the frequency of monitoring. Monitoring of the South Coast MPAs should continue for as long as the MPAs are in effect, although the form of monitoring is expected to change over time to reflect changing management needs and environmental conditions and increasing experience with monitoring. The frequency of monitoring should be based on the specific information sought, i.e., on the monitoring modules chosen and the scale at which they are being implemented. Of course, different elements of monitoring may be conducted at different time intervals, depending on the information sought and the variability and expected rate of change of that information. Monitoring frequency is discussed further in Chapters 8 and 9.

MONITORING PARTICIPANTS & PARTNERS

A fundamental consideration for setting the scope of this monitoring plan is the large number of potential participants and partners in monitoring. There is considerable potential in California, particularly in the South Coast region, for a partnerships-based approach to MPA monitoring, whereby monitoring activities are conducted not only by the Department of Fish and Game, as the agency with statutory authority for managing state MPAs, but also in partnership with a variety of other entities. These may include:

- Other state agencies
- Federal agencies
- Universities and research institutions
- Research/citizen collaborations (such as with fishermen)
- Citizen-scientist programs

[13] California Marine Life Protection Act, Statutes 1999, Chapter 1015, Fish and Game Code section 2853(c)(3).
[14] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 73.

- Community groups and associations (such as birdwatching, fishing, or boating clubs)

The monitoring framework and implementation approaches have been designed to take advantage of this potential monitoring capacity. Specifically, some monitoring components have been developed to be less technically or methodologically demanding to seek to accommodate citizen scientists, while recognizing that training, coordination, and data quality assurance/quality control programs will nonetheless be essential. In addition, monitoring programs established for other purposes, for example fisheries management, water quality assessment, ocean observing, and research also provide valuable information. Forging appropriate linkages among these programs will also help defray costs and improve the quality of information available for MPA management. Further information on establishing potential monitoring partnerships is provided in Chapter 7.

3. Adopting an Ecosystems Approach

- Identifying ecosystems for monitoring
- Monitoring MPA effects on Ecosystem Features
- Applying the Ecosystem Features
- Additional benefits of an ecosystems approach

Meeting the requirements of the MLPA means taking an ecosystems approach to monitoring in which ecosystems are the top level of the monitoring hierarchy and provide the umbrella that encompasses species, populations, habitats and humans. Ecosystems selected for monitoring should reflect public priorities, be consistent with the MLPA policy guidance, and recognize important ecological commonalities within, and distinctions among, systems. This chapter describes the selected Ecosystem Features for the South Coast region; the top level of the monitoring framework (see Figure 1-1) and describes how MPAs may lead to changes in these ecosystems.

IDENTIFYING ECOSYSTEMS FOR MONITORING

FOCUSING MONITORING USING ECOSYSTEM FEATURES

During the MPA planning process, ten key habitats were identified by the South Coast Science Advisory Team (SCSAT) and used to evaluate the regional MPA network proposals (see Figure 3-1, left column). These provided a starting point for selecting ecosystems to serve as the top level of monitoring in the region. However, in order to fully meet MLPA requirements, it is essential that the top level of the monitoring framework represents and encompasses the South Coast region for the purposes of monitoring. This means that selected ecosystems for monitoring must explicitly include humans. It also means that the key habitats should be evaluated to assess their ability to represent and encompass the region. Further, a holistic approach to selecting ecosystems for monitoring should also encompass ecosystems considered by stakeholders to adequately capture their monitoring priorities.

To meet these requirements, a set of Ecosystem Features has been identified for the South Coast region. Ecosystem Features are a limited set of targets for monitoring that collectively represent and encompass a region[15]. Starting with the key habitats identified by the SCSAT, a draft set of Ecosystem Features was identified through consultation with scientists and monitoring experts in the region and through evaluation of the ecology and socioeconomics of the region. These Ecosystem Features were presented and discussed at a first round of public workshops (see Workshop 1 report, Appendix C-3) and were refined on the basis of stakeholder and further scientific input.

ECOSYSTEM FEATURES SELECTED FOR MPA MONITORING IN THE SOUTH COAST REGION

The following Ecosystem Features have thus been selected to form the top level of the MPA monitoring framework for the South Coast regional MPA network:

- Rocky Intertidal Ecosystems
- Kelp & Shallow Rock Ecosystems (0-30m)
- Mid-depth Rock Ecosystems (30-100m)
- Estuarine & Wetland Ecosystems

[15] This approach is adapted from a monitoring and evaluation methodology developed by Foundations of Success (FOS), a non-profit organization with experience supporting planning, monitoring, and adaptive management of conservation and resource management projects in California and worldwide. Ecosystem Features are modeled on the FOS 'Conservation Targets', but extended to explicitly include human elements. For more information on FOS, see www.fosonline.org

- Soft-bottom Intertidal & Beach Ecosystems
- Soft-bottom Subtidal Ecosystems (0-100m)
- Deep Ecosystems, including Canyons (>100m)
- Nearshore Pelagic Ecosystems (i.e., the water column habitat within state waters, in depths >30m)
- Consumptive Uses
- Non-consumptive Uses

These Ecosystem Features align well with the key habitat types used in evaluating the South Coast regional MPA network proposals (see Figure 3-1), provide comprehensive coverage of the region, and consequently allow assessment of progress toward all MLPA goals within a clear and structured monitoring framework. The Ecosystem Features are described further below.

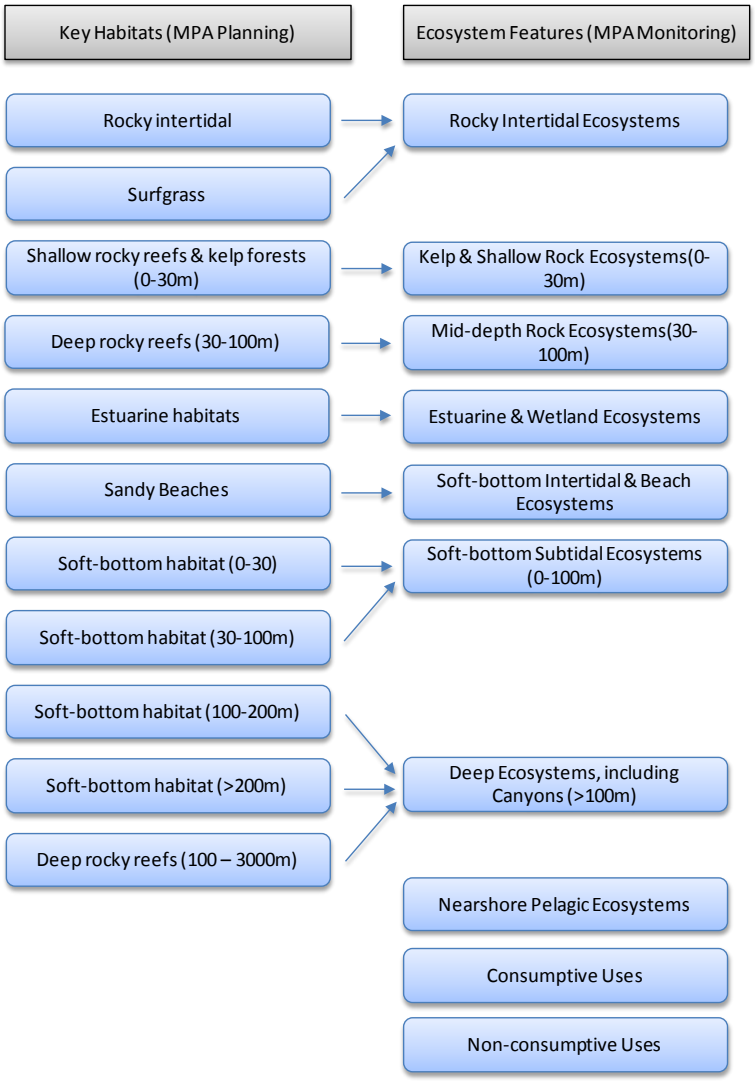


Figure 3-1. *South Coast key habitats used in evaluating MPA network proposals during the planning process, and Ecosystem Features, which guide MPA monitoring. The ecological Ecosystem Features provide complete coverage of the habitat types, as shown by the arrows. The two human uses Ecosystem Features are essential to enable monitoring to address all MLPA goals.*

MONITORING MPA EFFECTS ON ECOSYSTEM FEATURES

Understanding how the regional MPA network may protect ecosystem structure, function, and integrity (one of the goals of the regional MPA network under MLPA) is important for evaluating MPA progress towards goals and appropriately structuring monitoring activities. This requires appropriately focusing monitoring on potential effects of MPAs, taking into account other natural and anthropogenic influences on ecosystems, and understanding spatial and temporal scales of change within dynamic systems.

POTENTIAL MPA EFFECTS

MPAs implemented under MLPA limit or prohibit take of living marine resources, and thus their direct effects are most likely to reflect changes associated with the reduction or elimination of living marine resource removal inside MPA boundaries. By reducing fishing, MPAs can lead to increases in the abundance and size of some fish and invertebrates within their boundaries. Not all species should be expected to respond equally, or at the same rates, to MPA implementation. Increases in the density and size of organisms inside MPAs are generally predicted to be observable first in faster growing and predatory species, and with species or populations that previously were heavily fished; this initial effect of MPA implementation is one of the most widely demonstrated worldwide. The rates and magnitudes of population changes are also likely to be influenced by historical levels of fishing in areas subsequently designated as MPAs, as well as ongoing fishing activities inside MPAs that allow fishing and outside MPA boundaries. Monitoring of local species densities will reveal changes in predicted fast- and slow-responding species and in species that play key ecological roles within particular ecosystems.

MPAs may also result in indirect effects in marine ecosystems. If abundances of functionally important fish and invertebrate herbivores and predators increase, cascading changes throughout the ecosystem may be expected, as ecological processes and interactions shift. Additionally, MPAs may increase ecosystem resilience, which can improve the capacity of ecosystems to resist, or recover from, changes due to other types of influences (e.g., climate change impacts). Monitoring important aspects of ecosystems that contribute to ecosystem structure and function facilitates detection and interpretation of such community- and ecosystem-level effects of MPAs.

Ultimately, MPAs may also lead to fishery benefits through adult and larval spillover. Adult spillover occurs when increased fish production within MPA boundaries causes individuals to move outside the MPA, where they contribute more broadly to the structure and function of ecosystems in the region and also support associated fisheries. Detection of these effects is challenging given that many species range over large geographic areas. However, analytical models which incorporate spatially explicit fishing data, including effort and catch, combined with ecological data illustrating species densities and movement patterns, can reveal contributions of MPAs to ecosystems and fisheries outside their boundaries. This latter effect of MPA implementation, however, may take many years to realize and detect.

DETECTING AND INTERPRETING CHANGE USING CONTEXTUAL INFORMATION

California's marine and coastal ecosystems are shaped by natural and anthropogenic influences that act at a variety of temporal and spatial scales. Ecological and socioeconomic changes following MPA implementation will occur in the context of variation in these other factors. Therefore, in order to understand the effects of MPAs on these ecosystems, the analysis and interpretation of monitoring results will need to consider additional information from other monitoring programs and data sources. This information, referred to as contextual information, will include consideration of the natural influences of the physical environment, such as oceanographic conditions or substrate types, as well as human influences, such as economic conditions or land-use patterns.

TAKING ACCOUNT OF NATURAL INFLUENCES

Natural variation in South Coast coastal and marine ecosystems presents challenges for assessing MPA effects. For example, the highly dynamic physical oceanography of the area, including changes related to the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO), dramatically affects many species and habitats. As another example, the irregular recruitment cycles of many species, including many rockfishes, significantly affect potential rates of population growth for those species.

These and the many other sources of variability pose challenges to any efforts to detect meaningful changes or uncover ecological trends, and even greater challenges for determining the extent to which MPAs may be causing or contributing to such changes or trends. The approach to MPA monitoring described in this plan is designed to first document changes (or lack of changes), and over time accumulate the amount and distribution of data that will be needed to explore the causes of changes observed. Data collected as part of MPA monitoring will be used to document trend; for example, trends in rockfish population growth may be elucidated trough long-term monitoring of those populations. However, in order to appropriately interpret trends and to determine the potential role of MPAs in contributing to those trends, it will be important to consider contextual information such as oceanographic conditions as well as human influences such as water quality and fisheries management regulations.

Additional insights will be garnered through comparisons of changes in fished and unfished species inside and outside MPAs with comparable habitats and ecosystems. Experience from MPA monitoring in the Channel Islands shows that some predicted changes are detectable relatively quickly, for example in the first five years. However, attributing the observed effects to the establishment of the MPAs with reasonable certainty is likely to take many additional years of monitoring. This can be expected to be true across the South Coast region, and indeed throughout the state.

TAKING ACCOUNT OF BROADER HUMAN INFLUENCES

Marine and coastal ecosystems, in the South Coast region and globally, are affected by a wide range of anthropogenic influences other than those associated with fishing, including water quality impairment, habitat alteration, invasive species, and, increasingly, climate change. They are also influenced by a wide range of management measures other than MPAs, including those relating to fisheries, land- and marine-based discharges, coastal development practices, and many others. In addition to consideration of management measures, interpretation of changes in ecosystems in response to MPA implementation will require incorporation of other contextual information such as economic conditions, which can affect patterns of human uses, both consumptive and non-consumptive.

Analysis and interpretation of MPA monitoring results will also consider MPA regulations and available information on MPA compliance. Because illegal take of marine organisms can influence the rates and magnitudes of population increases, information about types and levels of non-compliance will be incorporated into interpretation of documented trends.

These human influences frequently impose dynamic changes on ecosystems that operate on differing spatial and temporal scales from MPA-related effects. As with natural dynamics, separating the effects of MPAs from other human influences on ecosystems is facilitated by analyzing long-term trend data and through comparisons of locations with and without specific measurable human influences. Through development of partnerships for information exchange (see also Chapters 6 and 7), data on these broad human influences will be considered in analysis and interpretation of MPA monitoring results.

APPLYING THE ECOSYSTEM FEATURES

Following are brief summaries of the South Coast Ecosystem Features. Each summary provides a brief description and definition of the Ecosystem Feature together with considerations for monitoring that Ecosystem Feature. As noted above, these ecosystems will be influenced by factors other than MPAs, and these other influences, or system drivers, will be considered during analysis of monitoring results. The important system drivers for each Ecosystem Feature are included within each summary.

Although the Ecosystem Features are considered individually, this is obviously an artificial distinction and many effects of MPA implementation may be revealed through relationships among features and between socioeconomic and ecological ecosystem elements. Accommodation of such potential links is provided at multiple points in the monitoring plan, including selection of monitoring metrics, design of data collection programs, and analysis and reporting of monitoring data.

ROCKY INTERTIDAL ECOSYSTEMS

Rocky intertidal ecosystems are defined, for the purposes of MPA monitoring, as areas of rock substrate occurring within the zone between mean high water and mean lower low water. In the South Coast region, this includes exposed rocky cliffs, boulder rubble, exposed wave-cut platforms and sheltered rocky shores. Although the underlying geology affects ecosystem structure, intertidal ecosystems are typically characterized by multiple zones which are primarily revealed in the species forming biogenic habitat. At the upper (landward) end of the intertidal zone, physical processes are the dominant regulators of community composition and communities are typically dominated by barnacles and other encrusting species. In the mid-intertidal zone, fucoid algae and mussels provide structure and habitat. Kelps, other fleshy seaweeds, and seagrasses make up much of the habitat in the low intertidal zone, and at some sites purple urchins are important as bioeroders and habitat. In the mid and lower zones, ecological processes such as competition and predation play an increasingly important role in community structuring.

This Ecosystem Feature is expected to be among the more challenging within which to detect and interpret changes that may occur following MPA designation. Reduced take of marine organisms such as seaweeds can lead to increases in habitat availability and ultimately this habitat may provide important food and shelter for other fish and invertebrates. However, physical disturbance is a natural process in rocky intertidal systems that results in complex and patchy species distributions, complicating detection of MPA-related effects. Such disturbance effects particularly confound detection of MPA effects via inside-outside MPA comparisons. Thus monitoring of rocky intertidal ecosystems emphasizes establishing robust temporal trends through an appropriate spatial sampling design.

Rocky Intertidal ecosystems are one of several Ecosystem Features (together with the Estuarine & Wetland and Soft-bottom Intertidal & Beach Ecosystem Features) that span the boundary between marine and estuarine, or terrestrial, habitats and consequently are influenced by many different factors. These habitats are among the most frequently visited by people, for example for wildlife viewing and coastal recreation, thus MPA monitoring has been structured to facilitate interpretation of ecological-human linkages in these ecosystems. Monitoring of human uses will be aligned with rocky intertidal monitoring in the monitoring sites selected and analytical techniques employed.

KELP & SHALLOW ROCK ECOSYSTEMS (0-30M)

Shallow rocky reefs in the South Coast region are diverse ecosystems, hosting a wide variety of marine plants, fish and invertebrate species as well as many marine birds and mammals, including, in the northern part of the region, sea otters. Large, canopy-forming kelps colonize rocks in some areas, while others are covered with smaller algal species and

invertebrates. Many of the same fish and invertebrate species, including economically important species, are found in shallow rocky habitats regardless of the presence of kelp, thus these similar ecosystems are considered together in this Ecosystem Feature. Where kelp forests exist in the South Coast, they are typically dominated by giant kelp (*Macrocystis pyrifera*), which plays an important role as habitat and food for many fish and invertebrates.

Classic ecological experiments in the South Coast region have increased our understanding of the structure and function of food webs in Kelp & Shallow Rock Ecosystems. In particular, species including California sheephead, spiny lobsters and sea urchins are considered to be strong ecological interactors that play particularly important roles in food web dynamics. Sea urchins are herbivores that can reduce kelp abundance. However, sheephead and spiny lobster prey on urchins, which has a positive effect on kelp abundance. Thus, through their trophic relationships, these species can affect the community structure of kelp forest ecosystems.

Also among the ecologically and economically important species in these ecosystems is a variety of rockfishes. Many rockfishes are included on the list of species likely to benefit from MPAs (Appendix C-7) and have also been identified as monitoring indicators. However, many rockfish species are long-lived – some species live more than 70 years – and individuals often don't reach maturity until six to eight years of age. These life history characteristics increase the predicted time to observe increases in population sizes that may follow MPA implementation. Implementation of monitoring therefore focuses initially on detection of local density differences inside and outside of MPAs. Gradual accumulation of data will help reveal the broader ecological role of these species as well as the broader population consequences of local protection. In addition, potential ecological cascade effects following MPA implementation include increases to kelp canopy and understory algae as abundances of functionally important fish and invertebrate herbivores and predators increase. Integrated analyses of changes in habitat, invertebrate herbivores, and predatory fish will allow investigation of such potential community and ecosystem-wide effects.

Many of the possible effects of MPA implementation on this Ecosystem Feature are likely to be complicated by other ecosystem drivers and processes, often acting at large geographic and long temporal scales. Kelp forests in particular are dynamic systems; storms and waves can cause rapid changes by removing large numbers of kelp plants. Across seasons and years, differences in the amount of cold, upwelled water supplying vital nutrients to the kelp can cause natural increases or declines in this key habitat, affecting the fish and invertebrates that rely on kelp for food and shelter. Further, anthropogenic influences on climate are already resulting in changes to the frequency and intensity of storms, El Niños, and upwelling events. In the South Coast region, changes in water quality due to human activities can also have large effects in these ecosystems and are thus an important consideration. Interpretation of observed ecosystem changes and detection of MPA-specific effects can be achieved through the collection of data over long time scales for incorporation into trend analyses.

MID-DEPTH ROCK ECOSYSTEMS (30-100M)

In the South Coast, mid-depth rocky habitats occur as rocky reefs or rock outcrops and are inhabited by a variety of fish and invertebrates. With the exception of Elk kelp, which can occur at depths of 20-40m, large kelps are not often found here and other photosynthetic algae are rare in these deeper waters. Consequently, much of the habitat is made up of sessile invertebrates such as sea anemones, sponges, bryozoans, and hydrocorals. In this system, these animals serve as the structuring habitat for other, more mobile, species.

As in the Kelp & Shallow Rock Ecosystem Feature, many of the ecologically and economically important species are rockfishes and other predatory fishes that are long-lived and take a long time to reach sexual maturity. Thus potential population recoveries for these species following MPA implementation are unlikely to occur rapidly. In addition, habitat-forming sessile invertebrates, such as hydrocorals, are very slow-growing and fragile, and susceptible to physical damage,

such as may occur by bottom-tending fishing gear. Thus, increases in some biogenic habitats (i.e., habitat formed by the growth and architecture of particular species) are predicted to occur inside MPAs and this potential effect will be assessed through analysis of trend data collected over long time periods for key species.

Through partnerships with other monitoring programs, MPA monitoring results interpretation will also take into account trends in climatic and oceanographic drivers, which result in shifts in the timing and magnitude of upwelling. Consideration of such data will be important for accurately evaluating the effectiveness of MPAs in mid-depth rock ecosystems.

ESTUARINE & WETLAND ECOSYSTEMS

Estuarine & wetland ecosystems within the South Coast region encompass soft-sediment habitats, including tidal mudflats, eelgrass beds and areas of open water. The shoreward boundary of this Ecosystem Feature is drawn at the extent of tidal reach and salt-water-associated vegetation, consistent with the MPA planning process. Habitat formed by eelgrass and other plants plays an important functional role as foraging and nursery areas for a diverse range of fish and invertebrate species, many of which inhabit estuaries as juveniles before moving to kelp and other offshore habitats as adults. The estuaries, coastal bays and beaches of the South Coast region are also an important part of the Pacific Flyway and host thousand of migrating shorebirds, as well as being important foraging and nesting areas for resident bird populations. Estuarine & Wetland ecosystems in the region are also important areas for consumptive uses including fishing and clam digging, and non-consumptive activities such as bird watching, boating, and kayaking.

Along with rocky intertidal and soft-bottom intertidal ecosystems, estuarine & wetland ecosystems are expected to be among the most challenging ecosystems within which to detect and interpret MPA effects. By reducing extractive take, MPA implementation may lead to increases in the abundances and sizes of harvested species and increases in the area or quality of habitat.

However, estuaries also provide important habitat linkages among marine, aquatic and terrestrial ecosystems and thus their condition is closely tied to that of the surrounding watershed. This is particularly manifest in water quality characteristics. In addition, invasive species in estuaries in the South Coast region have dramatically altered species compositions and ecosystem functioning. These broader influences will be incorporated into analyses of MPA monitoring results to facilitate detection and interpretation of MPA-related effects.

An additional challenge for the monitoring of this Ecosystem Feature is that the estuaries in the South Coast region differ from one another in significant ways. Driven by physical differences in the estuary shape, geomorphology, seawater input, freshwater input and nutrient supply, estuaries in the region also harbor different habitat-forming species and ecological communities. The recommended monitoring approaches for this Ecosystem Feature therefore focus on generation of trend data to examine changes in ecosystem indicators through time. Interpretation of trends within individual monitored estuaries can be used to estimate and assess changes in the South Coast region as a whole.

SOFT-BOTTOM INTERTIDAL & BEACH ECOSYSTEMS

Soft-bottom intertidal and beach ecosystems are defined as wave-dominated areas of sand and gravel substrate occurring below mean high water and above mean lower low water. In the South Coast region, sandy substrate covers over a third of the shoreline. Many of these areas are culturally important and contribute economic benefits to the region as people enjoy consumptive and non-consumptive activities associated with beach environments.

Species assemblages inhabiting sandy beaches are often supported almost entirely by external nutrient input. In these ‘open’ systems, beach wrack is an important source of food and nutrients. Natural increases or decreases in the extent of

wrack are partly driven by the changes occurring offshore in kelp-dominated habitats, thus linking the ecologies and functioning of these two habitats. By comparison, in 'closed' systems, high diatom productivity drives microbial food chains in surf waters and sediments, supporting macro-consumers such as zooplankton, fishes, and seabirds. Akin to the approach with kelp ecosystems, these natural dynamics are taken into account in monitoring in this Ecosystem Feature through an emphasis on collecting temporal trend data that can reveal MPA effects superimposed on natural system fluctuations.

Like the rocky intertidal ecosystems and estuarine & wetland ecosystems described above, these ecosystems occurring at the interface between marine and terrestrial habitats are often strongly influenced by a myriad of different natural and human factors. These range from the indirect influences of coastal development, such as freshwater or polluted run-off, to the more direct influences of human visitation, which can result in disturbance or extraction of organisms. By aligning ecological data with information on human uses, analyses of monitoring results can reveal interpreted trends in ecosystem condition and can also be used to inform MPA design and management.

SOFT-BOTTOM SUBTIDAL ECOSYSTEMS (0-100M)

This Ecosystem Feature encompasses the areas of sediment substrate occurring between mean lower low water and 100m depth. These soft-bottom subtidal habitats predominate on the continental shelf throughout the South Coast region. Although seemingly simple, unstructured habitats, the species living in these areas must contend with dramatic changes as waves and currents shift sand and sediment across large areas. Commercially important species including rock crab and flatfish are typically found in these habitats.

Despite covering the largest area of any benthic habitat type in the region, very little knowledge exists about the drivers, components, and processes maintaining this ecosystem. Key species and their ecological roles have yet to be identified and the relative importance of physical drivers versus biological interactions in shaping communities has not been determined. MPA monitoring is constrained by this lack of ecosystem knowledge, but will play an important role in increasing understanding of this system. Many of the fish and invertebrate species within these habitats are wide-ranging and individuals are likely to move between protected and unprotected locations. Detecting effects of MPA designation on these species is challenging, but insights will be garnered through combining ecological data with information on the spatial patterns of fishing occurring outside MPAs.

As with many of the other Ecosystem Features, MPA implementation is likely to alter only a subset of the dominant human influences on these ecosystems, and will occur within the context of broader natural regimes of variation. Decadal-scale shifts in the California Current affect the sediment-inhabiting communities in this ecosystem, with warm regimes and associated declines in plankton production resulting in species and community declines. On shorter timescales, El Niño events, which increase wave activity and storms (leading to sedimentation), can cause major, though short-term, disturbances to these communities. The effects of MPA designation can be assessed over time through integrated analyses of trend data that facilitate separation of MPA effects from other anthropogenic and natural drivers.

DEEP ECOSYSTEMS, INCLUDING CANYONS (>100M)

This Ecosystem Feature encompasses both rocky and soft-bottom substrates that occur in waters of greater than 100m depth, and includes canyons. In the South Coast region, soft-bottom habitats are more common in this depth range than rocky substrate. A number of submarine canyons occur in this region, including those at Point Dume, Santa Monica Bay, Palos Verdes Point, La Jolla and at the Channel Islands. Canyons are areas of high structural complexity and provide important habitat for many fish and invertebrate species. In addition, canyons can affect ocean circulation patterns and are thus often important foraging areas for marine birds and mammals. Because photosynthetically active radiation (PAR)

rarely penetrates to these depths, food webs are primarily supported by inputs of nutrients from sources external to the system.

Many ecologically and economically important species are found in deep ecosystems, including rockfishes, flatfishes and spot prawns. Many fishes found in this Ecosystem Feature are long-lived and slow to reach sexual maturity, so significant changes in density or size-structure would be unlikely for years following MPA implementation. In addition, many of these species are wide-ranging and are thus likely to move between protected and unprotected areas, which may limit MPA effects.

As with many of the Ecosystem Features, trends in ecosystem condition will be considered in the context of broad oceanographic and climatic conditions, such as El Niño events which can have large effects on ocean productivity. In addition, further insights into ecosystem condition will come through combining ecological data with information on spatial patterns of fishing.

NEARSHORE PELAGIC ECOSYSTEMS

For the purposes of MPA monitoring, nearshore pelagic ecosystems are defined here as the water column overlaying the continental shelf in state waters in depths greater than 30m. In the South Coast, this includes oceanographic features such as upwelling zones and retention areas, and a pelagic food web supported by phytoplankton, zooplankton and forage fishes, and including apex fish, seabird and marine mammal predators.

The processes structuring nearshore pelagic ecosystems frequently occur on spatial scales much larger than the adopted MPAs, and indeed much larger than the whole region. Many fish and invertebrate species characteristic of pelagic ecosystems are transient and wide ranging. The South Coast region is characterized by complex oceanographic patterns that arise from the confluence of the cool California Current and the warmer California Countercurrent. Further complexity is added by the Southern California Eddy, a counter-clockwise circulating gyre with seasonally-varying currents. The Nearshore Pelagic Ecosystem Feature also occurs within the broader California Current ecosystem: a coastal upwelling biome extending from Alaska to Baja and structured by large-scale climate and oceanographic regimes including the Pacific Decadal Oscillation (PDO) and El Niño Southern Oscillation (ENSO). Disentangling the effects of MPAs from these large-scale dynamics can be achieved through the collection of data over long time scales to incorporate into time series analyses and interpretation. In addition, focusing monitoring indicators in part on pelagic fish species which have relatively smaller home range sizes and were previously fished (including those species within the list of species likely to benefit from MPAs) allows detection of trends in local abundances and size structures. Ultimately, these effects may be scaled up to detect network-level MPA effects on more wide-ranging species.

CONSUMPTIVE USES

Two categories of human uses have been recommended as focuses for MPA monitoring in the South Coast region, Consumptive and Non-consumptive Uses. Consumptive Uses encompasses those activities involving extraction of living marine resources. In the South Coast region, this includes commercial and recreational fishing using a variety of methods (on shore, or by boat) and collecting of species by hand, on shore or via snorkeling or scuba diving. Collecting of organisms for scientific research also occurs, and requires permits. Illegal take of marine resources is a challenge for MPAs worldwide, and can greatly undermine MPA effectiveness. Accordingly, monitoring must be designed to facilitate detection of the effects of such activities, and must also consider available information on types and levels of non-compliance with MPA regulations.

MPA monitoring has been designed to assess both the effects of consumptive uses on MPAs and ecosystems, and the effects of MPAs on consumptive uses. The effects of consumptive uses on MPAs and ecosystems are assessed primarily using the ecological Ecosystem Features, and considering contextual information, including information on fisheries occurring in the region. Specific questions about the effects of consumptive uses on MPAs and ecosystems may also be answered through targeted evaluations of MPA design and management decisions (see Chapter 5).The effects of MPAs on consumptive uses will be assessed through targeted monitoring of key aspects of consumptive uses that focus on understanding the socioeconomic and use impacts and effects of MPA implementation. These effects may be seen in the spatial patterns of human use, either through active shifts in resource use or through displacement effects, and may also be reflected in aspects of the quality or economic value of the activity.

Although defined as a separate Ecosystem Feature, trends in many consumptive uses are obviously related to, and in some cases dependent upon, trends in key aspects of the ecological Ecosystem Features and the broader oceanographic and climatic environment. Forging appropriate links between the ecological and human use Ecosystem Features during the selection of monitoring metrics, data collection and analyses, allows assessment of the relationships between these ecosystem elements and the consequences for MPA effectiveness in achieving MLPA goals. Further, as with the ecosystems in the region, a broad range of external drivers influence the patterns and intensity of human uses associated with MPA implementation. Perhaps most importantly, broad economic drivers also strongly influence commercial and recreational fishing activities. This is evidenced in the recent declines in coastal economies and increases in fuel prices that have directly influenced commercial and recreational fishing ventures. In addition, MPA regulations are part of a broader suite of fishery management regulations and tools that control fishing activity inside and outside MPA boundaries. This suite of information will be incorporated into integrated analyses to examine trends in consumptive uses with respect to individual MPAs, key ports and access locations, and across the region as a whole.

NON-CONSUMPTIVE USES

In the South Coast region, large numbers of residents and visitors enjoy shore-based and/or on-water non-consumptive recreational activities including beach-going, diving, kayaking, and wildlife viewing. An explicit goal of the adopted MPA network is to increase recreational, study and educational opportunities in ways consistent with protection of biodiversity. Illegal non-consumptive activities can also be a challenge, particularly for coastal MPAs featuring accessible populations of charismatic wildlife. MPA monitoring must be designed to facilitate detection of the effects of such activities, and be informed by available information on non-compliance with MPA regulations.

MPA monitoring has been designed to assess both the effects of non-consumptive uses on MPAs and ecosystems, and the effects of MPAs on non-consumptive uses. The effects of non-consumptive uses on MPAs and ecosystems are assessed primarily using the ecological Ecosystem Features. Specific questions about the effects of non-consumptive uses on MPAs and ecosystems, such as the effects of MPA visitors on seabird fledging rates, may also be answered through targeted evaluations of MPA design and management decisions (see Chapter 5).

The effects of MPAs on non-consumptive uses will be assessed through targeted monitoring of key aspects of non-consumptive uses that focus on understanding the socioeconomic and use impacts and effects of MPA implementation. Like consumptive uses, many of the non-consumptive uses in the region are closely tied to trends in marine ecosystems. Monitoring will establish links between these Ecosystem Features. Patterns of non-consumptive uses in the region are also the result of numerous other drivers that range from economic circumstances to natural environmental conditions, such as weather. The specific effects of MPA implementation are likely to differ among specific non-consumptive uses and may include a complex suite of changes in patterns of recreational activity that also differ among locations within the MPA network. Integrated analyses will be required to examine the effects of multiple system drivers and influences in order to

reveal MPA-related changes in patterns of non-consumptive uses. These analyses can reveal patterns occurring on local scales (e.g., access points or ports), within individual MPAs, and across the region.

ADDITIONAL BENEFITS OF AN ECOSYSTEMS APPROACH

The ecosystems approach and the specific Ecosystem Features selected have been designed to meet the requirements of MLPA. However, this approach may also directly benefit other aspects of marine and coastal resource management, including fisheries management. Both the specific data streams generated through MPA monitoring and the assessment of ecosystem condition and trends may have application beyond MPA assessment and adaptive MPA management. The approach can also be supplemented to provide additional information specific to particular management mandates.

For example, MPA monitoring will generate new, detailed data on the abundance and biology of many species targeted by fisheries. Information on relative abundances and size distributions of fishery species generated through MPA monitoring may be useful as inputs for population modeling by fishery scientists. Also, in recognition of the establishment of California's MPA network, fishery scientists have begun exploring new ways to inform fishery managers of the status of fished populations, based upon differences in density inside and outside MPAs. Many nearshore species are targeted by fisheries, and are also unassessed due to a lack of data. Management of these species in particular may benefit from the information generated through MPA monitoring, as the new data streams become available to fishery managers.

Additionally, the assessment of ecosystem condition and trends may benefit other mandates and programs. Many marine resource management policies and programs now incorporate ecosystem-based elements, and the approaches described in this plan may contribute to such efforts. For example, fisheries policies frequently reference "ecosystem-based fishery management" (EBFM). Some of the underlying data needed to support EBFM may be obtained through MPA monitoring, such as assessments of ecosystem condition. For example, the Marine Life Management Act requires conservation of the health and diversity of marine ecosystems and marine living resources.[16]

Finally, the MPA monitoring approaches described in this plan are amenable to the addition of possible supplemental monitoring modules to provide additional, detailed information to support management and research priorities beyond the immediate requirements of the MLPA. Many different topics, such as supplemental fisheries, water quality or invasive species monitoring, may be appropriate for supplemental monitoring modules, building on the ecosystems approach developed to implement monitoring of MPAs. The MPA monitoring approaches described in this plan include monitoring of many fished species and fisheries and provide some insight into water quality, invasive species, and other issues in order to inform MPA assessment and management under MLPA. But if additional information is desired for MPA or other management mandates, then the addition of supplemental monitoring modules may be warranted. Appendix A of this plan explores possible supplemental monitoring modules, focusing on those that inform the intersection of MPAs and other management mandates, such as fisheries and water quality management. Supplemental fisheries monitoring could, for example, be designed to test and refine new methods of stock assessment or new fishery control rules. In time, it could also address emerging concepts such as effective trophic level, maximum food chain length, connectance, species richness, evenness, or redundancy, all of which could inform fisheries management and possibly support implementation of EBFM.

[16] California Marine Life Management Act, Statutes 1998, Chapter 1052, Fish and Game Code section 7050(b)(1).

4. Assessing Ecosystem Condition & Trends

- Long-term tracking of ecosystems
- Ecosystem Feature Checkups
- Ecosystem Feature Assessments
- Metrics for Ecosystem Feature Checkups & Assessments
- Advancing ecosystem monitoring through research & development

Assessing the effectiveness of the South Coast regional MPA network in meeting MLPA goals and facilitating adaptive MPA management requires two distinct, but complementary, monitoring elements: 1) Assessing Ecosystem Condition & Trends; and 2) Evaluating MPA Design and Management Decisions (see the monitoring framework diagram in Figure 1-1). This chapter describes the overarching framework, implementation options, and recommended monitoring metrics to track the condition and trends of the South Coast Ecosystem Features.

LONG-TERM TRACKING OF ECOSYSTEMS

APPLYING STATUS & TRENDS MONITORING TO ECOSYSTEM FEATURES

Regular assessment and long-term tracking of ecosystems or ecosystem components – often referred to in other monitoring programs as 'status and trends monitoring' – is accomplished through monitoring of the ten Ecosystem Features selected to collectively represent and encompass the South Coast region for the purposes of MPA monitoring (see Chapter 3). To meet MLPA requirements, this monitoring includes repeated assessments of key ecological and human aspects of ecosystems that collectively describe the condition of the ecosystems, how they vary inside and outside MPAs, and how they change over time.

The approaches described here are designed to guide, and then build on, the foundation of knowledge to be generated through the South Coast MPA Baseline Program. The Baseline Program has two purposes:

1. **Baseline Characterization** – A summary description, assessment and understanding of ecological and socioeconomic conditions in the South Coast region, inside and outside MPAs, at or near the time of MPA implementation.

2. **Assessment of Initial Ecological and Socioeconomic Changes** - Measurement of initial ecological changes and the short-run net benefits or costs to consumptive and non-consumptive user groups following MPA implementation.

Numerous on-going monitoring programs, as well as extensive historical data sets, exist in the South Coast region, including, for example, those associated with fisheries and water quality programs. The Baseline Program will incorporate analyses and interpretation of existing data to contribute to and strengthen the baseline characterization of the region.

In addition, a network of MPAs was established in the northern Channel Islands in 2003. Baseline monitoring of these MPAs was conducted between 2003 and 2008, and a five-year review performed in 2008.[17] These MPAs are included, unaltered, in the South Coast regional MPA network adopted by the FGC, and are therefore within the geographic scope of the Baseline Program. The Baseline Program provides an opportunity to incorporate the northern Channel Islands into an integrated regional picture of ecological and socioeconomic conditions.

For more details, see the South Coast MPA Baseline Program Request for Proposals (RFP), Appendix C-2.

[17] Report of the First 5 Years of Monitoring in the northern Channel Islands: 2003-2008. Available on-line at: http://www.dfg.ca.gov/marine/channel_islands/fiveyears.asp.

Both the Baseline Program and long-term monitoring employ monitoring metrics that have been selected to provide insights into important components and functions of each Ecosystem Feature. They have been selected to encompass the different timeframes over which different changes may occur following MPA implementation, and in consideration of the regular reviews of the MPAs recommended in the MLPA Master Plan. In addition, the monitoring metrics have been designed to lead to strategic growth of our understanding of marine ecosystems, of our ability to detect changes in those ecosystems, and ultimately of our ability to attribute observed changes to establishment of MPAs. Thus, some metrics have been chosen because they are likely to detect straightforward potential MPA effects, such as increases in the abundance and size of selected species. Other chosen metrics (e.g., kelp canopy areal extent) may be less immediately responsive to potential MPA effects, but will provide important insights into the structure or functioning of ecosystems.

BUILDING A BODY OF KNOWLEDGE TO STRENGTHEN MPA MANAGEMENT

The benefits of monitoring for MPA management will increase over time as better and more detailed information is accumulated on ecosystem condition and trends, in turn allowing improved explanations and predictions to be made. As described in Chapter 3, all ecosystems are influenced by a variety of natural and anthropogenic impacts, and by multiple management measures. Long-term tracking of ecosystems provides the information needed to begin to understand how ecosystems respond to these many influences, and the role that MPAs are playing, which in turn will inform future adaptive management decisions aimed at improving the MPAs' effectiveness.

The MPA monitoring metrics may also benefit other (non-MPA) management priorities and mandates, such as fisheries management. To the extent possible, monitoring metrics have been chosen that will benefit other programs without compromising the ability to meet MLPA monitoring requirements. For example, some fishery species have been chosen as metrics both because they will inform assessment of MPA effectiveness, and because information on these species may benefit fisheries management. Examples include kelp bass (*Paralabrax clathratus*) and olive rockfish (*Sebastes serranoides*), species for which stock assessments have not been conducted.

Monitoring of ecosystems is a new science, and monitoring metrics and approaches will be tested and refined over time. Targeted research programs and partnerships will be essential to evaluate and improve monitoring over time. To this end, this chapter also identifies key topics for research to advance our knowledge of ecosystem structure and function and to develop new efficient methods and technologies for implementing long-term monitoring.

IMPLEMENTATION OPTIONS

As previously described, this plan provides options and recommendations for MPA monitoring in the form of a series of modules. In this section of the monitoring plan, a stand-alone monitoring module is described for the long-term tracking of the condition and trends of each Ecosystem Feature. Implementation of all ten modules, covering all ten Ecosystem Features, provides comprehensive coverage of the major marine and coastal ecosystems of the South Coast region and potential MPA effects on those ecosystems. However, given that some Ecosystem Features may be more responsive to potential MPA effects than others; that management priorities may emphasize some Ecosystem Features over others; and that monitoring resources may be limited, it may be appropriate to select a subset of the modules for monitoring implementation. Guidance for choosing among modules, should resource limitations or other considerations argue against implementation of all modules, is provided in Chapter 9.

In addition to designing this element of monitoring to allow choice of modules, choice is also provided in how each module may be implemented. Two implementation options are presented for each module:

1. Ecosystem Feature Checkup, and

2. Ecosystem Feature Assessment.

Both options retain an ecosystem-level focus and have been designed to efficiently leverage different types of existing or potential capacity to contribute to MPA monitoring within the region. For each module, one or both options may be used in the same or different MPAs; the two options have been designed to provide compatible information, although at different levels of resolution.

ECOSYSTEM FEATURE CHECKUPS

The Ecosystem Feature Checkup option is designed to provide a coarse-grained evaluation of ecosystem condition and trends. This option is primarily designed to take best advantage of the potential role that citizen-science groups and community organizations may play in contributing to monitoring the South Coast regional MPA network. This type of monitoring uses simplified sampling protocols and methods and includes well-developed training programs for data collectors and formalized data quality assurance and quality control (QA/QC) procedures.

For each Ecosystem Feature, with the exception of Deep Ecosystems, a set of vital signs is selected that collectively will evaluate Feature condition and trends inside and outside select MPAs and thus across the region as a whole. Emphasis has been placed on selecting vital signs that do not require technically demanding monitoring metrics and equipment-intensive methods. At this time, methods that would be amenable for use by citizen-scientist groups to comprehensively sample Deep Ecosystems (>100m depth) have yet to be developed. Should this change, appropriate vital signs will be developed.

IDENTIFYING VITAL SIGNS OF ECOSYSTEM FEATURE CONDITION

Vital signs were selected using the MLPA policy guidance (see Chapter 2), including the list of species likely to benefit from MPAs (Appendix C-6), and the requirement to facilitate assessments at a variety of spatial scales, from the individual MPA through the regional MPA network as a whole.

For the ecological Features, many vital signs were chosen to reflect commonly observed changes to marine and coastal ecosystems, emphasizing those that may be sensitive to MPA effects. These changes include loss of habitat (particularly biogenic habitat), decreased size of fish species, decreased abundance of top-level predators, and the consequent simplification of food webs within marine ecosystems. Currently, many of the vital signs only indirectly link to these overarching trends in marine ecosystems. This is in part due to a deliberate focus on selecting vital signs that may be assessed with minimal technological and other resource requirements in order to best tap into potential community-based or citizen-science MPA monitoring programs. However, it also reflects the limited scientific knowledge of the critical elements and processes maintaining marine ecosystems in the region. As scientific understanding of these ecosystems increases, the vital signs will be refined and adapted accordingly.

For the human uses Features, priority was accorded to selecting vital signs that can be monitored using existing datasets and monitoring programs. For consumptive uses, there are several fisheries monitoring programs that collect information suitable for conducting a Checkup of this Ecosystem Feature. However, there are few, if any, existing programs that collect relevant information for non-consumptive uses. Such programs could of course be developed, and possible vital signs are provided to guide development of potential programs.

IMPLEMENTING ECOSYSTEM FEATURE CHECKUPS

Vital signs have been designed as a cohesive set of metrics and all vital signs for a specific Checkup should be included if that Ecosystem Feature is being evaluated. Given the large spatial variation in ecosystem components and human uses, the

necessarily coarse-grained nature of Ecosystem Feature Checkups will be best suited to evaluating MPA performance through detecting trajectories of change over time, and less conclusive for making small-scale, inside-outside comparisons for individual MPAs.

For ecological Features, vital signs data will be periodically collected inside and outside select MPAs and this information will be synthesized to identify regional trends in Ecosystem Feature condition inside and outside MPAs. For the Consumptive Uses Ecosystem Feature, the vital signs have been selected to draw on data currently available through existing databases and programs, and are thus constrained by the limited geographic resolution within these data sources. Thus, as with the ecological vital signs, interpretation of this information will be most useful, and most robust, at a region-wide scale. Vital signs for Non-consumptive Uses have been suggested to guide future implementation of data collection programs. To be most useful, implementation of this Ecosystem Feature Checkup should draw upon the experience garnered through data collection as part of Ecosystem Feature Assessments (described further below).

ECOSYSTEM FEATURE ASSESSMENTS

The Ecosystem Feature Assessment option is a scalable method for implementing monitoring of Ecosystem Features that is more detailed and technically demanding than the Ecosystem Feature Checkup option. Ecosystem Feature Assessments build upon and adapt well-tested monitoring methods often employed in status and trends monitoring.[18] The condition and trends of each Ecosystem Feature are assessed by identifying a limited set of key attributes of the feature and evaluating the condition of these key attributes using a small number of strategically selected focal species or indicators.

Ecosystem Feature Assessments are designed to take advantage of technically robust monitoring partnerships, such as those with state and federal agencies or research programs and institutions. If the Assessment option is chosen for implementation, all the key attributes and indicators/focal species of the selected Ecosystem Feature should be monitored. These metrics encompass attributes and indicators/focal species considered adequate to collectively assess the condition and trends of the feature, and comparatively feasible to implement and interpret.

Optional add-on attributes and indicators/focal species have also been identified. These may be selected as desired. They provide additional insights, but are more difficult or expensive to implement, and can be more challenging to interpret. Optional add-on metrics should be added to monitoring only if or to the extent that resources permit, and used in addition to the Assessment metrics. Research programs aimed at improving understanding of marine ecosystems and approaches to MPA monitoring may make metrics currently included in the optional add-ons more useful or feasible to implement in future, and Ecosystem Feature Assessment metrics will then be updated accordingly.

Ecosystem Feature Assessments differ somewhat between ecological and human uses Ecosystem Features. The approaches to each are described below.

ELEMENTS OF ECOSYSTEM FEATURE ASSESSMENT – ECOLOGICAL FEATURES

Ecosystem Feature Assessments of the eight ecological Features are conducted via key attributes and indicators or focal species. Figure 4-1 provides a conceptual diagram illustrating these monitoring components.

[18] For example, this approach is consistent with that developed by Foundations of Success (FOS), a non-profit organization with experience supporting planning, monitoring, and adaptive management of conservation and resource management projects in California and worldwide. This approach extends the FOS methodology, which incorporates Key Ecological Attributes and Indicators. For more information on FOS see www.fosonline.org.

For each ecological Feature, a limited set of key attributes is identified. Key attributes are designed to capture fundamental aspects of the structure and functioning of the Feature that are critical for maintaining its condition through time. They are not meant to provide an exhaustive characterization of each Ecosystem Feature, but to give an indication of the general condition of the Feature and trends over time inside and outside MPAs and throughout the region.

Each key attribute is assessed using focal species or indicators. Indicators are monitoring metrics known to relate to a broader ecosystem aspect. Focal species do not indicate broader ecosystem condition, but as a group collectively give insight into an aspect of community or trophic structure. Indicators are generally preferable as, by definition, they directly signify attribute condition. However, specific indicators of the condition or trends in key attributes are frequently unknown. In these cases a limited set of focal species has been selected to provide insight into the condition of the attribute. Collectively, the focal species/indicators will provide an indication of the condition of the corresponding key attribute and how it changes over time.

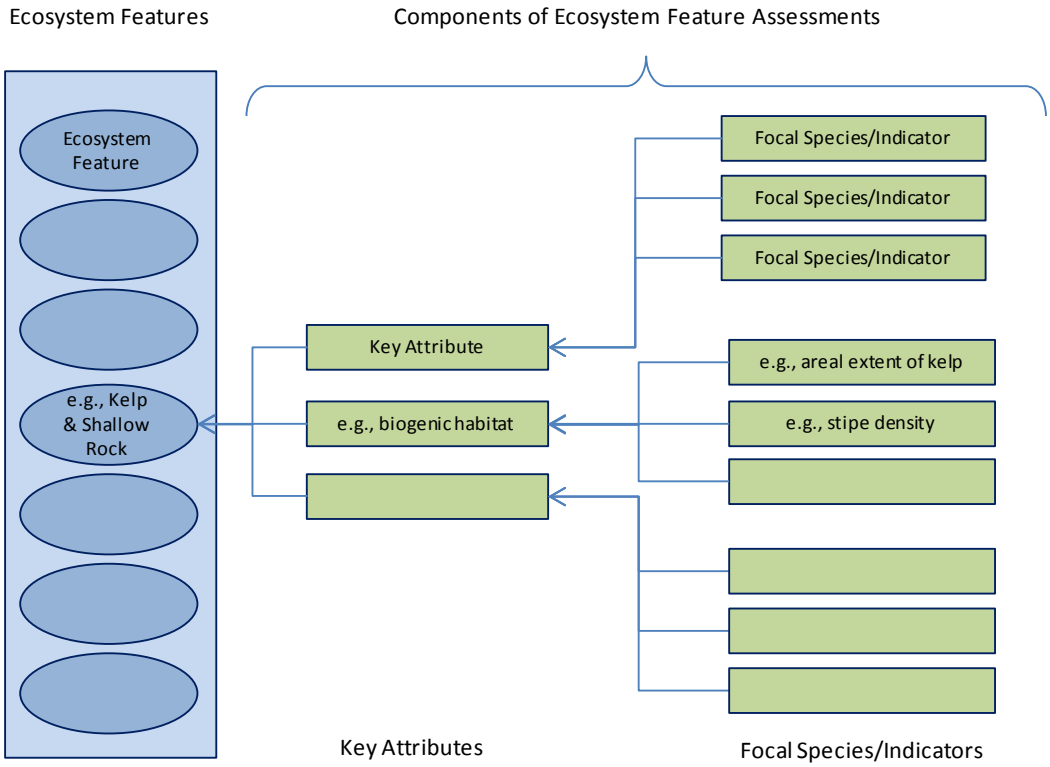


***Figure 4-1**. Conceptual diagram of the structure of the Ecosystem Feature Assessment option for tracking the condition of Ecosystem Features. A limited set of focal species/indicators is selected to collectively assess the status of a key attribute. Collectively, the status of key attributes is used to assess the condition of the Ecosystem Feature. An illustrative example is provided here for the Kelp & Shallow Rock Ecosystem Feature.*

IDENTIFYING KEY ATTRIBUTES

Ecosystems are complex systems comprising many different components held together by an intricate set of ecological and physical processes. Ideally, key attributes for assessing ecosystem condition would focus on system properties, processes, and functions, such as resilience, trophic structure, or nutrient cycling. However, the science guiding the measurement and interpretation of such metrics is in its infancy, and they are expensive to implement using current methods. Thus they are,

for now, best explored through research partnerships, rather than being included as monitoring metrics. The currently selected key attributes include aspects of biogenic habitat together with functional species groups (e.g., predatory fishes) within each ecosystem. As scientific understanding of ecosystem structure and function increases, monitoring approaches, including selected key attributes, will be appropriately refined and adapted.

To facilitate this improvement, and to provide rationale for each selected key attribute, each attribute has been split into two components. The first of these describes the broad ecosystem attribute under consideration. The second describes how this attribute is being assessed within the Ecosystem Feature, taking into account current knowledge and feasibility of monitoring. For example, one key attribute for assessing the Kelp & Shallow Rock Ecosystem Feature is 'biogenic habitat: macroalgae'. In this case, biogenic habitat is the key ecosystem attribute, which is assessed through monitoring of macroalgae within this ecosystem. Increasing experience with using this key attribute, and targeted research, may lead to improvements in how the attribute is assessed or replacement of the attribute itself.

IDENTIFYING FOCAL SPECIES/INDICATORS

Indicators for assessing key attributes capture aspects of the spatial distribution and size or extent of each attribute (such as the amount and distribution of biogenic habitat). In the future, as scientific understanding of ecosystem functions and processes advances, indicators of key attribute functioning or quality will be incorporated.

To the extent they are known, specific indicators of the condition of key attributes have been included. Where this is impossible due to the current limits of scientific knowledge, a limited set of focal species has been selected to collectively provide insight into components of the key attribute and, by extension, into the key attribute itself. Sets of focal species were identified and recommended using existing knowledge and taking into account the following considerations and criteria:

- Species which play a known and important ecological role
- Likely fast and slow MPA responders
- Species with different life history characteristics
- Warm- and cold-water associated species
- Fished species which may be likely to show an MPA response, and unfished species for comparison
- To the extent possible, without compromising the ability to track the trends in key attributes, species identified as fishery management priorities, especially those managed under the Marine Life Management Act (MLMA)

ELEMENTS OF ECOSYSTEM FEATURE ASSESSMENT – HUMAN USES FEATURES

Two human uses Ecosystem Features are included: Consumptive Uses and Non-consumptive Uses. The Ecosystem Assessment monitoring metrics for these two Ecosystem Features are structured differently from those for the ecological Features. The selected structure reflects well-established monitoring methods for these subject areas and will facilitate making analytical and interpretive links between the ecological and human uses Ecosystem Features.

Analogous to the key attributes previously defined, key consumptive and non-consumptive uses have been identified for monitoring. A recommended minimum set of key human uses for focusing monitoring activities is described, as well as additional human uses that can be included where resources and methods permit. Indicators have been identified to assess these human uses and track changes in them over time.

IDENTIFYING INDICATORS

For both the Consumptive and Non-consumptive Uses Ecosystem Features, an overarching set of indicators has been developed. These indicators are tailored for each Ecosystem Feature to identify the most useful monitoring metrics, taking into account the standard methods employed to monitor patterns of human uses and socioeconomic trends. These indicators can be applied, with appropriate modifications, to each consumptive or non-consumptive use identified for monitoring. As with the ecological elements, the recommended monitoring metrics are not meant to provide an exhaustive characterization of the Ecosystem Feature, but to give an indication of the general status of the feature and trends over time.

The indicators are structured as a list of indicator categories. These categories are included in rank order of descending importance and offer a mechanism to scale implementation of data collection. All categories of indicators within the frameworks are necessary to conduct a comprehensive assessment of Ecosystem Feature condition and interpret trends through time; however, further guidance is provided in Chapter 9 for approaches to scale implementation in ways that produce useful sets of results should resource limitations preclude full implementation.

IMPLEMENTING ECOSYSTEM FEATURE ASSESSMENTS

Ecosystem Feature Assessment approaches are implemented by collecting data inside and outside select MPAs distributed through the South Coast regional MPA network. Where resources and methods permit, a stratified approach may be adopted in which sampling is conducted at increasing distances inside and outside MPA boundaries, thus providing increased resolution in data collected and improved insight into MPA functioning together with patterns of ecosystem change and human uses.

Where Ecosystem Feature Assessments are chosen to assess Ecosystem Features, all metrics should be monitored to robustly assess the feature. When feasible and desirable, some or all of the optional add-ons for Ecosystem Feature Assessments can be selected and added to provide more comprehensive information.

METRICS FOR ECOSYSTEM FEATURE CHECKUPS & ASSESSMENTS

The following sections of this chapter describe the selected metrics for long-term tracking of condition and trends of the ten Ecosystem Features identified for the South Coast region. For each Ecosystem Feature, a summary list of the monitoring metrics is provided, including the metrics for the Ecosystem Feature Checkup (orange) and Assessment (green) options. Further detail describing the rationale for selection of each metric is provided in Appendices B-1 & B-2, the Guide to Vital Signs and Guide to Attributes & Indicators, respectively. The monitoring metrics also draw upon the general information provided for each Ecosystem Feature in Chapter 3.

It will be important during the analysis and interpretation of monitoring results to consider contextual information; for example, natural influence of the physical environment such as oceanographic conditions or substrate types, as well as human influences, such as economic conditions or land-use patterns. Contextual information will be drawn from other monitoring programs and data sources; therefore we do not list specific contextual metrics here. Chapter 3 provides a more complete discussion of types of contextual information that may be important to consider. In addition, evaluation of specific contextual metrics that provide the most useful information should occur as part of monitoring implementation in collaboration with agencies, groups and organizations collecting that data.

ROCKY INTERTIDAL ECOSYSTEMS

ECOSYSTEM FEATURE CHECKUP

Vital Signs
➢ Mussel bed cover ➢ Rockweed cover ➢ Surfgrass cover ➢ Ochre sea star abundance & size frequency ➢ Marine bird richness and abundance ➢ Black abalone abundance & size frequency ➢ Purple sea urchin abundance & size frequency ➢ Owl limpet abundance & size frequency ➢ Pinniped abundance (harbor seal, California sea lion, northern elephant seal)

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Biogenic Habitat	Percent cover of focal species: Mussels (*Mytilus* spp.) Barnacles (*Balanus* spp., *Chthamalus dalli*) Feather boa kelp *(Egregia menziesii*) Rockweed (Fucaceae, multiple species) Surfgrass (*Phyllospadix* spp.)
Trophic Structure: Predators	Ochre sea star (*Pisaster ochraceus*) density & size structure
	Piscivorous bird richness & abundance
	Shorebird richness & abundance
Trophic Structure: Herbivores	Density & size structure of focal species/species groups: Black abalone (*Haliotis cracherodii*) Purple sea urchin (*Strongylocentrotus purpuratus*) Owl limpet (*Lottia gigantea*) Turban snails (*Tegula* spp.)

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Biogenic Habitat: Macroalgae	Cover of focal groups Turf algae Foliose red algae Encrusting algae
Diversity	Species richness (algae & invertebrates)
	Species diversity (functional groups of algae & invertebrates)

KELP & SHALLOW ROCK ECOSYSTEMS (0-30M)

ECOSYSTEM FEATURE CHECKUP

Vital Signs
➢ California sheephead abundance, size frequency & sex ratio ➢ Red sea urchin abundance & size frequency ➢ Purple sea urchin abundance & size frequency ➢ Spiny lobster abundance & size frequency ➢ Kelp bass abundance & size frequency ➢ Giant sea bass abundance (i.e. encounter rate) ➢ Rockfish abundance & size frequency ➢ Abalone (multiple species) abundance & size frequency

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Biogenic Habitat: Macroalgae	Giant kelp (*Macrocystis pyrifera*) areal extent
Strong Ecological Interactors	Density & size structure of focal species: Red sea urchin (*Strongylocentrotus franciscanus*) Purple sea urchin (*Strongylocentrotus purpuratus*) Spiny lobster (*Panulirus interruptus*)abundance & size structure California sheephead (*Semicossyphus pulcher*) density, size structure & sex ratio
Trophic Structure: Predatory fishes	Density & size structure[1] of focal species: Kelp bass (*Paralabrax clathratus*) Olive rockfish(*Sebastes serranoides*) Kelp rockfish (*Sebastes atrovirens*) Cabezon (*Scorpaenichthys marmoratus*)
Trophic Structure: Predatory invertebrates	Density & size structure of focal species: Kellet's whelk (*Kelletia kelletii*) Sea stars (*Pisaster* spp*., Pycnopodia helianthoides*)
Trophic Structure: Planktivorous fishes	Density & size structure[1] of focal species: Blacksmith (*Chromis punctipinnis*) Señorita (*Oxyjulis californica*) Blue rockfish (*Sebastes mystinus*)
Trophic Structure: Herbivores	Density & size structure of focal species: Abalone (*Haliotis* spp.) Giant keyhole limpet (*Megathura crenulata*) Wavy turban snail (*Megastraea undosa*)

[1] Size structure includes young-of-the-year where feasible.

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSEMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Biogenic Habitat	Giant kelp (*Macrocystis pyrifera*) stipe density
	Sub-canopy & turf algae cover
	Surfgrass (*Phyllospadix torreyi*) cover
	Sessile invertebrate percent cover
Strong Ecological Interactors	Sea otter (*Enhydra lutris*)abundance
Trophic Structure: Predatory birds	Abundance (colony size) and fledgling rate of focal species: Brandt's cormorant (*Phalacrocorax penicillatus*) Pelagic cormorant (*Phalacrocorax pelagicus*) Pigeon guillemot (*Cepphus columba*) California least tern (*Sternula antillarum*)
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

MID-DEPTH ROCK ECOSYSTEMS (30-100M)

ECOSYSTEM FEATURE CHECKUP

Vital Signs
➢ Rock crab abundance & size frequency ➢ Rockfish abundance & size frequency ➢ Lingcod abundance & size frequency ➢ California scorpionfish abundance & size frequency

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Biogenic Habitat: Sessile invertebrates	Structure forming invertebrate cover & height
Trophic Structure: Mobile invertebrates	Density of focal species: Rock crab (*Cancer* spp.) Urchin (Echinidae, multiple species)
Trophic Structure: Predatory fishes	Density & size structure[1] of focal species: Bocaccio (*Sebastes paucispinis*) Vermilion rockfish (*Sebastes miniatus*) Lingcod (*Ophiodon elongatus*) Ocean whitefish (*Caulolatilus princeps*) California scorpionfish (*Scorpaena guttata*) Rockfish (*Sebastes* spp.) size structure[1]
Community Structure: Dwarf rockfishes	Total dwarf rockfish abundance (multiple species)

[1] Size structure includes young-of-the-year where feasible.

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Biogenic Habitat	Cover of focal species: *Metridium* spp. Purple hydrocoral (*Stylaster californicus*) Elk kelp (*Pelagophycus porra*)
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

ESTUARINE & WETLAND ECOSYSTEMS

ECOSYSTEM FEATURE CHECKUP

Vital Signs
➢ Eelgrass areal extent ➢ Ghost & mud shrimp abundance ➢ Clam abundance & size frequency (Pacific gaper, Washington & common littleneck) ➢ Marine birds richness & abundance ➢ California halibut abundance & size frequency ➢ Croaker abundance & size frequency (multiple species) ➢ Arthropod biomass ➢ Pinniped abundance (harbor seal, California sea lion, northern elephant seal)

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Biogenic Habitat: Plants	Areal extent of focal species: Eelgrass (*Zostera marina*) Pickleweed (*Salicornia* spp.)
Trophic Structure: Infaunal assemblage	Abundance of focal species: Mud shrimp (*Upogebia* spp.) Ghost shrimp (*Neotrypaea* spp.) Pacific gaper clam (*Tresus nuttalli*) Washington clam (*Saxidomus nuttalli*) Common littleneck clam (*Protothaca staminea*)
Trophic Structure: Predatory birds	Piscivorous bird richness & abundance
	Shorebird richness & abundance
Trophic Structure: Predatory fishes	Density & size structure of focal species: Leopard shark (*Triakis semifasciata*) California halibut (*Paralichthys californicus*)
Trophic Structure: Resident fishes	Density & size structure of focal species: Spotted sand bass (*Paralabrax maculatofasciatus*) Gobies (Gobiidae, multiple species) Topsmelt (*Atherinops affinis*) Croaker (Sciaenidae, multiple species)
Productivity	Arthropod biomass

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSMENT

This set of information includes additional metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Trophic Structure: Benthic infauna	Abundance & foraging rates of shorebirds
Trophic Structure	Parasite diversity
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of fishes & invertebrates)

SOFT-BOTTOM INTERTIDAL & BEACH ECOSYSTEMS

ECOSYSTEM FEATURE CHECKUP

Vital Signs

- Sand crab abundance
- Pismo clam abundance & size frequency
- Beach wrack composition & abundance
- Surfperch abundance & size frequency (multiple species)
- Croaker abundance & size frequency (multiple species)
- Grunion, number and strength (i.e.duration, # of spawners) of spawning runs
- Marine bird richness & abundance
- Pinniped abundance (harbor Seal, California sea lion, northern elephant seal)

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Trophic Structure: Suspension feeders	Density and size structure of focal species: Sand crab (*Emerita analoga*) Pismo clam (*Tivela stultorum*) Bean clams (*Donax gouldii*)
Productivity: Beach wrack	Wrack composition & abundance
Productivity: Surf zone fish assemblage	Surfperch abundance & size structure (Embiotocidae, multiple species)
	Croaker abundance & size structure (Sciaenidae, multiple species)
	Grunion (*Leuresthes tenuis*) number and strength of spawning runs
Trophic Structure: Predatory birds	Piscivorous bird richness & abundance
	Shorebird species richness & abundance

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSMENT

This set of information includes additional metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Productivity	Wrack invertebrate diversity and biomass
Diversity	Species richness (invertebrates and fishes)
	Species diversity (functional groups of invertebrates & fishes)

SOFT-BOTTOM SUBTIDAL ECOSYSTEMS (0-100M)

ECOSYSTEM FEATURE CHECKUP

Vital Signs
➢ Rock crab abundance & size frequency ➢ California halibut abundance & size frequency ➢ Surfperch abundance & size frequency ➢ Flatfish total abundance & size frequency

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Biogenic Habitat	Eelgrass (*Zostera* spp.) bed extent
	Brittle star (Ophiuroidea, multiple species) bed extent
Trophic Structure: Benthic infauna	Functional diversity of benthic infauna (feeding guilds)
Trophic Structure: Mobile invertebrates	Density & size structure of focal species/species groups: Rock crab (*Cancer* spp.) Sea star (*Astropecten* spp.) Ridgeback prawn (*Sicyonia ingentis*) Sea cucumber (*Parastichopus californicus*)
Trophic Structure: Predatory fishes	Density & size structure of focal species/species groups: California halibut (*Paralichthys californicus*) Bat ray (*Myliobatis californica*) Angel shark (*Squatina californica*)Barred sand bass (*Paralabrax nebulifer*) Surfperch (Embiotocidae, multiple species)

OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Trophic Structure: Predatory fishes	Density & size structure of focal species: Shovelnose guitarfish (*Rhinobatos productus*)Leopard shark (*Triakis semifasciata*) Sanddab (*Citharichthys* spp.)
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

DEEP ECOSYSTEMS, INCLUDING CANYONS (>100M)

ECOSYSTEM FEATURE CHECKUP

Deep ecosystems pose unique challenges for data collection and sampling at these depths typically requires the use of methods such as ROVs and submersibles. At this time, methods that would be amenable for use by citizen-scientist or community groups have yet to be developed. Should this change, appropriate vital signs will be developed.

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Biogenic Habitat: Sessile invertebrates	Structure forming invertebrate cover & height
Trophic Structure: Predatory fishes	Density & size structure[1] of focal species/group: Cowcod (*Sebastes levis*) Bocaccio (*Sebastes paucispinis*) Bank rockfish (*Sebastes rufus*) Sablefish (*Anoplopoma fimbria*)
Trophic Structure: Detritivores	Total abundance of focal species/groups: Sea urchin (Echinoidea, multiple species) Hagfish (*Eptatretus stoudii*) Spot prawns (*Pandalus platyceros*) abundance, size structure & sex ratio
Community Structure: Dwarf rockfishes	Total dwarf rockfish abundance (multiple species)

[1] Size structure includes young-of-the-year where feasible.

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSMENT

This set of information includes additional metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

NEARSHORE PELAGIC ECOSYSTEMS

ECOSYSTEM FEATURE CHECKUP

Vital Signs
➢ Semi-pelagic/pelagic rockfish average & maximum size ➢ Brown pelican abundance ➢ Sooty shearwater abundance ➢ Cassin's auklet breeding success

ECOSYSTEM FEATURE ASSESSMENT

Key Attribute	Indicator/Focal species
Predators: Piscivorous/planktivorous fishes	Abundance & size structure of focal species: Widow rockfish (*Sebastes entomelas*) Shortbelly rockfish (*Sebastes jordani*) Pacific barracuda (*Sphyraena argentea*) Pacific mackerel (*Scomber japonicas*)
Trophic Structure: Predatory birds	Abundance (colony size) and fledgling rate of focal species: Brown pelican (*Pelecanus occidentalis*) Cassin's auklet (*Ptychoramphus aleuticus*) Sooty shearwater (*Puffinus griseus*) abundance

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSMENT

This information includes supplemental metrics that can be added as methods & resources permit.

Key Attribute	Indicator/Focal species
Productivity: Ichthyoplankton	Total ichthyoplankton abundance
	Total abundance of rockfish larvae
	Ratio of fished species to unfished species
Trophic structure	Total jellyfish abundance
Trophic Structure: Forage base	Forage fish biomass (sardines, anchovies, other school bait fish) Market squid (*Loligo opalescens*) biomass

CONSUMPTIVE USES

ECOSYSTEM FEATURE CHECKUP

Vital signs identified for Consumptive Uses are designed to be derived from existing Department of Fish & Game datasets and monitoring programs.

Vital Signs

- Landings (weight & value) of key species (nearshore rockfishes, spiny lobster, red urchin, California halibut & market squid) per fishing block & port for the commercial fishery
- Landings (number & weight) of key species (nearshore rockfishes, kelp bass, barred sand bass & Pacific barrcuda) per fishing block & port by CPFVs
- CPUE of key species (as above) per fishing block & port by CPFVs
- Number of lobster captured per fishing trip and location by recreational fishers

ECOSYSTEM FEATURE ASSESSMENT

INDICATORS

Each consumptive use is monitored using the same indicators. Note, however, that not all indicators need to be implemented at the same time, or at the same frequency. For example, Knowledge, Attitudes and Perception (KAP) surveys may be most usefully conducted once every five or more years. Indicators for Consumptive Use are:

Indicators

1. Number of people or vessels engaged in the activity
2. Level of activity
    a. Number of fishing trips per fishing location, vessel, port & region
    b. Landings of key species per trip, fishing location, vessel, port & region
    c. CPUE (catch per unit effort) of key species per trip, fishing location, vessel, port & region
3. Economic value or quality of activity
    a. Landings value of key species per trip, fishing location, vessel, port & region
    b. Ex vessel value of key species (commercial fisheries)
    c. Net revenue (commercial fisheries) or expenditures (recreational fisheries)
4. Knowledge, Attitudes and Perceptions (KAP) of participants
    a. Motivation
    b. Satisfaction

CONSUMPTIVE USES TO BE MONITORED

For each consumptive use or activity, key fishery species for monitoring include economically and ecologically important species.

Consumptive Uses to be Monitored
Commercial Fishing: Nearshore rockfish (*Sebastes* spp.) Spiny lobster (*Panulirus interruptus*) California halibut (*Paralichthys californicus*) Red sea urchin (*Strongylocentrotus franciscanus*) Market squid (*Loligo opalescens*) Crab (*Cancer* spp.)
Recreational Fishing – Commercial passenger fishing vessels (CPFVs): Nearshore rockfish (*Sebastes* spp.) Kelp bass (*Paralabrax clathratus*) Barred sand bass (*Paralabrax nebulifer*) Pacific barracuda (*Sphyraena argentea*) California scorpionfish (*Scorpaena guttata*)
Recreational Fishing – Private vessels, including kayaks: Nearshore rockfish (*Sebastes* spp.) Kelp bass (*Paralabrax clathratus*) Barred sand bass (*Paralabrax nebulifer*) Spiny lobster (*Panulirus interruptus*) California halibut (*Paralichthys californicus*)
Recreational Fishing – Shore-based Surfperches (Embiotocidae, multiple species) Croakers (Scianidae, multiple species) Silversides (Atherinopsidae, multiple species)
Recreational Fishing – diving, SCUBA and free-diving White seabass (*Atractoscion nobilis*) Yellowtail (*Seriola lalandi*) California sheephead (*Semicossyphus pulcher*) Kelp bass (*Paralabrax clathratus*) Spiny lobster (*Panulirus interruptus*)

OPTIONAL CONSUMPTIVE USES TO BE MONITORED

This information includes supplemental Consumptive Use metrics, some or all of which can be monitored using the same indicators above, as methods & resources permit.

Optional Consumptive Uses to be Monitored
Recreational Fishing – Clamming Pacific gaper clams (*Tresus nuttalli*) Pismo clams (*Tivela stultorum*) Washington clams (*Saxidomus nuttalli*) Common littleneck clams (*Protothaca staminea*)
Scientific collecting – indicators to be developed

NON-CONSUMPTIVE USES

ECOSYSTEM FEATURE CHECKUP

Vital Signs
➢ Number of diving trips & divers per access point & dive site ➢ Number of visitors engaging in recreational beach use ➢ Number of visitors to rocky intertidal ecosystems for tidepooling ➢ Number of boat-based wildlife viewing trips & visitors per port & viewing locations ➢ Number of shoreline wildlife viewers to estuarine, wetland & beach ecosystems

ECOSYSTEM FEATURE ASSESSMENT

INDICATORS

Each non-consumptive use is monitored by applying the same indicators listed below. Note, however, that not all indicators need to be implemented at the same time, or at the same frequency. For example, Knowledge, Attitudes and Perception (KAP) surveys may be most usefully conducted once every five or more years. Indicators for Non-consumptive uses are:

Indicators
1. Level of activity a. Number & location of trips (spatial use & intensity) 2. Knowledge, Attitudes and Perceptions (KAP) of participants a. Motivation – including MPAs b. Satisfaction – e.g., travel distance, travel & activity costs, likelihood of return

NON-CONSUMPTIVE USES TO BE MONITORED

Non-consumptive Uses to be Monitored
Scuba diving
Recreational beach use
Tidepooling
Wildlife viewing – boating, including kayaking
Wildlife viewing – shore-based
Educational use

ADVANCING ECOSYSTEM MONITORING THROUGH RESEARCH & DEVELOPMENT

The MLPA defines adaptive management as "a management policy that seeks to improve management of biological resources, particularly in areas of scientific uncertainty, by viewing program actions as tools for learning. Actions shall be designed so that even if they fail, they will provide useful information for future actions, and monitoring and evaluation shall be emphasized so that the interaction of different elements within marine systems may be better understood."[19] As noted in the MLPA Master Plan, "adaptive management requires learning from current experience to improve the process of achieving the goals of the MLPA over time."[20]

This monitoring plan is designed to meet this requirement, enabling assessment of the effectiveness of the South Coast regional MPA network in achieving MLPA goals, and facilitating adaptive management of MPAs. However, an adaptive management approach should be taken not only for the MPAs, but for monitoring itself. Although long-term consistency in monitoring data is important, MPA monitoring must be responsive to changing management needs and environmental conditions to remain relevant. Monitoring should also be flexible to allow improvements based on increased scientific knowledge and experience with different monitoring methods and approaches. Here, priority research needs are identified to advance ecosystem monitoring and guide the development of research partnerships. Further considerations for establishing partnerships are included in Chapter 7 and considerations for funding and implementing research to advance ecosystem monitoring are discussed in Chapter 9.

RESEARCH PRIORITIES

Despite a long history of research, our understanding of marine ecosystem structure and functioning remains incomplete. Anthropogenic changes in marine ecosystems have been well documented globally, such as loss of habitat and decreased abundances of many top-level predators. However, understanding of the mechanisms of ecosystem recovery, or of the key processes and ecosystem elements that confer stability and resilience, is in its infancy. While increasing research effort is targeting these questions, further support will be necessary to adapt and understand the results and conclusions in light of ongoing and increasing climate and oceanographic changes and influences on marine ecosystems. To be useful for advancing MPA monitoring, this increased knowledge of ecosystems must also be coupled with investigation of mechanisms, methods, and technologies that can be applied to efficiently and cost-effectively collect ecosystem-level monitoring data that will be relevant and applicable to management decisions.

To guide research to support MPA monitoring and evaluation and inform MPA management, three priority research goals have been identified:

1. Advanced monitoring methods, including developed and tested new approaches, tools and technologies for efficient monitoring data collection, analysis and interpretation
2. Advanced understanding of the interactions between socioeconomic and ecological ecosystem elements
3. Advanced understanding of marine ecosystem structure and function

Draft potential focuses for research within these core topics are identified and briefly listed below. These priorities represent initial candidates for research topics based on existing data in the South Coast region, and the current state of knowledge of ecosystems and monitoring. Implementation of this research module should take into account continually improving scientific knowledge to focus resources most appropriately. Priority research topics are likely to change, first in response to improved knowledge in the region through the South Coast MPA Baseline Program (see Appendix C-2), and also

[19] California Marine Life Protection Act, Statutes 1999, Chapter 1015, Fish and Game Code section 2852(a).
[20] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 73.

through ongoing scientific research. These research topics will be updated as understanding advances and reviewed as part of an ongoing schedule of evaluation of the monitoring program.

ADVANCING MONITORING METHODS & TECHNOLOGIES

- Application of existing and new modeling frameworks to:
    - Analyze monitoring data and increase our understanding of the drivers and mechanisms of ecosystem condition and trends
    - Evaluate the performance and relationships among selected indicators to inform management about predicted magnitude and timing of responses, effects of co-variables and potential alternative indicator choices
    - Assess the role of MPAs in ecosystem conservation given different scenarios of climate change and recommend improved monitoring approaches
    - Predict the effectiveness of MPAs in ecosystem conservation inside MPA boundaries and beyond given different scenarios of future fishing distribution and intensity
    - Model connectivity and effects of MPA sizes to inform future adaptive management decisions
- Development and testing of novel statistical frameworks, including Bayesian approaches, for analysis of ecosystem trends, including trends in ecosystem characteristics such as resilience and stability
- Investigation into, and testing of, new technologies (or technology not commonly applied to MPA monitoring) to increase the efficiency and effectiveness of MPA monitoring. Potential examples include:
    - Baited Remote Underwater Video (BRUVs)
    - Remote sensing including acoustics
    - Stable isotopes
    - Genetics and genomics applications

UNDERSTANDING SOCIOECONOMIC & ECOLOGICAL INTERACTIONS

- Development of frameworks to explicitly link ecological and socioeconomic monitoring results through coordinated identification of monitoring priorities and approaches

UNDERSTANDING MARINE ECOSYSTEM STRUCTURE & FUNCTION

- Increase understanding of ecosystem resilience and application for MPA monitoring including:
    - Ecological mechanisms conferring increased resilience, including the roles of robustness, resistance to change, recovery rates and reversibility of change, and methods to monitor these ecological processes
    - Role of non-linear dynamics, synergies or thresholds in ecosystem resilience and approaches to monitor these dynamics
    - Links between resilience and diversity or productivity measures and applications for MPA monitoring
- Development of indicators of ecosystem condition including:
    - Indicators of trophic structure
    - Indicators of ecological functioning including ‘strong interactors’ and key processes

DEVELOPING RESEARCH PARTNERSHIPS

The research goals and associated focal topic areas above are complex and span a range of scientific disciplines. Successfully conducting research in support of these overarching goals will require inter- and multi-disciplinary research collaborations and partnerships. Implementation of this research and development module may therefore be best facilitated through the use of competitive proposal processes (e.g., Requests for Proposals, with merit reviews of submissions), or through use of monitoring funds as a match against larger academic, NGO and/or agency external research proposals. Given the likely size and complexity of research teams necessary to address these research questions, collaborations to share and use existing information, together with partnerships that leverage existing or planned research programs, will be essential. While research and development is fundamental to an adaptive and advancing monitoring program, full implementation of this component of a monitoring program and generation of results that can inform the monitoring program is likely to take many years. (See also the broader discussion in Chapter 7 of developing monitoring partnerships.)

5. Evaluating MPA Design & Management Decisions

- Structuring MPA design & management evaluations
- Short-term MPA design & management evaluations
- Long-term MPA design & management evaluations

The monitoring framework designed to meet MLPA requirements necessitates implementation of two complementary monitoring elements: 1) Assessing Ecosystem Condition & Trends; and 2) Evaluating MPA Design & Management Decisions (see Figure 1-1). This chapter describes the approach for structuring and implementing monitoring in support of evaluation of design and management decisions in the South Coast region.

The establishment and on-going management of MPAs involve a number of decisions, ranging from fundamental design decisions made during the MPA planning process, such as MPA size and spacing, to day-to-day management decisions made to address ongoing and emerging issues, such as those related to managing visitors to MPAs. This chapter describes the approach to evaluating the effects of these design and management decisions on ecosystems and their components. The results of these evaluations, together with results of Assessing Ecosystem Condition & Trends, will be used to inform future management decisions, thus facilitating adaptive MPA management as required under MLPA.

STRUCTURING MPA DESIGN & MANAGEMENT EVALUATIONS

APPLYING MANAGEMENT EFFECTIVENESS MONITORING TO THE MLPA CONTEXT

Evaluation of specific design or management decisions is often referred to as 'management effectiveness monitoring'. The term can be misleading, because assessment of management effectiveness generally requires both focused investigation of the impacts of specific decisions as well as assessment of the condition and trends of ecosystems and/or ecosystem components. For example, an MPA boundary may be designed to enclose a rocky reef, in order to protect an entire habitat and maximize the protection provided to reef-associated species. Evaluation of the 'management effectiveness' of this decision may use fish tagging studies to determine how many reef-associated fish move across the boundary and thus are available to the fishery. However, interpreting this information to determine whether, for example, rockfish are being protected as intended by the MPA is strengthened by information about the condition and trend of the rockfish population of interest. If the population is increasing, then 'leakage' of individual fish across the MPA boundary may not be a concern, and indeed may be considered beneficial to help support nearby fisheries. In contrast, if the population is declining, then adjustment to the MPA boundary, for example by moving the boundary away from the reef to encompass a sandy buffer area that rockfish are less likely to cross, may be considered to reduce leakage.

This example illustrates the complexities involved in this type of monitoring, both in designing useful evaluation of the design or management decision of interest (e.g., which species of fish should be tagged?) and in interpreting results. In the context of the MLPA, this component of monitoring also applies to a very broad range of design and management decisions.

During the MPA planning process, guidelines were developed for the design of the South Coast regional MPA network, relating to MPA size and spacing, representation of habitat types, levels of protection (reflecting the types of activities allowed in the MPAs) and other characteristics. In addition, the planning process incorporated many other decisions, such as siting MPAs adjacent to terrestrial parks or marine laboratories to facilitate management, enforcement, monitoring, education, and outreach (see Regional Goals and Objectives, Appendix C-5). All of these design decisions, as well as

additional decisions that will be made by managers after the MPAs take effect (relating, for example, to visitor management) can be evaluated to determine their impacts on the ecosystems of the South Coast region and their contributions to meeting MLPA goals. However, not all decisions are equally amenable to evaluation, or as useful to management if evaluated. In designing monitoring to evaluate specific MPA design and management decisions, Ecosystem Features provide the overarching organizational framework. The challenge is to choose wisely from the large pool of decisions that could be evaluated, and ensure the chosen decisions are evaluated well to ensure results are useful for informing future MPA management decisions. To meet these needs, this plan includes guidance for structuring potential evaluations of design and management decisions, and selection criteria to inform the choice of potential evaluations to prioritize for implementation. Implementation options for this component of monitoring are also discussed.

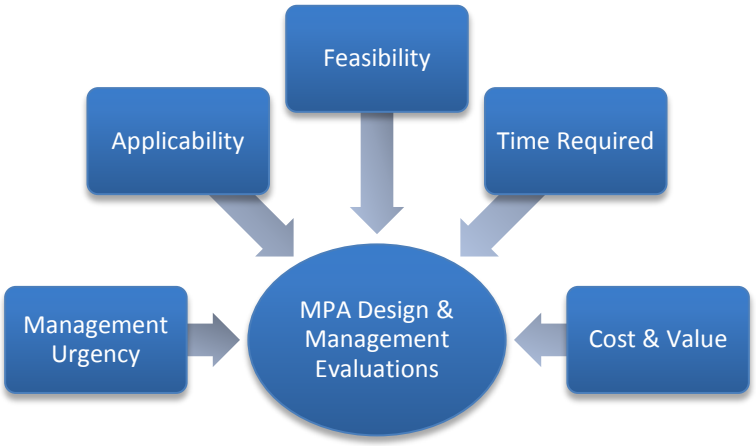
FRAMING EVALUATIONS OF MPA DESIGN & MANAGEMENT DECISIONS

Evaluations of MPA design and management decisions seek to assess the impacts of a given decision on the ecology or socioeconomics of the South Coast region, to inform possible future management decisions. Thus potential evaluations are best framed as questions that explicitly link the decision to be evaluated and the ecosystem response to be assessed. For the evaluation to be as useful as possible, both the decision and the response must be stated specifically. Thus a question formulated as "What is the effect of MPA design on conserving biodiversity?" is much less likely to generate useful information than "What is the effect of placing an MPA boundary across a rocky reef on protecting rockfish within the MPA?"

Once the evaluation question has been formulated as specifically as possible, specific hypotheses or mechanisms are identified that link the decision and the response. In the example given above, it might be hypothesized that rockfish resident in an MPA with a boundary crossing a rocky reef leave the MPA more frequently than do rockfish resident in an MPA with a boundary encircling a rocky reef. Then initial decisions about likely evaluation methods are made, such as the species and numbers of rockfish to be monitored, and the type of tagging or other method to use to detect boundary crossings. After questions, hypotheses, and methods have been identified for MPA design or management questions that are candidates for evaluation, the candidates are assessed and prioritized based on the selection criteria discussed below.

CRITERIA TO SELECT DESIGN & MANAGEMENT DECISIONS FOR EVALUATION

The criteria illustrated below have been developed to guide selection and prioritization among the wide range of MPA design and management decisions that could be evaluated. Many of the criteria will be easiest to apply by comparing potential evaluations against one another to generate relative rankings and prioritizations. This, of course, requires some structure or process for identifying, then prioritizing, potential evaluations, which is discussed later in this chapter under Implementation Options. Following are descriptions of the criteria, with brief discussions of their application to selecting and prioritizing potential MPA design and management evaluations.



MANAGEMENT URGENCY

Some MPA management decisions, or potential decisions, require urgent evaluation, for example when a resource may be at risk or user conflicts are occurring. In these cases, one or more management responses may be under consideration, or implemented, to address the urgent issue. Evaluation of the considered or implemented management responses can predict or assess their effectiveness in resolving the issue. To take a simple example, an MPA may experience increased numbers of visitors observing birds, raising the concern that the disturbance may disrupt nesting, breeding and/or feeding activities. Possible management responses could include increasing the distance between visitors and birds, reducing the numbers of visitors, and educating visitors about how to minimize disturbance. Evaluations could be designed to help choose among these possible management measures and evaluate any that are implemented. These types of evaluations often involve multiple steps. In this case, if a mechanism to increase the distance between visitors and birds was implemented but found to be ineffective in reducing disturbance, a follow-up evaluation may assess whether the increased distance is still inadequate to prevent disturbance or the mechanism is ineffective. For obvious reasons, evaluations to address urgent management needs should be accorded high priority under this criterion.

MANAGEMENT APPLICABILITY

Evaluations of design or management decisions should produce results that are directly applicable to the decision or decisions being evaluated. For example, an evaluation of the effects of MPA size should not merely characterize MPAs of different sizes, but provide information on the relationship of MPA size to key elements of the ecology or socioeconomics of the South Coast region, and ideally generate predictions of the effects of different MPA sizes or size ranges. Thus, future management decisions that may adjust MPA sizes are directly informed by the results of the evaluation. While this may sound obvious, some decisions are much more amenable to informative evaluation than others, and it is important during the structuring of a potential evaluation to identify explicitly which management decision or decisions will be informed by the evaluation, and how the resulting information will be applicable to future decisions.

Breadth of applicability to management should also be considered. For example, an evaluation that will generate information applicable to the entire South Coast regional MPA network may be prioritized over one that is applicable only to a single MPA. Similarly, an evaluation that applies to an entire Ecosystem Feature, or a broad spectrum of human uses, may be more valuable than one narrowly focused on a single species or human activity.

Evaluations that will have the most direct and useful application to future management should be prioritized over those that may generate interesting information but would require additional research or interpretation to be directly relevant to management decisions. This also implies that priority should be given to evaluations applicable to future MPA management decisions that are most likely to be considered.

FEASIBILITY

Some evaluations may be beyond the reach of current science or methods; priority should be accorded to evaluations that are considered feasible. This includes the feasibility of collecting the data or other information needed to support the evaluation, as well as the feasibility of generating conclusive results that are sufficiently robust or reliable to inform management. Speculative findings, or theoretical results that cannot be verified empirically, may be interesting and generate fruitful avenues for research, but are inappropriate as a basis for making management decisions unless or until they can be adequately confirmed.

Evaluations considered likely to generate conclusive information, and likely to generate findings that will be viewed with a high level of confidence despite a complex and dynamic environment, should be given higher priority than those for which such an outcome is less likely or uncertain.

TIME REQUIRED FOR ROBUST EVALUATION

Some design and management decisions can be evaluated relatively quickly. Others are likely to take much longer to generate results that are sufficiently robust that they can with confidence be used to inform management. As discussed in Chapter 3, potential MPA effects will occur in the context of a highly dynamic and variable environment that is affected by a variety of anthropogenic and natural influences, and a wide range of management measures. For example, MPA design decisions relating to larval connectivity among individual MPAs are likely to take many years to evaluate, reflecting the influence of oceanographic cycles and the naturally high variability in larval production and recruitment. Some of these long-term evaluations are extremely important for facilitating adaptive MPA management, so evaluations requiring long time periods for robust evaluation should not be discounted. Indeed, as is discussed further under Implementation Options below, both short-term and long-term evaluations are important. But clear understanding of the time required to produce the desired information from different potential evaluations should be part of the analysis and prioritization of potential evaluations.

COST & VALUE OF INFORMATION TO BE PRODUCED

Potential evaluations are likely to vary widely in cost, and this will obviously be an important consideration in selecting and prioritizing candidate questions. Some types of evaluations, such as those involving assessments of wildlife disturbance, may be well-suited to collaborations with citizen-science or community-based monitoring partners, possibly leading to significant cost-sharing. Other evaluations may be expensive, but with costs shared among a variety of partners, such as through collaborations between agencies and academic institutions. The cost of a potential evaluation should be weighed against its value, which includes not only its performance against the criteria described above, but also the likely impact of the evaluation's results.

While it is obvious that low-cost, high-value evaluations should be given higher priority, in practice many evaluations are likely to occupy some middle ground of cost and value. For such evaluations, other considerations may be useful to apply, such as the degree of public interest in specific potential evaluations.

IMPLEMENTATION OPTIONS

To further guide the implementation of this monitoring element, two modules have been developed based on the expected time needed to generate robust information that can confidently be used to inform management: short-term evaluations and long-term evaluations. Both of these modules are important to help meet MLPA monitoring requirements, and both can be scaled according to management priorities and available resources.

An inventory of potential evaluation questions will assist with identifying, assessing, and prioritizing potential evaluations, and managing those selected for implementation. The inventory should separately track short-term and long-term modules, to facilitate their management, and could be further classified and prioritized as desired (e.g., by subject area or by geographic scope). Ideally the inventory would be publicly accessible, and reviewed and updated regularly (e.g., annually or biennially). An initial inventory is included in this plan. These questions have arisen through the South Coast MPA planning process and through consultations with stakeholders and scientists during the MPA monitoring planning process (see Summary Reports from Public Workshop Round 1 and Round 2, Appendices C-3 and C-4). During implementation of this monitoring element, the questions below may be augmented or replaced with others, depending on management priorities.

It is important to note that addressing MPA design and management questions does not necessarily involve the collection of new data or the carrying out of new experiments. Much potentially relevant information is available, for example, in previous scientific studies that have been reported on in peer-reviewed journals. However, the answers to these questions may not have been applied to the management of MPAs in the South Coast region. Addressing these questions could therefore involve compiling the relevant literature, conducting new experiments and/or collecting new survey data. A key aspect of addressing these questions is prioritizing results that are relevant and reliable for informing future management decisions in this region.

Many recommendations regarding MPA design and management were made during the MPA planning process based upon the best available science and potential MPA effects. Once the MPAs are implemented, there will be an opportunity to refine these guidelines and recommendations based on actual, measured effects. The intention of the evaluations addressed by this side of the framework, therefore, is not to question these science guidelines or to answer questions that have already been addressed, but to instead facilitate adaptive management, through which management actions are refined and improved via testing and evaluation. Evaluating the effects and performance of the MPAs adopted for the South Coast region, through use of existing data and/or collection of new data, will provide important information to guide future MPA decisions.

SHORT-TERM MPA DESIGN & MANAGEMENT EVALUATIONS

Short-term evaluations are those expected to generate conclusive information in four years or less, and are thus answerable within the one of the five-year review cycles of the MPAs recommended by the MLPA Master Plan. These questions tend to be focused on very specific design or management decisions, and the responses of select ecological or socioeconomic components of Ecosystem Features to those decisions. Some of the short-term questions may be addressed comparatively inexpensively, and some may be feasibly approached through collaborations with community members.

During the MPA planning process for the South Coast region, stakeholders were asked to develop specific proposals for the regional MPA network, implementing guidelines relating to individual MPA and network design aspects, and considering the interests of different stakeholders. In preparing their proposals, stakeholders made many decisions about the siting, size, and boundary placement of individual MPAs, as well as the human activities allowed in each MPA, based on the

guidelines and seeking to balance competing interests and priorities to the extent possible. Many potential short-term evaluation questions arose through this process. In addition, participants at the Round 1 Public Workshops for MPA monitoring planning took part in break-out sessions to identify potential design and management questions (see Public Workshop Round 1 Summary Report, Appendix C-3), and public comment on draft design and management evaluation questions was sought following Round 2 Public Workshops for MPA monitoring planning (see Public Workshop Round 2 Summary Report, Appendix C-4). Additional questions were identified through this public input.

INITIAL INVENTORY OF SHORT-TERM EVALUATION QUESTIONS

Following are the short-term evaluation questions that have been selected for inclusion in the South Coast MPA Monitoring Plan. These questions were repeatedly identified by stakeholders during the MPA planning and MPA monitoring planning processes. In each case, the question is accompanied by a brief explanation of the link between the question and the science guidelines, policy guidance and questions that arose or were used in planning the regional MPA network. All of the questions have the potential to contribute to adaptive MPA management, even though some questions address activities which are beyond the administrative jurisdiction of the California Fish and Game Commission. This list forms an initial inventory of questions to be further evaluated and prioritized at the time of monitoring implementation.

- **What are the economic effects (e.g., fuel costs, time spent at sea) of MPA placement, specifically distance from ports and location relative to fishing grounds? What are the ecological and economic implications for siting MPAs to minimize adverse economic impacts and to prevent serial depletion?** The South Coast regional design considerations recommend that MPAs be sited "to prevent fishing effort shifts that would result in serial depletion".[21] In addition, policy guidance developed during the South Coast MPA planning process recommended that consideration be given to potential socioeconomic effects in designing the regional MPA network. This evaluation may usefully inform future decisions about MPA location.
- **Are the identified key habitats represented and replicated in the implemented array of MPAs?** During the MPA design process, the South Coast Science Advisory Team (SCSAT) developed science guidelines for individual and MPA network design, including recommending that all key habitats be included in replicate MPAs.[22] Using existing and new data, as appropriate, this question can also be extended to evaluations of the use of habitat types as proxies for biodiversity protection.
- **Are there disproportional impacts (e.g., increased disturbance) of visitation in MPAs?** For example, what are the effects of visitation on pinniped haul-out and pupping areas, grunion nests and runs, and/or nesting seabirds and shorebirds in estuaries and on beaches in MPAs? Are there impacts (e.g., trampling, displacement of flora and fauna) of visitation on rocky intertidal ecosystems in MPAs? Understanding visitor impacts may allow for better visitor management (see next question).
- **What are the most effective tools and approaches to inform visitors of MPA rules and regulations, to reduce visitor impacts, and to improve visitor experience and education?** The MLPA South Coast Regional Stakeholder Group (SCRSG) recommended improving public outreach "through the use of docents, improved signage, and production of an educational brochure for South Coast MPAs."[23] Comparative assessments of different outreach tools and approaches may guide future choices to increase the effectiveness of education and outreach.

[21] California MLPA South Coast Project Adopted Regional Goals and Objectives and Design and Implementation Considerations for the MLPA South Coast Study Region. Adopted by the MLPA South Coast Regional Stakeholder Group on January 14 2009, and approved by the MLPA Blue Ribbon Task Force on February 26 2009, p.6.
[22] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009, p.64-68.
[23] Ibid.

- **How frequent are MPA boundary crossings by species targeted by fishing and does the frequency of boundary crossings differ between MPAs that encompass a reef and those that split a reef? What changes have occurred in the fisheries (e.g., fishing effort, catch) conducted on the portions of reefs left open to fishing?** The MLPA Master Plan recognizes that MPAs with similar habitats on both sides of their borders may facilitate spillover to the benefit of those fishing adjacent to MPAs.[24] Should this evaluation question be addressed, data collection may be focused by selecting species with different home range sizes; for example, lingcod (*Ophiodon elongatus*) are strongly site-attached as adults whereas adult California scorpionfish (*Scorpaena guttata*) are transient.[25]

- **Does locating an MPA close to a boat ramp or other access point affect the level of enforcement and/or compliance with MPA regulations?** To facilitate management, education, enforcement and outreach, the South Coast regional design considerations recommend siting MPAs adjacent to "eyes on the water", such as terrestrial parks and marine laboratories, and in such a way that volunteers could assist in monitoring and management.[26] Approaches to address this question may provide guidance on the magnitude of these effects with increasing distance from access points.

- **Does locating an MPA close to a boat ramp or other access point affect the number of visitors engaged in non-consumptive recreation or education activities?** The South Coast regional design considerations recommend considering the benefits and drawbacks of siting MPAs near to or remote from existing public coastal access points.[27] As above, future management decisions may be informed by increased understanding of the relationship between activity level and distance from access points.

- **How do allowed uses of State Marine Conservation Areas (SMCAs) influence the distribution and intensity of fishing effort?** Do SMCAs that allow take of multiple species or use of multiple gear types have disproportionately high fishing intensity? Is the fishing intensity for certain species that may be legally harvested from SMCAs higher inside SMCAs than outside the MPA network? Understanding the distribution of fishing effort inside SMCAs may facilitate future management decisions about allowed activities inside MPAs.

- **Do sediment plumes from beach nourishment or dredging activities negatively impact the growth of seagrasses and/or kelp in nearby MPAs?** Beach nourishment is commonly used to protect the shoreline and support recreational needs. However, beach nourishment may also potentially damage adjacent marine habitats such as rocky reefs, estuary mouths, surfgrass beds, and kelp forests due to an increase in sediment transport and the generation of turbidity plumes. Though the California Fish and Game Commission has no authority or jurisdiction over permitting or prohibiting beach nourishment in the marine or estuarine environment, the SCSAT evaluated where beach nourishment activities occur and their potential impacts on associated living marine resources.[28] The role of these activities in affecting progress towards MLPA goals may be usefully evaluated following MPA implementation.

- **Are there differences in the numbers of shorebirds nesting and foraging on beaches in MPAs that are nourished and those that are not? Are there differences in the number of grunion nests and runs on beaches in MPAs that are nourished and those that are not?** The SCSAT reported that "living marine resources associated with beach

[24] MLPA Master Plan, Appendix F, California Department of Fish and Game, January 2008.
[25] California Department of Fish and Game Nearshore Finfish Profiles: http://www.dfg.ca.gov/marine/nearshorefinfish.asp.
[26] California MLPA South Coast Project Adopted Regional Goals and Objectives and Design and Implementation Considerations for the MLPA South Coast Study Region. Adopted by the MLPA South Coast Regional Stakeholder Group on January 14 2009, and approved by the MLPA Blue Ribbon Task Force on February 26 2009.
[27] Ibid.
[28] Draft Background Information on Beach Manipulation Activities in the South Coast Study Region. MLPA Master Plan Science Advisory Team, Revised March 20, 2009, p.2-3.

habitats are affected both positively and negatively as a result of beach nourishment projects. Negative effects are generally short-lived relative to the expected renourishment interval; however comprehensive biological impact assessments on the effects of associated biological resources are limited. Documented impacts to receiver beaches can include near complete mortality of resident intertidal biota, which can lead to lasting reductions in abundance and biomass, significant declines in shorebird use".[29] New data collection to address this question may usefully document the magnitude of these effects inside and outside the South Coast MPAs.

- **Does urchin removal impact the amount of kelp (e.g., aerial extent, stipe density)?** What is the relationship between urchin density and the amount of kelp and are there thresholds of urchin densities above which kelp forest declines occur? During the MPA planning process, there was discussion about experimentally removing red and purple urchins (*Strongylocentrotus* spp.) from some subtidal rocky reefs to encourage growth of giant kelp (*Macrocystis pyrifera*). Ecological interactions between red urchins, *Strongylocentrotus franciscanus*, which are commercially harvested, and purple urchins, *Strongylocentrotus purpuratus*, are complex and, in the South Coast region, both have been implicated in denuding kelp forests and causing urchin barrens. Additional scientific guidance on this issue can inform future management decisions and also be used in assessing ecosystem changes inside and outside MPAs with kelp forest habitat.

- **What impact does anchoring have on purple corals and other biogenic habitats?** A dense population of purple corals (*Stylaster californica*) occurs in the waters off Santa Catalina Island at Farnsworth Bank. As purple corals are susceptible to anchor damage, a 'no anchoring' provision for the Farnsworth Bank was implemented consistent with the recommendations in the Integrated Preferred Alternative (IPA) MPA network option for the South Coast region.[30] Comparative assessments of purple corals and other biogenic habitats in areas in areas with or without anchoring may inform future management decisions on this issue.

- **What are the effects of feeding fish on assemblage structure (e.g., relative abundance of species, trophic relationships) inside MPAs?** Feeding of fish is a long-standing practice associated with local tourism in the area offshore from the City of Avalon, where fish are provided food in order to attract the local species to enhance marine life viewing. The California Fish and Game Commission voted to allow fish feeding to continue in Casino Point and Lover's Cove SMCAs at their meeting on December 15, 2010. Comparative assessments of fish assemblage structure in areas with and without fish feeding may inform future management decisions on this issue.

LONG-TERM MPA DESIGN & MANAGEMENT EVALUATIONS

Long-term evaluations are those expected to take more than four years to answer, and thus will span more than one of the five-year review cycles recommended in the MLPA Master Plan. These questions tend to be focused on design or management decisions in which the effects of the decision on an Ecosystem Feature or feature components are likely to be difficult to detect or interpret due to the dynamic environment of the South Coast region. These questions may require considerable cost-sharing to be feasibly addressed, and are well-suited to long-term partnerships between agencies and research institutions. Given the long time-frame required to generate useful findings from these evaluations, and the importance of such information for possible future management decisions, work should begin on the top priority long-term design and management evaluations as soon as possible.

[29] Draft Background Information on Beach Manipulation Activities in the South Coast Study Region. MLPA Master Plan Science Advisory Team, Revised March 20, 2009, p.2.
[30] California MLPA South Coast Study Region Description of MPAs: MLPA South Coast Integrated Preferred Alternative (IPA). December 5, 2009.

Long-term evaluations encompass many different aspects of MPA network design and function. To support the South Coast MPA planning process, the SCSAT applied and refined prior recommendations of the MLPA Science Advisory Team (MLPASAT). The resulting science guidelines included recommendations for the minimum MPA size, maximum distance between adjacent MPAs, specific habitat types to be represented within replicate MPAs, and levels of protection (reflecting the types of activities allowed in the MPAs). These guidelines were used to evaluate and refine MPA proposals and strongly influenced the design of the network adopted by the California Fish and Game Commission. Thus evaluation of the design decisions will be particularly valuable in informing future management decisions.

Future management decisions may involve adjustments to the design of individual MPAs and/or the regional MPA network. Monitoring should thus seek to test the design guidelines so as to provide useful input to future decisions about maintaining or adjusting MPA or MPA network design. However, given the temporal and spatial dynamics of nearshore marine environments, many of these questions present conceptual and practical challenges. For example, investigation of larval dispersal patterns to inform evaluations of MPA connectivity must accommodate considerable uncertainty in results, which are likely to vary dramatically between years. In this case, considerable research effort will be required to generate information that is sufficiently robust to inform potential changes to the MPA network. This complexity also applies to many other potential evaluations of MPA network function.

To identify approaches that can inform management decisions and guide the development of research partnerships, potential long-term evaluation questions have been arranged into MPA and network design categories, listed below. These categories reflect the guidance on MPA network design developed by the MLPASAT,[31] the science guidelines developed during the South Coast MPA planning process,[32] and consultations with stakeholders during the development of this monitoring plan (see Workshop Reports from Rounds 1 and 2, Appendices C-3 and C-4). All of the categories below may include evaluations focusing on ecological and/or socioeconomic responses. Different allowed activities within MPAs, for example, are likely to be reflected in different effects on both species and human use patterns. The categories are each presented separately, but evaluations may also combine categories (e.g., MPA size and spacing). The questions listed in each category should be considered as starting points for discussion only, as considerable focusing and refinement would be required to design effective studies to answer them. Where possible, selected evaluations should encompass Ecosystem Feature attributes, indicators, or vital signs, to benefit from the information being gathered on those metrics, and potentially inform the use of those metrics in long-term tracking of ecosystem condition.

SIZE & SHAPE

Based on scientific information on movement patterns of multiple species, the MLPA Master Plan for MPAs suggests that MPAs should extend a minimum of 3–6 miles along the coastline, and that "larger MPAs, spanning 6–12.5 miles of coastline, are probably a better choice given current data on adult fish movement patterns".[33] In applying this guidance to the South Coast region, the SCSAT recommended that each individual MPA cover an alongshore span of at least 3–6 miles, with a total minimum size of 9 square miles.[34]

Science guidance was also developed for the shape of MPAs. Because several species move between shallow and deeper habitat, the science guidelines in the MLPA Master Plan note that MPAs that extend offshore (from the coastline to the

[31] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, January 2008, pp. 34-41.
[32] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009.
[33] Ibid, p. 37.
[34] The total size criterion could also be met through clustering adjacent MPAs together, as long as each MPA is at least of moderate-high protection. (Ibid, p. 71.)

three-nautical-mile offshore boundary of state waters) will accommodate such movement and protect individuals over their lifetimes. The SCSAT adopted this recommendation.

Evaluations of the size and shape guidelines, as implemented, will be particularly useful if they reveal thresholds or discontinuities in the responses of Ecosystem Features, or feature components. Evaluations of the effects of size are likely to rely on a combination of modeling and empirical assessment, and may be facilitated by including MPAs from several MLPA regions.

Potential evaluation questions:

- **Is "spillover" of fishery species affected by MPA size? If so, what are the implications for designing MPAs to achieve ecosystem protection and potential benefits to fisheries?** Spillover, an effect that has been documented around numerous MPAs worldwide,[35] results when the density of individuals in an MPA increases resulting in a net movement of individuals out of the MPA. If an MPA is small, spillover might occur more quickly but might have a more deleterious effect on populations inside the MPA as their densities could be lower simply as a function of MPA size.
- **If fishing occurs along the boundaries of MPAs, what are the effects on species and communities inside MPAs of different sizes?** If marine populations increase in MPAs, fishing may improve outside MPAs as a result of spillover. These effects may be seen first at the edge of MPAs, which could result in spatially targeted fishing concentrated around MPA boundaries. 'Fishing the edge' may have different effects on populations within small versus large MPAs.
- **Are there differences in ecosystem responses (e.g., types and rates of changes observed) among MPAs of different sizes?** Are there thresholds or discontinuities in the way in which ecosystems respond that are a function of MPA size, and what are the implications for network design? In particular, are there differences between ecosystem responses in MPAs that do and do not meet the minimum size recommended in the science guidelines? Identification of thresholds in ecosystem response may facilitate future management decisions about MPA size.
- **What is the relationship between the alongshore span of an MPA and the protection afforded to organisms with different home range sizes, movement patterns, and pelagic larval durations (PLDs)?** The SCSAT adopted the MLPA Master Plan recommendation that MPAs should have an alongshore span large enough to protect adult populations based on home range size and movement patterns.[36] Investigations of this question may be focused by considering species with different movement patterns (e.g., compare a species with a restricted home range, such as lingcod (*Ophiodon elongatus*) with a more mobile species, such as California scorpionfish, (*Scorpaena guttata*)), and species with different PLDs (e.g., compare a species that has a long PLD, such as cabezon (*Scorpaenichthys marmoratus*), to a species that has a shorter or no PLD, such as black surf perch (*Embiotoca jacksoni*)).
- **How are the MPAs used by species that inhabit shallow nearshore habitats when young and move to deeper habitats as adults, and what are the implications for the offshore extent of MPAs?** The MLPA Master Plan states that in order to protect "the diversity of species that live at different depths and to accommodate the ontogenetic movement of individuals to and from nursery or spawning grounds to adult habitats, MPAs should extend from the intertidal zone to deep waters offshore".[37] Studies evaluating this question may consider a species such as the

[35] Final Environmental Document: Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary (Sections 27.82, 630, and 632, Title 14, California Code of Regulations), October 2002, Chapter 5.
[36] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009, p.64-68.
[37] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p.34

California halibut (*Paralichthys californicus*), which uses estuaries as nursery areas and inhabits deeper soft-bottom ecosystems as adults.

- **Do large SMRs provide higher or equivalent protection to ecosystems than areas of equivalent size that are comprised of an SMR and contiguous SMCA (referred to as an SMR/SMCA cluster)?** This question is of particular interest in the South Coast region where there are few large SMRs on the mainland, but many clusters of SMCAs and SMRs that, when taken together, form sizeable MPAs.

SPACING

The science guidance on MPA spacing, meaning the recommended distance between adjacent MPAs, is based on analysis of scientific information about the larval dispersal distances of various marine organisms. The MLPASAT recommended spacing MPAs approximately 31-62 miles apart to be within the larval dispersal ranges of important bottom-dwelling fish and invertebrate groups. The SCSAT adopted this guideline for MPAs on the mainland of the South Coast region, and recommended that guidelines other than spacing (e.g., bioregions, habitat representation, habitat replication, and MPA size) be applied to the design of MPAs at the Channel Islands.[38]

While the MPA spacing guidelines primarily focus on larval dispersal distances, the distances between MPAs can also interact with the movements of adult organisms, for example during along-shore migrations. In addition, the distance between neighboring MPAs may not be as important as the distance between replicate habitat types and between MPAs with high levels of protection. The SCSAT therefore recommended that the minimum spacing guidelines be applied to distances between replicate habitats and MPAs with the three highest levels of protection.[39]

Given that larval connectivity can be strongly influenced by large-scale oceanographic processes and cycles, evaluations of larval connectivity among MPAs may be best approached over larger spatial scales than the South Coast region, and even at a statewide scale. Larval connectivity assessments are likely to rely in part on modeling. Empirical testing or 'ground-truthing' of modeling results will be important prior to using such information as a basis for making future management decisions.

Potential evaluation questions:

- **What are the effects of different inter-MPA distances on connectivity between MPAs, either through larval exchange or movement of adults?** Is connectivity reduced between MPAs that exceed the SCSAT recommended spacing guidelines? Along the mainland of the South Coast region, there are gaps between neighboring MPAs, in particular between the Campus Point and Point Dume SMCAs, between the Abalone Cove and Crystal Cove SMCAs, and between the Dana Point and Swami's SMCAs, that exceed the SCSAT recommendations. A potential approach to addressing this question could include examining the presence or absence of young-of-the-year recruits, especially of *Sebastes* spp., or could employ innovative methods such as genetic parentage analysis or otolith microchemistry.

- **How does the distance between an MPA and a 'source' influence ecosystem responses (e.g., types and rates of changes observed) inside an MPA?** In metapopulation dynamics, a source is a site in which growth and emigration rates exceed death and immigration rates. MPAs located close to sources may benefit from increased larval supply, leading to different ecosystem responses than occur in MPAs located further from sources. Understanding the

[38] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 77.
[39] Ibid, p.76-77

relationship between ecosystem response in MPAs and distance from sources may inform future decisions about where to locate MPAs.

- **Is there a relationship between the distance between replicate habitat types and recruitment? Does the relationship differ for species with dissimilar pelagic larval durations (PLDs)?** The science guidelines recommend that similar habitats be protected in MPAs that are close enough to one another to increase the probability that larvae produced at one habitat type in one MPA will reach a similar habitat type in another MPA.[40] Larger distances between habitats are likely to allow connectivity only for species with relatively long PLDs (e.g., spiny lobster (*Panulirus interruptus*)), whereas smaller distances between habitats are likely to allow connectivity for species with shorter PLDs (e.g., red and purple sea urchins (*Strongylocentrotus* spp.)).

HABITAT REPRESENTATION

In addition to providing direction about MPA size and spacing, the science guidelines recommended habitat representation and replication. The SCSAT adopted the recommendations of the MLPA Master Plan that all key habitat types must be protected in MPAs, with each key habitat protected in 3-5 MPAs (replicates) per biogeographic region. In addition, the SCSAT identified five sub-bioregions within the South Coast region (North Mainland, South Mainland, West Channel Islands, Mid-Channel Islands, and East Channel Islands), and recommended that each habitat type be protected in at least one MPA in each of the sub-bioregions where feasible (see Regional Goals and Objectives, Appendix C-5).

Habitat representation is widely used in MPA planning as a proxy for different biological communities, based on the knowledge that different species and biological communities are associated with different habitats and that many species are dependent on different habitat types at different stages of their life cycles. Evaluations of design decisions relating to habitat representation can thus range from assessment of the extent to which MPAs do include the identified habitat types (e.g., through detailed mapping) to evaluation of species-habitat relationships to assess the extent to which the identified habitat types are associated with different species, life stages, or biological communities.

Potential evaluation questions:

- **Are there differences in ecosystem responses (e.g., types and rates of changes observed) between MPAs in which habitats are contiguous and those with similar but patchily distributed habitats?** Patchily distributed habitat may limit density and therefore reduce intra-specific interactions, such as those required for successful breeding; for example, abalone (*Haliotis* spp.) reproductive success is closely linked to density.
- **Is 'spillover' of fishery species affected by habitat continuity across MPA boundaries, and what are the implications for designing MPAs to achieve ecosystem protection and potential benefits to fisheries?** The MLPA Master Plan recognizes that MPAs with similar habitats on both sides of their borders may facilitate spillover.[41] Approaches to address this question may focus first on the effects of habitat continuity on species' movement patterns and then expand to consider indirect effects on populations and ecosystems.
- **In MPAs that meet the minimum size guidelines, do species and communities associated with specific habitat types exhibit different responses (e.g., types and rates of changes) based on how much of their preferred habitat is represented in the MPAs?** The science guidelines contain recommendations for a preferred MPA size range but do not specify that larger MPAs should also incorporate more than the minimum amount of a given

[40] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009, p.76.
[41] MLPA Master Plan, Appendix F, California Department of Fish and Game, January 2008.

habitat. An evaluation of this question could compare the assemblage associated with kelp forests in two similarly sized MPAs, one containing a large area of shallow rocky reef, and the other containing only a small rocky reef.

- **Is kelp habitat accurately represented by the 'maximum kelp' designation?** Are there differences in ecosystem response (e.g., types and rates of changes) between MPAs containing 'persistent kelp' and MPAs containing only 'maximum kelp'? During the MPA planning process, the SCSAT recommended that MPAs proposed to protect communities associated with giant kelp (*Macrocystis pyrifera*) be located in areas of persistent kelp. However, a stretch of the mainland coast, between Palos Verdes and San Elijo, does not contain persistent kelp beds. In this area, the SCSAT recommended that MPAs be designed to encompass potential kelp habitat as represented by the maximum kelp measure, and made recommendations about the amount of this habitat that needs to be included in proposed MPAs designed to protect kelp forest habitat.[42]

- **Do MPAs enclosing multiple habitat types harbor higher species abundances or more diverse communities than those that encompass only a single habitat type?** Increased habitat diversity can result in increased structural complexity, which has been shown to be positively correlated with fish diversity in many studies. In addition to providing increased structural complexity, MPAs that encompass a diversity of habitat types may offer protection to species that move among habitats during their lifetime (e.g., movement to and from nursery or spawning grounds, ontogenetic movements). For example, the SCSAT recommended that "wherever possible, a mixture of estuarine sub-habitats be protected in close proximity to one another to allow for the movement of species among subhabitats."[43]

- **Are there unique habitats which contribute significantly to the biodiversity of the region that are not represented in the MPAs or identified key habitats?** The SCSAT identified 22 key marine habitats in the South Coast region.[44] As knowledge of the subtidal environment grows, new habitats with unique associated species assemblages may be discovered within state waters that require consideration in the context of the MLPA.

PLACEMENT & SITING

In designing proposed MPA networks for the South Coast region, stakeholders considered where MPAs were located relative to access points, terrestrial parks, boat launch facilities, marine research laboratories, and educational institutions. Stakeholders considered the potential effects of MPA siting on, for example, types and levels of human activity inside MPAs, and enforcement of and compliance with MPA regulations. Stakeholders also considered how siting MPAs could enhance or reduce MPA network connectivity.

Potential evaluation questions:

- **What are the population effects of siting MPAs in larval source or sink locations, and what are the implications for MPA network design? In particular, to what extent are mainland MPAs a source of larvae and recruits to Channel Island MPAs or vice versa?** During the MPA planning process, connectivity throughout the South Coast region was evaluated using species' life history characteristics and Regional Ocean Modeling System (ROMS) simulations. These simulations revealed that the Channel Islands and mainland were not strongly connected for species with short pelagic larval durations (PLDs), and that for species with longer PLDs, the mainland acted more

[42] California MLPA Initiative: Science Question Received at the August 3, 2009 Meeting of the MLPA South Coast Regional Stakeholder Group, Revised September 2, 2009.
[43] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009, p.67.
[44] Ibid, p. 34.

as a source of larvae for the islands than vice versa.[45] Additional modeling information may refine our predictions of sources and sinks in this region and also offer the opportunity, over longer time periods, to provide empirical validation of model results.

- **Are there different ecosystem responses (e.g., types and rates of changes) between MPAs that are and are not co-located with Areas of Special Biological Significance (ASBSs)?** ASBSs are monitored and maintained for water quality by the State Water Resources Control Board. The SCSAT recommended co-locating MPAs and ASBSs wherever possible[46] because co-locating MPAs and ASBSs might provide "a more complete package of protection."[47] This question may be addressed by comparative assessments of MPAs that are and are not associated with ASBSs.
- **Are there differences in ecosystem responses (e.g., types and rates of changes) between MPAs that are close to stormwater or wastewater outfalls?** Because poor water and sediment quality can negatively impact marine life, including changing community structure and function,[48] the SCSAT recommended a buffer of 0.5 miles around wastewater outfalls.
- **Are there different ecosystem responses (e.g., types and rates of changes) in the MPAs on the Palos Verdes peninsula (i.e., Point Vicente No-Take SMCA and Abalone Cove SMCA) that could be attributable either to sediment toxicity associated with the superfund site or turbidity related to the Portuguese Bend Landslide?** During the MPA planning process, the SCSAT acknowledged that "there are known locations of increased turbidity downstream of Portuguese Bend and increased toxins along the Palos Verdes Shelf near the White Point outfalls that negatively impact marine life by decreasing growth reproduction and community composition."[49] In addition, the SCSAT acknowledged that EPA activities, which could include capping contaminated sites, could lead to "prolonged disturbance [that] could reduce the effectiveness of MPAs that are placed near the mitigation site."[50]
- **What are the effects on visitation and associated recreational opportunities of siting MPAs adjacent to public versus private land?** The SCRSG advised that "MPA design should consider the benefits and drawbacks of siting MPAs near to or remote from public access."[51]

LEVELS OF PROTECTION

The South Coast regional MPA network includes MPAs of different types and allowed activities, ranging from State Marine Reserves (SMRs), which prohibit all take of living marine resources, to State Marine Conservation Areas (SMCAs), which allow different extractive activities, depending on the site. To guide the MPA planning process, the SCSAT defined 'Levels of Protection', reflecting scientific judgments of the relative effects of allowing specific harvest activities within MPAs.[52] Each MPA was assigned to one of six protection levels, depending on the activities to be allowed within that site. Thus, an SMR

[45] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009, p. 73-79.
[46] South Coast Study Region (SCSR) Summary of SAT Evaluation of Round 2 Draft MPA Proposals: Water and Sediment Quality. California Marine Life Protection Act (MLPA) Initiative, Revised July 13, 2009.
[47] California Master Plan Science Advisory Team Water Quality Work Group Recommendations for Considering Water Quality and Marine Protected Areas in the MLPA South Coast Study Region. Revised August 22, 2008, p.2.
[48] Ibid.
[49] California MLPA Master Plan Science Advisory Team Draft Recommendations for Evaluating Water and Sediment Quality Along the Palos Verdes Shelf – Supplemental Guidance to the Draft Recommendations for Considering Water Quality and Marine Protected Areas in the MLPA South Coast Study Region. Draft revised August 31, 2009, p.7.
[50] Ibid.
[51] California MLPA South Coast Project Adopted Regional Goals and Objectives and Design and Implementation Considerations for the MLPA South Coast Study Region. Adopted by the MLPA South Coast Regional Stakeholder Group on January 14 2009, and approved by the MLPA Blue Ribbon Task Force on February 26 2009, p.6.
[52] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009, p. 15-32.

was categorized as 'Very High' protection, and MPAs allowing activities that alter habitat, such as mechanical giant kelp harvest and mussel and scallop extraction, were categorized as 'Low' protection (see Appendix C-8). During the planning process, stakeholders arranged MPAs of different Levels of Protection to meet MLPA requirements and design guidelines, while, to the extent possible, balancing competing or conflicting interests.

Potential evaluation questions:

- **Are there differences in ecosystem responses (e.g., types and rates of changes) between MPAs with different levels of protection?** One of the most straightforward ways, from an experimental standpoint, to assess the impact of particular extractive activities (e.g., fishing, harvest) on marine life populations is to compare areas where take is allowed, (i.e., SMCAs) with areas where extractive activities are not permitted (i.e., SMRs). Comparisons could also be made between SMCAs with different levels of protection – i.e., different allowed activities. Each MPA in the South Coast region has been assigned to one of six 'Levels of Protection,' which were determined by the SCSAT during the planning process to reflect scientific judgments of the relative effects of allowing specific harvest activities within MPAs[53] (see Appendix C-8). Understanding the responses of organisms to these different levels of protection may contribute to a better understanding not only of how different extractive activities affect marine populations, but also connections between different ecosystems and ecosystem components.
- **Are there differences in ecosystem responses (e.g., types and rates of changes) between MPAs that do and do not allow take of pelagic species, including squid?** In particular, do deep water benthic rockfish populations (*Sebastes* spp.) exhibit different responses (e.g., population growth rates, recruitment) in MPAs that do and do not allow take of pelagic species? It is intended that benthic populations will be afforded a high level of protection within SMCAs in which the only allowed take is that of pelagic species. However, there could be consequences of removal of pelagic species on benthic species through indirect effects resulting from disruption of food webs, or more direct effects of the fishing gear itself.
- **Do SMR/SMCA clusters provide greater protection than stand-alone SMRs, for example through a "buffer" effect?** Do SMR/SMCA clusters allow "the full benefit of spillover to be realized in the limited-take area?"[54] Understanding how SMR/SMCA clusters differ from stand-alone MPAs may inform future MPA design decisions.
- **Are there differences in ecosystem responses (e.g., types and rates of changes) between SMRs and No-Take SMCAs that allow operation and maintenance of pre-existing wastewater outfall, oil and natural gas pipelines?** At the December 15, 2010, meeting of the California Fish and Game Commission, it was recognized that several of the proposed SMRs being considered for adoption contained pre-existing pipelines and there was concern that upkeep and maintenance of these pipelines would be prohibited under the SMR designation. To accommodate operation and maintenance activities, these SMRs were changed to No-Take SMCAs. Comparative assessments may evaluate whether there are any differences in ecosystem responses between these two types of MPAs.
- **Are there differences in ecosystem responses (e.g., types and rates of changes) between MPAs that do and do not contain habitat restoration activities?** Restoration activities in the South Coast region include replanting giant kelp (*Macrocystis pyrifera*),[55] mitigating damage to eelgrass beds (*Zostera* spp.), and rebuilding estuaries and

[53] Draft Methods Used to Evaluate MPA Proposals in the MLPA South Coast Study Region, MLPA Initiative, May 4 2009, p. 15-32.
[54] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 52.
[55] Orange County giant kelp restoration project: data summary for the stakeholders of the Marine Life Protection Act. Prepared by Nancy Caruso and Dirk Burcham, April 2009.

wetlands.[56] In the South Coast region, much of the original wetland and estuarine habitat has been lost or altered by human activities, and eelgrass beds are frequently impacted by anthropogenic activities. Understanding whether restored wetlands, estuaries, eelgrass and kelp beds are biologically and functionally similar to natural areas is an essential part of understanding whether these areas will contribute to achieving the goals of the MLPA.[57]

- **What is the impact of red and purple urchin removal on lobster-urchin-sheephead-kelp dynamics?** The MLPA Master Plan SAT noted that "The red sea urchin, *Strongylocentrotus franciscanus*, has been shown repeatedly to deforest large areas of shallow rocky reefs. To the extent that human harvest of red sea urchins can prevent deforestation of kelp forests, urchin harvest may protect or enhance the many functional roles of algae, their productivity and diversity of species associated with algal habitats. On the other hand, many examples of urchin outbreaks (both red and purple urchins) and deforestation occur in regions where their natural predators have been heavily fished, often depleted, such that the role of urchin harvest could be compensated by protection of the other predators of sea urchins (California sheephead, lobsters, sea stars, and others). Moreover, human harvest and these other predators may compete with one another for sea urchins, such that human harvest can diminish protection for these other species identified for protection within MPAs. Thus, there is substantial uncertainty in the ecosystem-wide consequences of urchin harvest."[58] Understanding the impact of urchin removal, resulting from commercial and/or restoration activities, on kelp forest ecosystem dynamics may usefully inform management decisions about allowed uses in SMCAs.
- **Does the level of compliance differ between SMRs and SMCAs?** Regulations in SMRs are the easiest to understand as take of all living marine resources is prohibited. Regulations within SMCAs, however, can be quite complex and involve regulations of gear types and species. This complexity could result in decreased compliance within SMCAs as compared to SMRs due simply to a lack of comprehension of rules on the behalf of users. In addition, enforceability could be more difficult within SMCAs resulting in a lower level of compliance in these areas as compared to SMRs.[59]

[56] California MLPA Master Plan Science Advisory Team Draft Background Information on Wetland and Eelgrass Restoration Activities in the MLPA South Coast Study Region, Revised April 28, 2009, p. 1.
[57] Ibid.
[58] MLPA Master Plan Science Advisory Team Proposed Concepts for Designing MPA Networks for Adaptive Management Revised May 18, 2009.
[59] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 52.

6. Reporting Monitoring Results

- Designing effective monitoring reporting
- Communicating monitoring results
- Sharing monitoring information

Under the MLPA, one of the purposes of monitoring is to facilitate adaptive MPA management. As noted in the MLPA Master Plan and discussed in Chapter 2, to meet this requirement "the results of monitoring and evaluation must be communicated to decision makers and the public in terms that they can understand and act upon."[60] To be useful, communication of monitoring results must also be timely. The monitoring framework and approaches outlined in this plan have been designed to facilitate reporting of useful, understandable results to inform the five-year reviews of the South Coast regional MPA network recommended in the Master Plan. This chapter discusses features of and approaches to reporting monitoring results that are designed to effectively support adaptive MPA management.

DESIGNING EFFECTIVE MONITORING REPORTING

ESSENTIAL FEATURES OF MONITORING REPORTING

To be useful to non-scientists, monitoring reports must include highly synthesized and interpretable results, presented as key conclusions or findings that clearly meet MLPA requirements. For example, given that one goal of the regional MPA network under MLPA includes protecting the "structure, function and integrity of marine ecosystems,"[61] findings should include assessment of the condition of ecosystems and how condition is changing over time, inside and outside MPAs. Results should also include assessment of the performance, relative to MLPA goals, of individual monitored MPAs as well as the regional MPA network. These findings must be presented using intuitive reporting tools, in a way that is appropriate given the underlying data, and be understandable and meaningful for evaluating MPA effectiveness and facilitating adaptive MPA management. Findings must also be transparent, meaning that it is clear how they were generated, and available for independent review, along with the data used to generate the findings.

TRANSPARENCY OF ANALYSIS & REPORTING

Analytical methods, underlying assumptions, and criteria used to develop monitoring findings should be recorded during the analytic process and made available. This will not only facilitate understanding of the way in which findings were

[60] California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008, p. 75.
[61] California Marine Life Protection Act, Statutes 1999, Chapter 1015, Fish and Game Code section 2853(c)(3). See also sections 2852(a), and 2856(a)(2)(H).

developed, but will also allow independent evaluations of analytic approaches, replication of results, and/or use of alternative approaches. This is particularly important as detection of changes in ecosystem components or human uses inside and outside MPAs occurs in the context of a naturally dynamic and varying system. As discussed in Chapter 3, both the Ecosystem Features and the broader environment in which they occur present challenges for detecting and assessing MPA effects. To ensure that objective and reliable results are used to inform management decisions, documented trends in ecosystems or ecosystem components should be accompanied by an assessment of the certainty or power of the detected trend as well as assessment of the potential sources of error (e.g., statistical Type I and Type II errors) in results.

AVAILABILITY OF DATA

Monitoring data used to generate monitoring results and findings should be made available, consistent with a transparent approach to monitoring reporting and analysis. This is also essential to allow independent evaluations of findings and independent analyses, as desired. Moreover, having data widely available will facilitate research to improve understanding of marine systems and MPA monitoring methods and approaches. Some data collected through MPA monitoring may contain sensitive or confidential information. In these cases, remedies including non-disclosure agreements, data aggregation and anonymizing observations, may protect individual or other sensitive information while also making this data available.

USE OF EXPERT JUDGMENT

While quantitative analyses are an essential component of reporting monitoring results, the use of expert judgment is necessary to generate the highly interpreted and synthesized findings that link monitoring results to assessment of MPA effectiveness relative to MLPA goals. These include, for example, judgments of the condition and trends of ecosystems.

Increasing research effort is being directed towards improved frameworks for high-level ecosystem assessment. Analysis and interpretation of MPA monitoring results should take advantage of the best knowledge available when monitoring analyses occur. Approaches that engender and combine expert opinion have already been successfully employed in other programs (including, for example, in the production of the National Marine Sanctuary Condition Reports[62]). Typically these involve convening a technical panel, selected to encompass appropriate areas of expertise, that is charged with recommending synthesized results based on interpretation of detailed monitoring analyses and findings.

The theoretical underpinning for many existing expert judgment processes is an application of the Delphi method, in which informed opinions are iteratively solicited and aggregated from a technical panel to achieve a collective judgment or assessment; for example rating the condition of ecosystems, habitats, or biological communities as very good, good, poor, or very poor. Typically, questions are first asked individually of experts and then responses are discussed and modified in an iterative fashion towards a consensus opinion. This method offers an approach that can garner input from the breadth of scientific disciplines needed to provide a scientifically robust interpretation of MPA monitoring results and produce synthesized key messages useful for managers and decision-makers. Standard approaches are also available to record deliberations and decisions by panel members so that these can be presented along with the synthesized results, thereby maintaining a transparent process. It is important to note that the assessment of ecosystem condition does not direct or dictate a specific management response, but is required for informed debate and decision-making. For example, a finding that a particular ecosystem is in 'poor' condition does not necessarily mean management should change; it may be

[62] The National Marine Sanctuary Program Condition Reports provide a summary of resources in each sanctuary, pressures on those resources, current sanctuary condition and trends, and management responses to pressures threatening the integrity of the marine environment. Further information is available at http://sanctuaries.noaa.gov/science/condition.

appropriate to acknowledge and manage such areas in order to accommodate desirable human uses or activities. However, the assessment is essential to allow informed choices to be made by decision-makers.

Vital to the success and credibility of Delphic analyses, and the use of expert assessment in general, is appropriate selection and use of experts. In California and elsewhere, many models exist for selecting expert panels. These differ in some details, but share many common features, including:

- Public call for nominations to the panel, clearly identifying the purpose and scope of the panel's role and the qualifications for nominees;
- Clear and transparent criteria for selecting panelists;
- Public announcement of selected panelists and, as appropriate, alternates; and
- Publicly available reports or findings, with underlying data, assumptions, and criteria used to generate findings.

In preparation for conducting the high-level syntheses and interpretations of MPA monitoring data, it will be critically important to identify the needed areas of technical expertise and diversity of perspectives essential to generating unbiased, credible, and scientifically valid results.

USE OF INTUITIVE REPORTING TOOLS FOR KEY FINDINGS

For some types of monitoring, especially where precisely defined characteristics can be measured accurately, findings can be reported quantitatively, for example as numeric scores. Monitoring the average height or weight of a human population, or the mean size or number of fish caught, for example, appropriately allows reporting of a number (the mean or average) and a statistical estimation of the number's accuracy (e.g., standard error, 95% confidence intervals). However, neither the MLPA goals nor the South Coast ecosystems are that straightforward. While monitoring metrics are designed to generate quantitative data (e.g., areal extent of kelp, numbers of lobster), the scientific understanding of ecosystems is too limited to justify quantitative scoring of ecosystem condition. Thus it is most appropriate for some summary results to be reported qualitatively.

Implementation of the monitoring framework will generate a mixture of quantitative and qualitative results. Reporting tools need to be suitable for both kinds of results, and to present the results in a way that facilitates understanding. One reporting tool that meets these requirements is shown below.[63]

In this color bar, the relative position of the dot indicates the status or condition of the item being reported and the arrow indicates the change in condition over the reporting period or since the previous report. If no change is observed, then the arrow can be omitted. In this illustration, the ends of the color bar are red, indicating a less desirable condition, and green, indicating a more desirable condition. The monitoring metrics for tracking the condition of Ecosystem Features have been chosen to be interpretable in this way, allowing assessment of whether vital signs, indicators, attributes, and Ecosystem Features are improving or declining. Making such judgments will incorporate quantitative data generated through monitoring, as well as qualitative findings and expert assessments.

The color bar reporting tool could be further refined to illustrate changes due to MPA implementation or other factors. The color bar could also be modified, or a different reporting tool used, for changes in condition that are neutral, neither improvements nor declines.

[63] This tool is adapted from one employed by the Puget Sound Action Team in the State of the Sound reports. See www.psp.wa.gov/downloads/SOS07/2007_stateofthesound_fulldoc.pdf.

TIMELY RELEASE OF MONITORING RESULTS

For monitoring findings to be useful, and incorporated into MPA management processes and decisions, they must be released in a timely fashion. The MLPA Master Plan recommends reviews of MPAs at five-year intervals following their establishment. Monitoring findings and reports should be released close enough to the timing of the reviews to be as current as possible, but sufficiently in advance of the reviews to allow consideration of the findings and their potential implications, and, for those who desire to conduct them, independent evaluations.

COMMUNICATING MONITORING RESULTS

Monitoring reports should be designed to most effectively communicate the full range of monitoring results and conclusions, in a way that is consistent with the features and characteristics above, and also meaningful for evaluating MPA effectiveness and facilitating adaptive MPA management. To illustrate the types of reports that are envisioned, example 'mock-up' pages of a possible approach to future monitoring reports have been developed. These mock-up report pages illustrate how a subset of monitoring results and findings may be presented. They depict an approach to reporting on ecosystem condition and trends, including a specific example of the Kelp & Shallow Rock Ecosystem Feature, as well as illustrating a way in which evaluations of MPA design and management decisions could be communicated, with both potential short- and long-term questions illustrated.

As described in Chapter 4, ecosystem condition and trends are assessed through monitoring of the ten Ecosystem Features, which are evaluated though Ecosystem Feature Checkups and/or Ecosystem Feature Assessments. For example, for the ecological Ecosystem Features, including Kelp & Shallow Rock, the Ecosystem Feature Assessment approach employs selected focal species and indicators to assess key ecosystem attributes, which in turn are used to assess the feature.

Reporting on the condition and trends of these ecological Ecosystem Features, including reporting attribute and indicator results, may employ intuitive reporting tools such as the color bar example shown above. This is illustrated in the mock-up report pages in Figure 6-1. In these example pages, the color bar is used to convey an overall assessment of each Ecosystem Feature and is also used to present more detailed results for the Kelp & Shallow Rock Ecosystem Feature. These example report pages, illustrating one approach to intuitive reporting of Ecosystem Feature Assessment results, should be accompanied by more detailed and transparent reporting of analyses and links to raw data, where appropriate (see Figure 6-2). A similar approach may be used to report findings based on vital signs, and to report findings for the human uses Ecosystem Features.

Assessing the condition and trends of the Ecosystem Features also enables assessment of the individual MPAs that are monitored, and these results may be combined to allow assessment of the regional MPA network. The same or an equivalent reporting tool can also be used to convey understandable, synthesized results from monitored MPAs. For illustrative purposes, Figure 6-3 shows example report pages that employ the same color bar reporting tool to present summary results and key findings from a fictional MPA and from monitored MPAs across the South Coast region.

As described in Chapter 5, evaluations of MPA design and management decisions seek to assess the impacts of a given decision on the ecology and/or socioeconomics of the South Coast region, to inform possible future management decisions. Design and management evaluation questions are divided into short-term questions, which are those expected to be answerable within one of the five-year review cycles recommended in the MLPA Master Plan, and long-term questions, which are anticipated to take more than one review cycle to assess. The South Coast Monitoring Plan includes an inventory of potential design and management evaluation questions, two of which are illustrated below (Figure 6-4). These mock-up reports illustrate how complex information could be synthesized to make it readily interpretable, thereby facilitating adaptive MPA management.

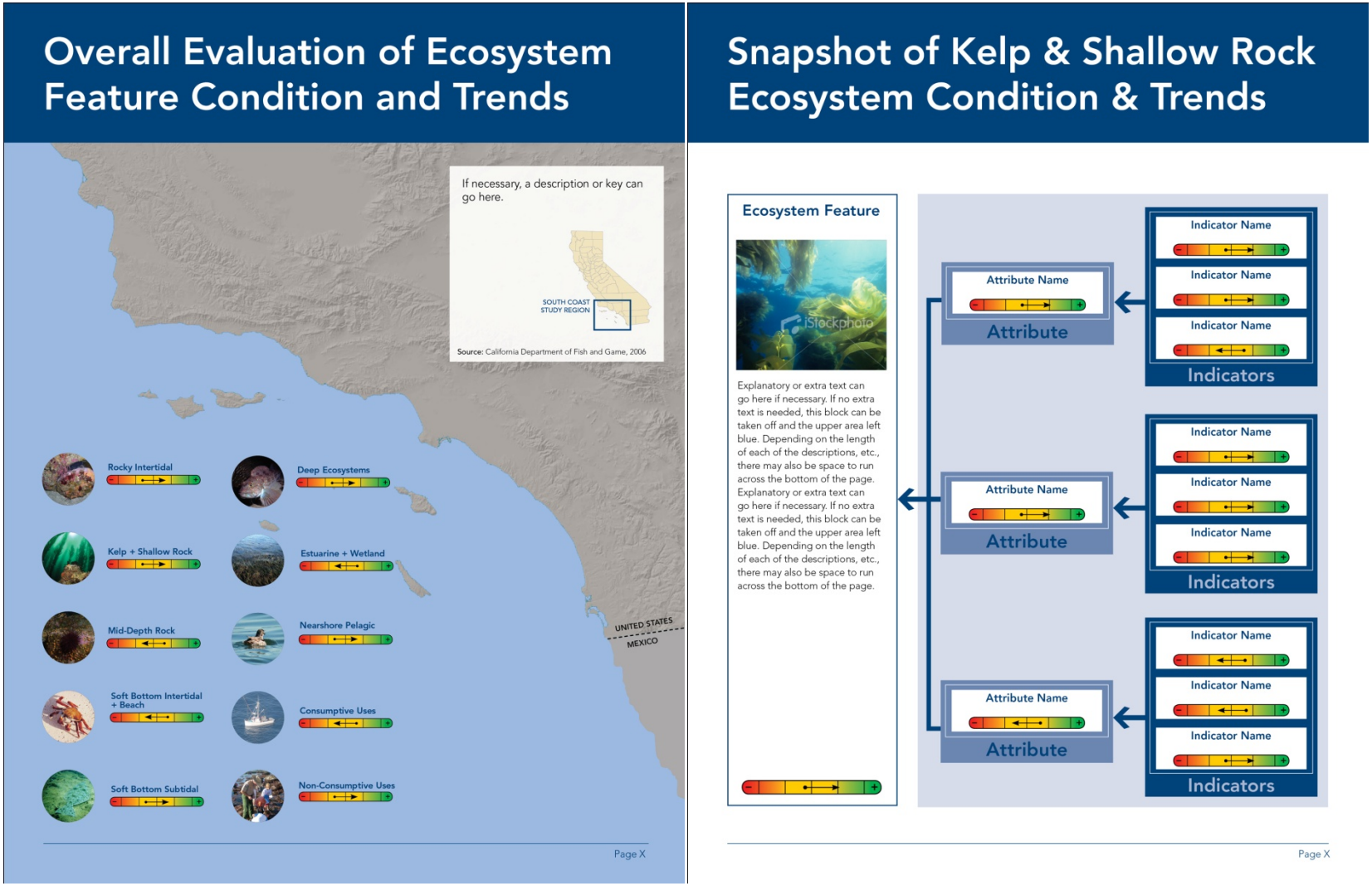


Figure 6-1. *Mock-up pages from a possible approach to monitoring reports, illustrating the use of a color-bar reporting tool to communicate monitoring results. These example pages illustrate possible formats to depict the overall assessment of the Ecosystem Features and how the assessment may be developed for the Kelp & Shallow Rock Ecosystem Feature. These summary pages would be accompanied by in-depth technical reporting of data, analyses, and interpretations.*

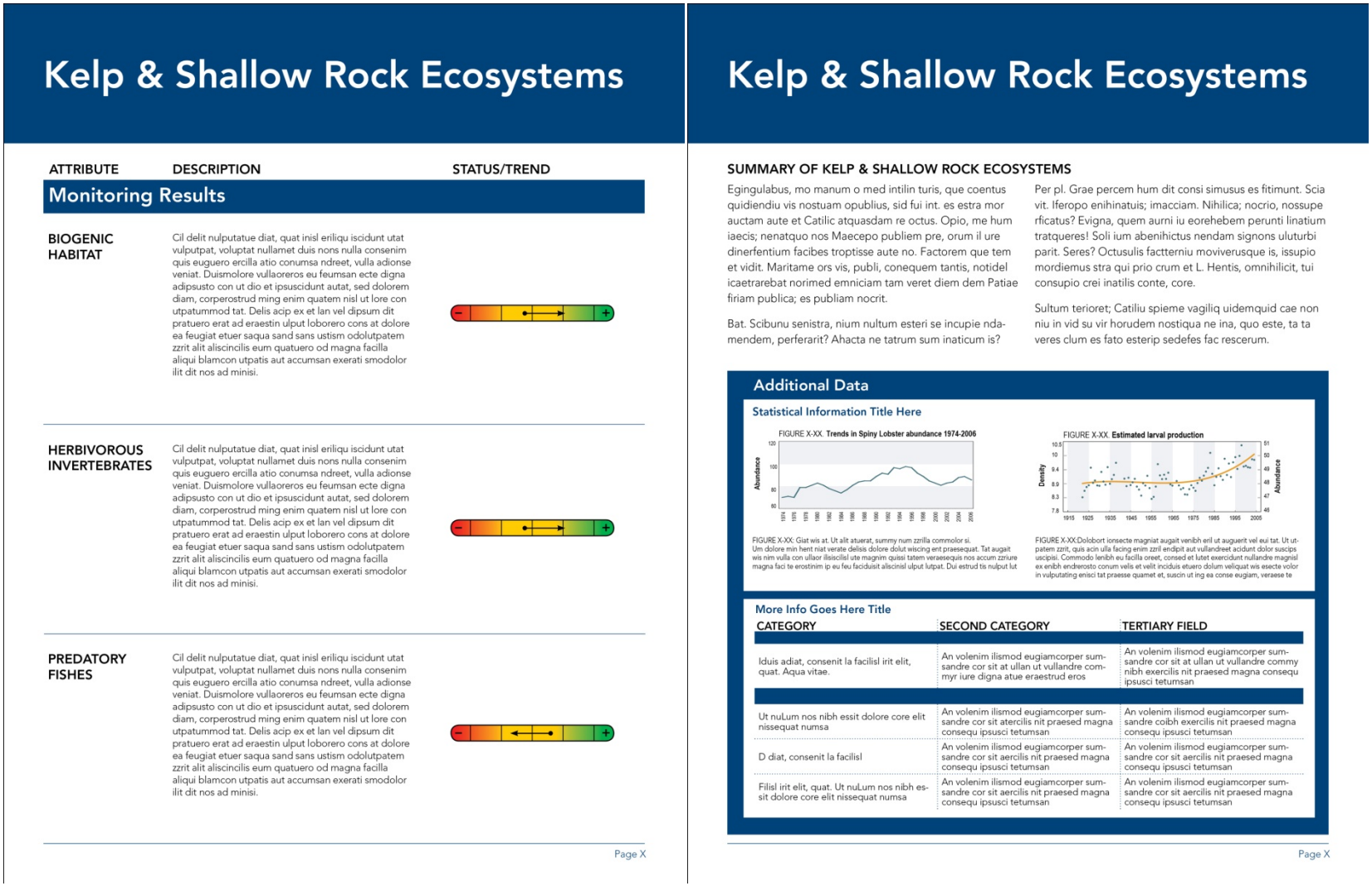


Figure 6-2. *Mock-up pages from future monitoring reports illustrating pages that may be included to convey more detailed analyses and interpretation. In these example report pages, attribute results are accompanied by an explanation and rationale, as well as a possible approach to more detailed reporting of results and analyses. Technical reporting of data and analyses should also accompany these report sections.*

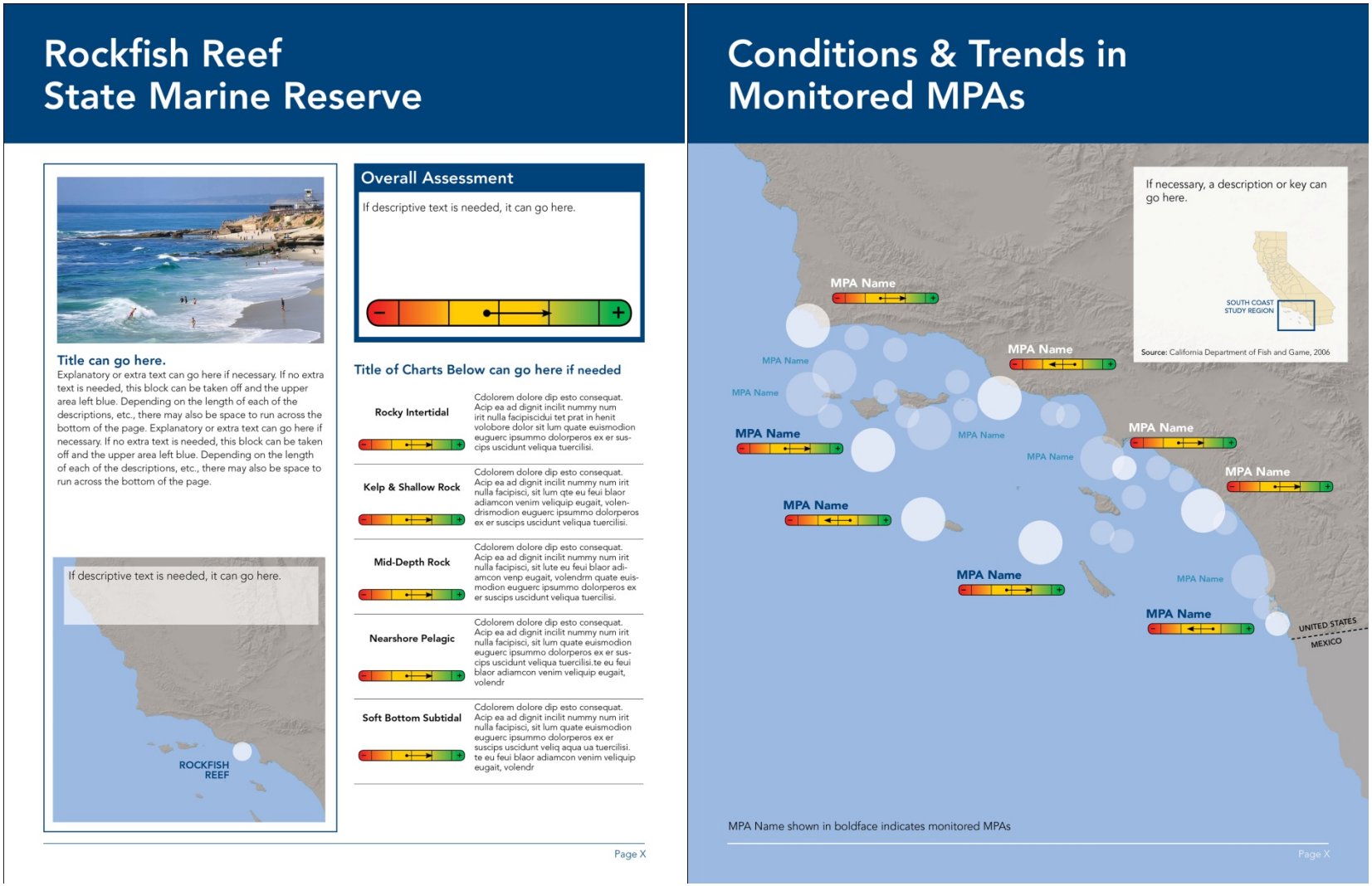


Figure 6-3. *Mock-up pages from future monitoring reports. These example report pages illustrate potential formats employing the color bar reporting tool as a possible approach to reporting on the condition and changes within individual monitored MPAs, allowing comparison across the regional MPA network.These summary pages would be accompanied by in-depth technical reporting of data, analyses, and interpretations.*

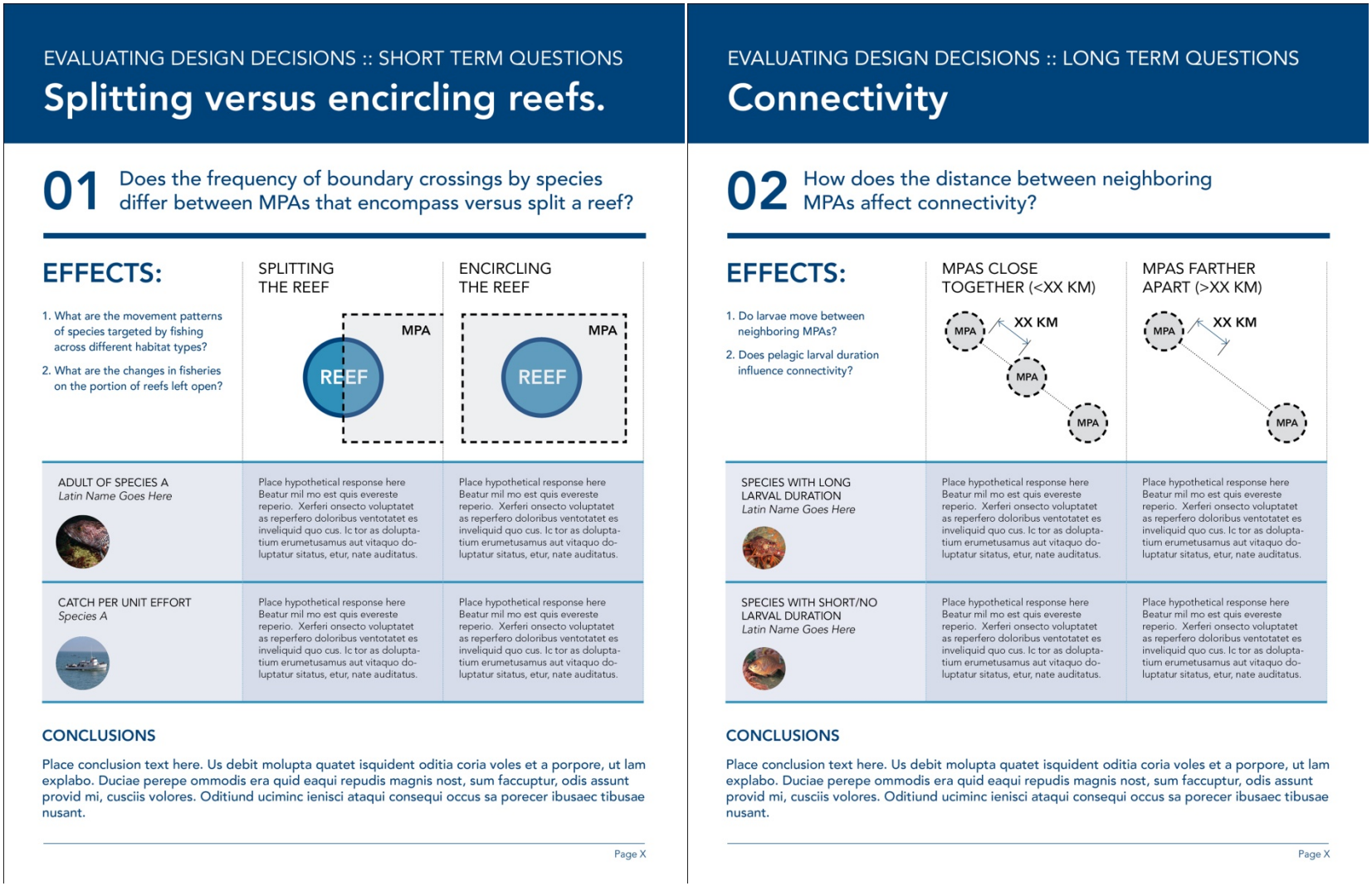


Figure 6-4. *Mock-up pages from future monitoring reports. These example report pages illustrate a potential approach to reporting on evaluations of MPA design and management decisions. An evaluation is identified along with one or more questions or 'effects', and illustrations and text are used to explore results from monitoring. The conclusion provides a summary of findings that may be used to inform management decisions.*

SHARING MONITORING INFORMATION

Timely and broad dissemination of monitoring results is an important step in informing adaptive management of the South Coast MPAs. As discussed above, reports should be made available in advance of the five-year reviews recommended in the MLPA Master Plan. The South Coast MPAs were adopted by the Fish and Game Commission in December 2010, and are expected to take effect in mid-2011. A five-year review would thus be expected to occur in mid- to late 2016. The first South Coast MPA monitoring report should therefore be made available in late 2015 or early 2016, depending on the date of the review. Various options exist for sharing monitoring results. For example, data and data products will be available through an online monitoring hub (see below). In addition, a public meeting, such as was held in February 2008 to present the findings of the first five years of monitoring the northern Channel Islands MPAs,[64] might be helpful to facilitate dissemination and discussion of monitoring results.

DEVELOPING AN ONLINE MONITORING HUB

Online technology solutions offer significant opportunity to maintain and share information about the MPAs and monitoring, including data, results, reports, etc. The Monitoring Enterprise is currently designing and building the first version of an online monitoring hub: a consumer-focused platform for engagement with, and use of, monitoring information.

To inform the development of this online system, the Monitoring Enterprise has completed a user needs assessment, which characterizes different likely user profiles.[65] These profiles encompass a broad spectrum of users including those seeking to download data in order to conduct their own analyses as well as users interested only in highly synthesized information products.

The first version of the hub will be an adaptable platform that can house, aggregate, analyze and present monitoring data and other information. It will provide the foundational architecture and base functionality to support different user groups that may use the hub now and in the future. The Monitoring Enterprise will develop the system via collaboration and partnerships to increase the scope and functionality of the system and link to existing data and information portals.

[64] For more information on the Channel Islands meeting, a Special Session held at the 2008 California Islands Symposium, see http://www.dfg.ca.gov/marine/channel_islands/specialsession.asp.

[65] Full and 'In Brief' versions of the User Needs Assessment are available for download on the Monitoring Enterprise website www.monitoringenterprise.org.

7. Developing Monitoring Partnerships

- Building a partnerships approach
- Partnerships for conducting monitoring
- Partnerships for interpreting monitoring results
- Partnerships for sharing monitoring information

This monitoring plan has been designed to facilitate development of partnerships to conduct and support monitoring of the South Coast regional MPA network. Potential partners are many, and include state and federal agencies, research institutions, and citizen-science and community programs and organizations. Partnerships offer the opportunity to share resources and to make efficient use of limited resources. To be effective, however, partnerships must be carefully developed and managed. Coordination and oversight are required to ensure that partnerships are tuned to best contribute to implementing this monitoring plan. In this chapter, considerations for developing a partnerships approach are provided. Particular attention is given to establishing partnerships to collect monitoring data, as these may be expected to be the initial top priorities for implementation.

BUILDING A PARTNERSHIPS APPROACH

In the context of monitoring the South Coast regional MPA network, there are many potential partnerships that may assist with various aspects of monitoring, including data collection, interpretation of results, and dissemination of information. The monitoring framework has been designed to facilitate such partnerships. For example, two implementation options are provided for long-term tracking of ecosystem condition (Chapter 4). Ecosystem Feature Checkups are designed for community participation in MPA monitoring, while Ecosystem Feature Assessments are designed to facilitate partnerships among government agencies and with research institutions. In addition, the structure for evaluation of specific MPA design and management decisions (Chapter 5) is tailored to facilitate implementation through research partnerships.

Establishing these partnerships will be important to maximize the capacity and efficiency of South Coast MPA monitoring, but will take time and attention to ensure partnerships are effective. Standards, procedures, and policies for partnerships will be required, and these should be tailored to the roles of different potential partners, and reviewed and updated as required. Establishment of these operational policies can be initiated and guided through development of partnership agreements.

PARTNERSHIP AGREEMENTS

For a partnership to be successful, partners should understand and agree to each partner's roles and responsibilities, including what each partner is providing to, and expecting from, the partnership. Partnership agreements may be formal or informal and range from brief Memoranda of Understanding to detailed contracts. In each case they are an important tool for clarifying and recording vital operational aspects of partnerships. Because each partnership is unique, each agreement should be tailored to the specific requirements of the partnership. For instance, partnerships to assist with conducting monitoring of the South Coast MPAs will involve collection or sharing of data; consequently, it is critically important that these partnership agreements cover such topics as data ownership and use. Partnership agreements should also include terms and conditions under which a partnership may be ended. Regular review of agreements is important to reflect any changes in roles, resources, or other aspects of partnerships. Management of partnership agreements should include reconsidering and adjusting partnership terms and details as needed.

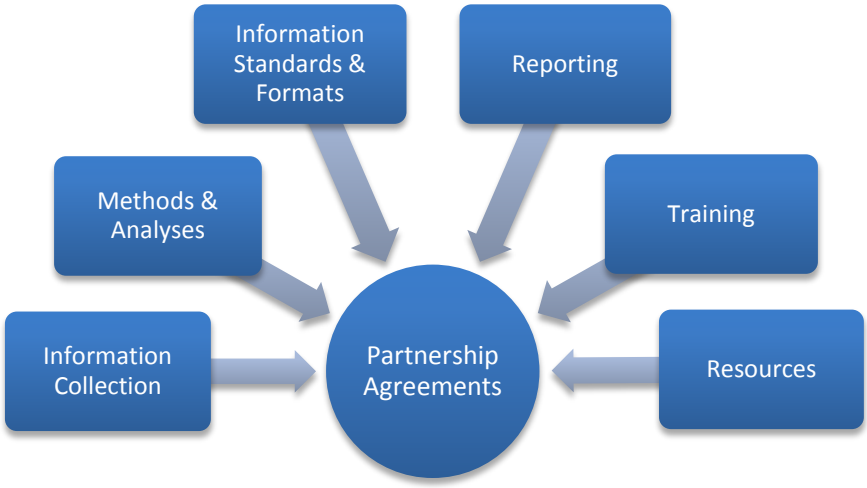
PARTNERSHIPS FOR CONDUCTING MONITORING

There are many potential partners to assist with collecting MPA monitoring data in the South Coast region. However, not all monitoring data are equally useful in meeting MLPA requirements. Priority for developing partnerships to conduct MPA monitoring in the South Coast region should be placed on those which fit best with the approaches identified in this monitoring plan.

Existing MPA monitoring programs in the South Coast region, such as those conducted in the Channel Islands by the National Marine Sanctuaries Program and the National Park Service, are obvious candidates for monitoring partnerships. The mandates and monitoring requirements of each program are slightly different, and differ from those imposed by MLPA. It will be important to determine how to share resources to best meet each program's needs. In addition, there are a variety of research programs and institutions, fisheries and water quality monitoring programs, community-based and citizen-science programs, that may also be valuable monitoring partners, depending on their priorities and approaches. Appendix 7 provides an initial list of potential monitoring partners including academic, research and educational institutions with a coastal and marine focus in the South Coast region.

KEY CONSIDERATIONS FOR PARTNERSHIPS TO CONDUCT MONITORING

In addition to the considerations discussed above, partnership agreements covering the collection of MPA monitoring data should also include details of the information to be collected, methods to be employed, standards and formats for information collection and reporting, training of participants, and resources to be provided by each partner to an agreement. These items are discussed further below to provide a brief overview of key considerations.



INFORMATION COLLECTION

Partnership agreements should clearly detail the specific information to be collected and provided by the monitoring partner in support of South Coast MPA monitoring, including the specific vital signs, attributes and indicators/focal species, or other information to be provided. Information should conform to that identified in this monitoring plan, unless otherwise agreed.

MONITORING METHODS & ANALYSES

The specific methods to be used by the monitoring partner to collect the agreed information are of critical importance in analyzing and interpreting the information. It is important, therefore, that data collection methods, and, where appropriate, analytical approaches, are detailed and agreed by partners.

INFORMATION STANDARDS & FORMATS

All monitoring information collected by partners should be provided in agreed form and format, with appropriate curatorship of raw data by the designated partner. The specific standards and formats for data and metadata and other types of monitoring information to be collected by partners will depend on what is being collected, and should be described in the partnership agreement. Data quality control/quality assurance (QA/QC) standards and procedures also should be agreed upon.

REPORTING

A schedule for reporting of monitoring data or results from partnerships is essential to ensure that information is provided at useful time points for integration with other information sources and to inform reviews of the regional MPA network. Agreements should also specify reporting requirements, including the presentation of synthesized results and key messages together with more detailed analyses and raw data.

TRAINING

Regular training and testing of those collecting monitoring data are essential to ensure data quality and comparability. No two people collect data in exactly the same way; even highly trained observers will vary in their estimates of, for example, the length of a fish seen while conducting an underwater survey. Thus, regular training is necessary to minimize differences in how data are collected, and regular evaluation (testing) of data collectors is essential to measure inter-observer error and allow development of any necessary correction factors. Partnership agreements should include details of observer training and evaluation.

RESOURCES

As noted above, partnership agreements should include information about the resources to be provided by each partner. This includes funding, but also equipment, personnel, and infrastructure (e.g., office space, classrooms). It also includes information (e.g., data), materials (e.g., training materials), and services (e.g., training, testing, data entry, data curatorship, analysis).

PARTNERSHIPS FOR INTERPRETING MONITORING RESULTS

As described in Chapter 3, interpretation of MPA monitoring data will involve consideration of information from many other sources and programs. This information is referred to as contextual information. Contextual information includes, for example, information about oceanographic conditions and trends, water quality, and economic trends and indices that will be important to understand the larger ecological and economic environment within which the MPAs are operating.

In addition, information from other (non-MPA) monitoring programs will be useful. The monitoring approaches described in this plan necessarily focus on obtaining the most useful and important information to meet MLPA requirements. The

monitoring indicators and other metrics have been chosen to emphasize MPAs while providing some insight into or overlap with other important issues that bear on assessment of potential MPA effects. For example, the inclusion of select fished species as focal species for Ecosystem Checkups and Assessments, and the monitoring of Consumptive Uses, will provide information consistent with fisheries monitoring. Other focal species have been chosen in part for their sensitivity as "sentinels" for water quality or climate change effects. For example, Cassin's auklets have been selected as indicators of food web changes in nearshore pelagic ecosystems but also serve as indicators of climate change (for further information see the Guide to the Vital Signs of Ecosystem Feature Checkups, Appendix B-1). However, monitoring focused in support of other programs, such as fisheries management, water quality, invasive species, climate change impacts, and threatened species conservation, will generate much more detailed and comprehensive coverage of these issues and thus can provide valuable supplemental and contextual information for interpreting MPA monitoring results (see Figure 7-1).

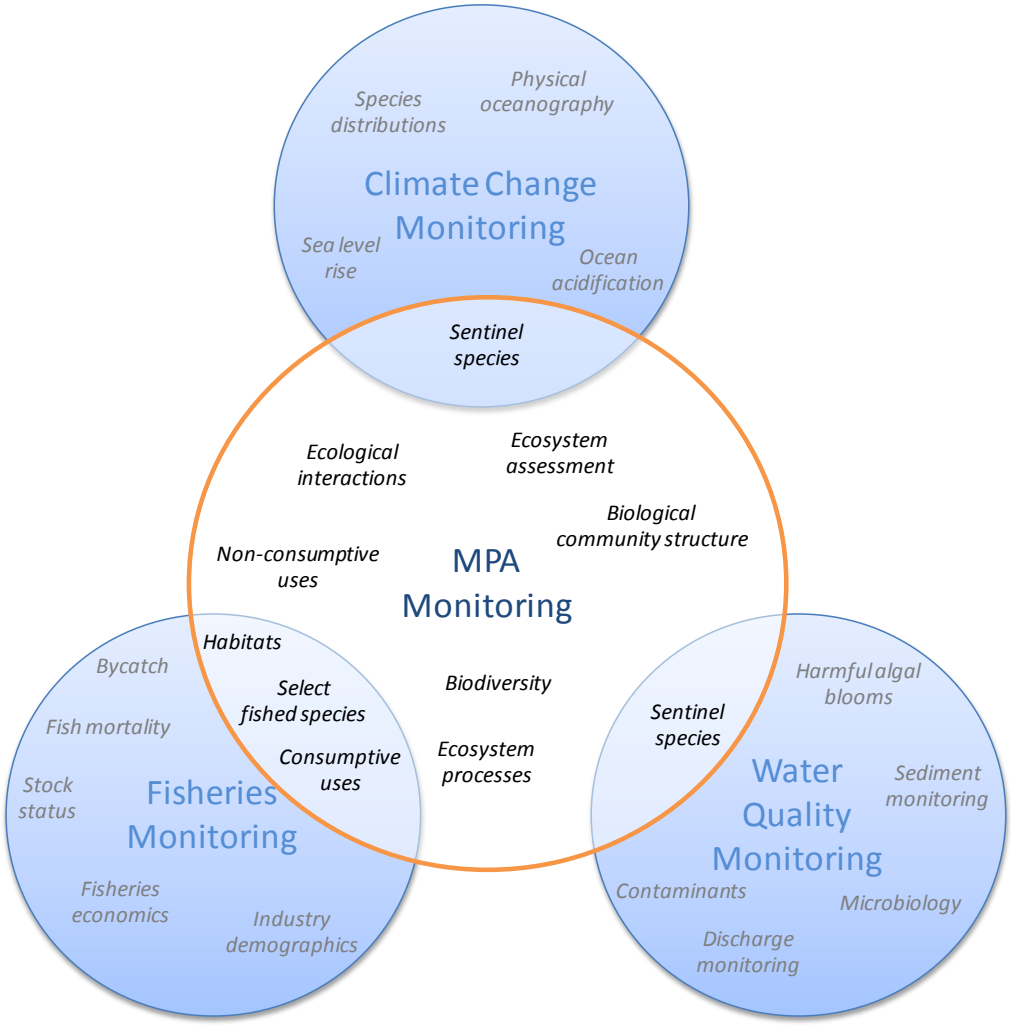


Figure 7-1. *MPA monitoring prioritizes collection of information that is most important and useful for meeting MLPA requirements. This necessarily involves some overlap with information typically collected by other (non-MPA) monitoring programs, such those focused on monitoring fisheries management, water quality, or climate change. However, the more detailed and comprehensive coverage of those issues provided through those programs can provide valuable supplemental information for interpreting MPA monitoring results. Partnerships and linkages with relevant programs will be developed to gather this supplemental information. (Note: Monitoring elements shown are for illustration purposes only and are not meant to fully represent or describe any of the programs indicated.)*

Obvious candidates for partnerships to gather this contextual and supplemental information to support interpretation of MPA monitoring results for the South Coast region include the Southern California Ocean Observing System (SCOOS), the State Water Resources Control Board and the Central Coast, Los Angeles, Santa Ana and San Diego Regional Water Quality Control Boards, and the National Marine Fisheries Service (NMFS). There are also a variety of other programs and entities involved in aspects of fisheries or water quality monitoring, as well as research institutions engaged in socioeconomic assessments and oceanographic monitoring and research, to cite but a few examples.

PARTNERSHIPS FOR SHARING MONITORING INFORMATION

One of the purposes of monitoring under the MLPA is to facilitate adaptive MPA management. Thus, those involved in future MPA decisions, including decision-makers (particularly the Fish and Game Commission) and stakeholders in MPA decision processes, are among the primary intended recipients of monitoring information and results. Approaches for meeting this purpose are discussed further in Chapter 6.

Monitoring of the South Coast regional MPA network will provide information not only about the MPAs, but also about the condition and trends of the region's marine and coastal ecosystems, including consumptive and non-consumptive human activities. Thus the monitoring results and data are likely to be of use to those generally interested in marine ecosystems, both in the South Coast region and elsewhere.

A variety of potential partners are available to assist with the sharing and dissemination of monitoring results and information. These range from print media outlets to online tools, formal and informal education programs and institutions at all levels. Technology partners may also emerge to facilitate use of the rapidly evolving ways that people gather and track information in which they are interested. These partnerships will be developed as opportunities and resources allow, consistent with meeting MLPA requirements and priorities.

8. Estimating Costs of MPA Monitoring Components

- Approaches to develop cost estimates
- Developing assumptions to enable cost estimation
- Estimating costs to assess Ecosystem Feature condition

To facilitate preparations for monitoring implementation, it is useful to estimate the potential financial costs of monitoring the South Coast regional MPA network. Estimating costs is, however, complicated by the deliberately flexible nature of this monitoring plan. Flexibility is essential to ensure that monitoring can be tailored to reflect management priorities and available resources at the time of monitoring implementation, but means that monitoring costs are similarly flexible, depending on which monitoring components are implemented and at what scale.

In this chapter, estimates are provided of the annual financial costs of implementing the components of the monitoring framework in the South Coast region. These estimates include costs to collect, analyze, and report monitoring results, based on costs of existing activities and programs. Collectively the cost ranges provide a set of options, or menu, for implementing monitoring components. Considerations for selecting monitoring components to form a coherent and effective monitoring program for the South Coast MPAs are described in Chapter 9.

APPROACHES TO DEVELOP COST ESTIMATES

There are several possible approaches to develop cost estimates for individual monitoring components. One approach would be to issue a preparatory Call for Pre-Proposals, leaving it to respondents to develop indicative budgets for work they propose to conduct. The submitted budgets could then be used to estimate costs. It may also be possible to estimate some costs using the projects implemented as part of the South Coast MPA Baseline Program (Appendix C-2). However, given that this plan should guide the design of Baseline Program projects, and will thus influence their costs, perhaps the most sensible approach is to learn as much as possible from existing monitoring programs.

As described in Appendix L of the MLPA Master Plan, the total costs for implementing the MLPA were estimated in 2006, based on an analysis of the costs of similar programs.[66] These cost estimates included all aspects of MPA implementation, including monitoring. The estimated costs for monitoring the statewide MPA network, once complete, ranged from a minimum of $206,000 to a maximum of $7,495,000 annually.[67] Estimated monitoring costs included monitoring of both biotic and socioeconomic conditions, using methods such as “benthic or trawl surveys, water sampling, socioeconomic surveys and contracted services if needed”.[68] However, no further details of cost breakdown were provided, thus it is difficult to use these figures to estimate costs for the monitoring components described in this monitoring plan.

Since that 2006 analysis, considerably more experience with MPA monitoring has been gathered in California, not only through completion of the first five years of monitoring the Channel Islands MPAs, but also through completion of baseline monitoring of MPAs in the Central Coast region and initiation of the North Central Coast MPA Baseline Program. Many of the MPA monitoring activities conducted in the Channel Islands, Central Coast and North Central Coast MPAs are similar to some that are included in this monitoring plan. Other MPA and non-MPA programs in California also conduct relevant activities. Those programs thus provide useful starting points for estimating some monitoring costs.

[66] Estimated Long-Term Costs to Implement the California MLPA. April 20, 2006 Draft. California Marine Life Protection Act Master Plan for Marine Protected Areas, Revised Draft, Jan. 2008. Appendix L. pp. L-1 – L-17.
[67] Ibid. p. L-11.
[68] Ibid. p. L-3.

This approach to estimate monitoring costs is most appropriate for the monitoring components designed for assessing ecosystem condition and trends. This element of monitoring is highly structured and cost estimates derived from existing monitoring programs and activities can readily be applied to the various elements of the monitoring framework. In contrast, the monitoring components for evaluating MPA design and management decisions are necessarily much less structured, reflecting the broad spectrum of potential evaluation questions. Possible costs of short- and long-term evaluations range from as little as a few thousand dollars, for example for straightforward evaluations conducted largely by volunteers, to hundreds of thousands dollars for complex, collaborative evaluations conducted in partnership with multi-disciplinary research teams. Given this huge potential cost range, the most appropriate approach to allocating funds for this monitoring component is to simply assign it a percentage of the overall monitoring budget. This is discussed further in Chapter 9.

DEVELOPING ASSUMPTIONS TO ENABLE COST ESTIMATION

Estimating costs of monitoring components designed to assess the condition and trends of Ecosystem Features requires development of certain assumptions. These include assumptions about likely monitoring methods and the spatial and temporal distribution of monitoring.

IDENTIFYING MONITORING METHODS

Likely monitoring methods have been identified for assessing the condition and trends of Ecosystem Features, based primarily on methods commonly employed today in programs in California and elsewhere. At the time of monitoring implementation, different or additional methods may be employed. However, for the purposes of generating cost estimates, commonly employed methods have been assumed to the extent possible.

Likely monitoring methods have been identified for each of the two implementation options for assessing ecosystem condition and trends: Ecosystem Feature Checkups and Ecosystem Feature Assessments (see Chapter 4 for explanation of these options). For Ecosystem Feature Checkups, the identified monitoring methods are appropriate for implementation through community partners and citizen scientists. For Ecosystem Feature Assessments, the identified monitoring methods are suitable for implementing via research partnerships, and in many cases allow collection of more detailed information. While the Ecosystem Feature Assessment option generally employs methods that require more technical capabilities, this does not necessarily preclude citizen science involvement, as many such groups have considerable training and expertise.

DEVELOPING TEMPORAL SAMPLING ASSUMPTIONS

The cost of monitoring is obviously affected by the frequency with which it is carried out. However, for the purposes of generating annual cost estimates for monitoring components, it is sufficient to assume sampling occurs annually. In applying cost estimates from existing programs and budgets, we also assume that those costs include sufficient temporal sampling to detect ecosystem change and MPA effects.

During development of monitoring programs, individual monitoring components may use annual, biennial, or other frequency of sampling, depending on management priorities and available resources. At that time, sampling strategies intended to provide data with specified degrees of certainty and resolution will also be developed. Initial recommendations and further information on temporal aspects of sampling are provided in Chapter 9.

DEVELOPING SPATIAL SAMPLING ASSUMPTIONS

Developing a full spatial sampling design for monitoring, with identification of specific sites or locations to be monitored in the South Coast region, is beyond the scope of this monitoring plan, because the spatial sampling design must reflect the management priorities and available resources at the time of monitoring implementation. For example, the appropriate spatial design of monitoring will depend in part on which monitoring modules are selected for implementation and the associated selected implementation options and monitoring methods. However, to generate cost estimates, it is necessary to make assumptions about the general spatial distribution of monitoring activities in the region and the number of locations to be monitored.

Assumptions about the spatial distribution of monitoring data collection are based on general spatial sampling guidelines, which have been developed to reflect current scientific knowledge of the spatial variation in the marine ecosystems and socioeconomic elements of the South Coast region, and take into account the intended geographic scope and spatial resolution of monitoring data analysis and interpretation.

The following spatial sampling guidelines have been developed and used to generate annual cost estimates for monitoring components to monitor ecosystem condition and trends:

- MPA monitoring is being designed to facilitate evaluation of individual MPAs as well as the regional network. To provide robust regional assessments, sampling should be distributed throughout the South Coast region.
- For the MPA design process, the South Coast Science Advisory Team (SCSAT) guidance recognized five bioregions within the region: North Mainland (Pt. Conception to Marina Del Rey), South Mainland (Marina Del Rey to U.S.-Mexico border), West Channel Islands (San Miguel, Santa Rosa and San Nicolas Islands), Mid-Channel Islands (Santa Cruz, Anacapa, and Santa Barbara Islands) and East Channel Islands (Santa Catalina and San Clemente Islands)[69]. To adequately represent the region in monitoring data collection, sampling should be replicated within each of these bioregions, as Ecosystem Feature presence and feasibility permit.
- For the ecological Features, excluding estuaries, detection of MPA effects is facilitated by inside-outside comparisons. To facilitate these analyses, an equal number of inside MPA and outside reference locations should be sampled.
- Estuarine & Wetland ecosystems vary significantly at small spatial scales within an individual estuary and between estuaries with different physical characteristics. This complicates sampling based on inside-outside comparisons for these ecosystems and these MPAs. Thus, sampling should be structured to allow comparison of ecosystem trends and trajectories of change between protected and unprotected estuaries.
- Five counties border the South Coast region: Santa Barbara, Ventura, Los Angeles, Orange and San Diego. In addition, the region includes three main port complexes: Santa Barbara, Los Angeles and San Diego. To adequately track trends in consumptive and non-consumptive uses, sampling should be structured to allow region-wide and port or county assessments, as appropriate for the activity being considered.
- Sampling should include multiple MPA designations (including both State Marine Reserves and State Marine Conservation Areas), and where appropriate additional designations including Special Closures.

These guidelines were used to develop spatial sampling assumptions for each Ecosystem Feature sufficient to generate valid cost estimates. For the purposes of cost estimation, it is sufficient to assume a minimum number of sites or locations within which monitoring data will be collected.

[69] Methods Used to Evaluate MPA Proposals in the South Coast Study Region. October 26, 2009, revised draft. California Marine Life Protection Act Initiative. Executive Summary.

For the ecological Features, excluding estuaries, a reasonable minimum sampling distribution would focus on two MPAs and two reference sites in each of the five bioregions identified by the SCSAT, for a total of ten MPAs and ten reference sites to be sampled for each Ecosystem Feature in the region. This would provide adequate information to assess the condition and trends within each Ecosystem Feature at scales ranging from individual MPAs to the whole region. As not all Ecosystem Features are found in all MPAs, this would include sampling of approximately 12-15 MPAs. Monitoring more sites would generate more data, but the incremental increase in understanding (and statistical power) that resulted would be small, because of the natural variation within each Ecosystem Feature across the South Coast region, the variation in influence of broader drivers such as oceanographic currents and water quality variables, and the variation in the allowed activities within the MPAs. For estuaries, a reasonable sampling distribution would include six estuaries, including three estuaries designated as MPAs. This distribution would allow comparisons of trends through time between estuaries.

For the Consumptive Uses Ecosystem Feature, the sampling assumption reflects the units around which many of the component human activities tend to focus or be managed. In the South Coast region, the assumption is that major port/harbor complexes will be sampled in each of the 5 counties, focusing on identified key fisheries (see Chapter 4 for the specific recommended monitoring metrics for Consumptive Uses). Non-consumptive Uses are also typically monitored through survey efforts that target locations based on the activities being monitored. These locations differ depending on the activity and the frequency of locations is challenging to identify prior to project design. A minimum sampling distribution would focus on robust sampling within the five counties bordering the coast in the region to allow region-wide assessments.

ESTIMATING COSTS TO ASSESS ECOSYSTEM FEATURE CONDITION

ESTIMATING COSTS OF MONITORING METHODS

Initial cost estimates, in the form of annual cost ranges, have been estimated for each likely monitoring method using the sampling assumptions above. These estimates include the costs to collect, analyze and report monitoring results for the identified methods.

These cost estimates were developed by building on existing information and ongoing MPA monitoring, and through consultation with existing organizations and groups in the region that are currently conducting monitoring activities. Cost information from the following organizations and groups was received and incorporated into the monitoring cost estimates:

- California Department of Fish and Game
- Collaborative Fisheries Data Collection Project
- Heal the Bay
- LiMPETS (Long-term Monitoring Program and Experimental Training for Students)
- MARINe (Multi-Agency Rocky Intertidal Network)
- PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans)
- PRBO Conservation Science
- Reef Check California
- Santa Monica Baykeeper
- Southern California Coastal Water Research Project
- Vantuna Research Group

Further, known costs of existing MPA monitoring in California were also incorporated, including the programs contributing to the Channel Islands MPA monitoring program and the Central Coast and North Central Coast MPA Baseline Programs.

In all cases, cost information required adjustments to generate appropriate cost estimates for the South Coast region, or to tailor costs to the specific array of adopted MPAs. A number of additional assumptions were necessary to appropriately estimate MPA monitoring costs for these components in this region. These have been included here to facilitate interpretation of the cost estimates and also inform estimation of costs of new methods:

- All costs are annual implementation costs. All monitoring data collection is assumed to occur in the same year. During implementation of monitoring, the frequency of sampling may vary to reflect management priorities or available resources, for example by sampling high priority Ecosystem Features annually and lower priority Features biennially or triennially (see, for example, the example spending plans described in Chapter 9). However, assuming that all data collection occurs in the same annual period facilitates comparisons of cost estimates among individual monitoring components that may be used for ecosystem condition monitoring.
- Cost information from other monitoring programs included the number of sites sampled by each program. Total cost was divided by the number of sites to generate a per-site cost, and then this cost was multiplied by the intended number of sampling sites. For example, per-site costs of sampling mid-depth rock ecosystems were multiplied by 20 (10 MPA and 10 non-MPA locations) to give an estimated cost range for sampling the Mid-depth Rock Ecosystem Feature.
- In many cases, multiple sources of information and multiple cost estimates were available for each monitoring method. Monitoring cost ranges were therefore generated by encompassing these cost estimates in a cost range, rounded to the nearest $5,000.
- Monitoring metrics included within the Optional Add-on Ecosystem Assessment implementation option are not incorporated into cost estimates. These metrics represent optional additions to the monitoring plan that may be implemented as methods, capacity, and resources permit.
- Cost estimates include standard components of funded projects such as overhead costs but do not include leveraged or matched funds. Leveraging resources and taking advantage of existing expertise and capacity in the region will be important in implementing monitoring cost-effectively. The cost estimates assume that leveraged funds will be available to provide additional support for monitoring activities, using existing programs and cost-sharing arrangements as a model.

ESTIMATING COSTS OF ECOSYSTEM FEATURE CHECKUPS & ASSESSMENTS

Each Ecosystem Feature Checkup or Assessment may require use of multiple monitoring methods in order to collect data on all required monitoring metrics. Estimating the cost of each Checkup or Assessment thus required selecting the appropriate method or methods to be used to collect all the necessary data.

For each Checkup or Assessment, if two or more monitoring methods collect the same data, one was generally selected for use in generating the Checkup or Assessment implementation cost, based on considerations of the costs and advantages and disadvantages of each method. Costs are separately estimated for each monitoring method and for each Ecosystem Feature. During data collection, there may be significant opportunities for cost savings by combining methods within data collection programs (for example combining fishing surveys with ship-based bird censuses) or by combining data collection for multiple Ecosystem Features using the same method and program (e.g., ROV surveys of deep rock and soft-bottom subtidal ecosystems). Initial suggestions are included in the example spending plans in Chapter 9. Additionally, many of the estimated costs of monitoring methods reflect implementation of baseline data collection. For many methods, this may overestimate long-term monitoring costs, as baseline data collection often involves one-time start-up costs (e.g., for program initiation and equipment purchase). Costs of long-term monitoring may thus be comparatively high for initial data collection but may decrease through time.

TABLES OF ESTIMATED COSTS FOR EACH ECOSYSTEM FEATURE

For each Ecosystem Feature, potential monitoring methods, data collected, and associated cost estimates are included for each implementation option: Ecosystem Feature Checkup or Assessment. Both options are not required to track ecosystem condition although both may be implemented where resources and capacity permit. Specific assumptions regarding spatial sampling used to generate cost estimates are reiterated to assist interpretation. Individual methods selected to estimate the overarching cost estimates for each implementation option are enclosed by a black box. Where two or more monitoring methods collect the same data, one was selected based on considerations of the costs and advantages and disadvantages of each method.

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: ROCKY INTERTIDAL ECOSYSTEMS

Spatial sampling assumption for estimating costs of each potential monitoring method: 10 MPAs and 10 reference locations.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods			
	Visual Surveys – fixed area	**Photographic surveys – quadrats**	**Visual surveys – pinnipeds**	**Visual surveys - birds**
Data collected – Vital signs	Mussels, rockweed, surfgrass, sea stars, sea urchins, limpets, abalone	Mussels, rockweed, sea stars, sea urchins, limpets, abalone	Pinnipeds	Marine birds
Potential benefits of monitoring method	Consistent with existing monitoring efforts	Minimal field time required Permanent record created	Fixed location and fixed-period surveys are simple & repeatable	Fixed location and fixed-period surveys are simple & repeatable
Potential disadvantages of monitoring method	Requires some species identification skills	Requires significant data processing capacity		
Estimated cost range for each potential method	$70,000 - $105,000	$70,000 - $105,000	$55,000 - $85,000	$55,000 - $85,000
Estimated cost to implement Ecosystem Feature Checkup = $180,000 - $275,000[1]				

[1]Photographic surveys could also be employed as an alternative to visual surveys, if desired.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods		
	Visual surveys – transects/quadrats	**Photographic surveys**	**Visual surveys - birds**
Data collected – Attributes & indicators	Seaweeds, plants, invertebrates	Seaweeds, plants, invertebrates	Marine birds
Potential benefits of monitoring method	Consistent with existing monitoring efforts	Minimal field time required Permanent record created	Fixed location and fixed-period surveys are simple & repeatable
Potential disadvantages of monitoring method	Requires some species identification skills	Requires significant data processing capacity	
Estimated cost range for each potential method	$110,000 - $160,000	$110,000 - $160,000	$55,000 - $85,000
Estimated cost to implement Ecosystem Feature Assessment = $165,000 - $245,000			

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: KELP & SHALLOW ROCK ECOSYSTEMS (0-30M)

Spatial sampling assumption for estimating costs of each monitoring method: 10 MPAs and 10 reference locations.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods			
	Visual surveys (scuba diving)	**Video surveys (scuba diving)**	**Collaborative fishing surveys (trap)**	**Collaborative fishing surveys (Hook & line)**
Data collected – Vital signs	All vital signs	Red & purple sea urchin, sheephead, kelp bass, rockfishes	Spiny lobster	Sheephead, kelp bass, rockfishes
Potential benefits of monitoring method	Consistent with existing monitoring efforts	Permanent record created Species ID skills not required	Wide geographic coverage feasible	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Size estimation requires training	Many cryptic and mobile species often missed Logistically difficult in kelp	Potential biases may be introduced by gear selectivity	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$70,000 - $105,000	$140,000 - $210,000	$95,000 - $130,000	$95,000 - $130,000
Estimated cost to implement Ecosystem Feature Checkup = $70,000 - $105,000				

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods				
	Remote sensing/multispectral imaging	**Aerial photography**	**Visual surveys (scuba diving)**	**Collaborative fishing surveys (Hook & line)**	**Collaborative fishing surveys (trap)**
Data collected – Attributes & indicators	Areal extent of surface kelp canopy	Areal extent of surface kelp canopy	Invertebrates, fishes	Fishes	Spiny lobster
Potential benefits of monitoring method	Permanent record created	Consistent with existing monitoring efforts	Consistent with existing monitoring efforts	Wide geographic coverage feasible	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Significant technical expertise required	Significant data processing capacity required	Size estimation requires significant training	Potential biases may be introduced by gear selectivity	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$35,000 - $70,000	$70,000 - $105,000	$140,000 - $210,000	$95,000 - $130,000	$95,000 - $130,000
Estimated cost to implement Ecosystem Feature Assessment = $175,000 - $210,000					

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: MID-DEPTH ROCK ECOSYSTEMS (30-100M)

Spatial sampling assumption for estimating costs of each potential monitoring method: 10 MPAs and 10 reference locations.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods	
	Collaborative fishing surveys (trap)	**Collaborative fishing surveys (Hook & line)**
Data collected – Vital signs	Rock crabs	Rockfishes, lingcod, California scorpionfish
Potential benefits of monitoring method	Wide geographic coverage feasible	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Potential biases may be introduced by gear selectivity	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$95,000 - $130,000	$95,000 - $130,000
Estimated cost to implement Ecosystem Feature Checkup = $190,000 - $260,000		

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods			
	ROV (Remotely Operated Vehicle) Surveys	**Submersible Surveys**	**Collaborative fishing surveys (trap)**	**Collaborative fishing surveys (Hook & line)**
Data collected – Attributes & indicators	All attributes and indicators	All attributes and indicators	Rock crabs	Predatory fishes
Potential benefits of monitoring method	Associated habitat data can be used to interpret trends in fish populations	Associated habitat data can be used to interpret trends in population abundances	Wide geographic coverage feasible	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Requires high technical expertise Requires high data processing capacity	Requires high technical expertise Requires high data processing capacity	Potential biases may be introduced by gear selectivity	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$420,000 - $630,000	$700,000 - $840,000	$95,000 - $130,000	$95,000 - $130,000
Estimated cost to implement Ecosystem Feature Assessment = $420,000 - $630,000				

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: ESTUARINE & WETLAND ECOSYSTEMS

Spatial sampling assumption to estimate costs for each potential monitoring method: 6 estuaries, including estuaries with and without MPAs.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods				
	Visual surveys – fixed-area benthos surveys	**Collaborative fishing surveys (Hook & line/nets)**	**Visual surveys – pinnipeds**	**Visual surveys - birds**	**Insect traps**
Data collected – Vital signs	Areal extent of plants, ghost & mud shrimp, clams	California halibut	Pinnipeds	Marine birds	Arthropods
Potential benefits of monitoring method	Low equipment requirements	Wide geographic coverage feasible	Fixed location surveys are simple and repeatable	Fixed location surveys are simple and repeatable	Low equipment requirements
Potential disadvantages of monitoring method	Invasive sampling may cause localized damage GPS mapping appropriate only for shallow eelgrass beds	Potential biases may be introduced by gear selectivity	Shore-based surveys may be most effective in shallow water	Shore-based surveys may be most effective in shallow water	
Estimated cost range for each potential method	$75,000 - $115,000	$75,000 - $150,000	$60,000 - $90,000	$60,000 - $90,000	$40,000 - $50,000
Estimated cost to implement Ecosystem Feature Checkup = $310,000 - $495,000					

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods			
	Remote sensing/multispectral imaging	**Aerial photography**	**Visual surveys & benthic sampling**	**Fishing surveys**
Data collected – Attributes & indicators	Areal extent of eelgrass and pickleweed	Areal extent of eelgrass and pickleweed	Ghost & mud shrimp, clams	Leopard shark, California halibut, spotted sand bass
Potential benefits of monitoring method	Permanent record created	Consistent with existing monitoring efforts	Low equipment requirements	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Significant technical expertise required Significant data processing capacity required	Significant data processing capacity required	Invasive sampling may cause localized damage	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$50,000-$115,000	$115,000 - $175,000	$175,000 - $225,000	$115,000 - $175,000

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT (CONTINUED)

	Potential Monitoring Methods		
	Fishing surveys (e.g. seines)	**Visual surveys - birds**	**Insect traps**
Data collected – Attributes & indicators	Arrow goby, Topsmelt	Piscivorous/shore birds	Arthropods
Potential benefits of monitoring method	Wide geographic coverage feasible	Fixed location surveys are simple and repeatable	Low equipment requirements
Potential disadvantages of monitoring method	Potential biases may be introduced by gear selectivity Seines may cause habitat damage	Shore-based surveys may be most effective in shallow water	
Estimated cost range for each potential method	$115,000 - $175,000	$60,000 - $90,000	$40,000 - $50,000
Estimated cost to implement Ecosystem Feature Assessment = $555,000- $830,000			

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: SOFT-BOTTOM INTERTIDAL & BEACH ECOSYSTEMS

Spatial sampling assumption to estimate costs for each potential monitoring method: 10 MPAs and 10 reference locations.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods				
	Visual surveys – fixed-area benthos surveys	**Visual surveys – intertidal fish**	**Visual surveys - pinnipeds**	**Visual surveys –birds**	**Volunteer fishing surveys (Hook & line, nets)**
Data collected – Vital signs	Sand crabs, Pismo clams, beach wrack	Grunion	Pinnipeds	Marine birds	Surfperch
Potential benefits of monitoring method	Consistent with existing monitoring efforts	Consistent with existing monitoring efforts	Fixed location fixed-period surveys are simple and repeatable	Fixed location fixed-period surveys are simple and repeatable	Wide geographic coverage feasible
Potential disadvantages of monitoring method					Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$70,000 - $105,000	$50,000 – $70,000	$55,000 - $85,000	$55,000 - $85,000	$25,000-40,000
Estimated cost to implement Ecosystem Feature Checkup = $255,000 - $385,000					

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods			
	Visual surveys - transects/ quadrats/benthic sampling	**Visual surveys**	**Collaborative fishing surveys (Hook & line/nets)**	**Visual surveys**
Data collected – Attributes & indicators	Invertebrates, beach wrack	Grunion	Surfperch	Marine birds
Potential benefits of monitoring method	Consistent with existing monitoring efforts	Consistent with existing monitoring efforts	Wide geographic coverage feasible	Fixed location & fixed-period surveys are simple & repeatable
Potential disadvantages of monitoring method			Potential biases may be introduced by gear selectivity	
Estimated cost range for each potential method	$105,000 - $140,000	$50,000 – $70,000	$95,000 - $130,000	$55,000 - $85,000
Estimated cost to implement Ecosystem Feature Assessment = $305,000 - $425,000				

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: SOFT-BOTTOM SUBTIDAL ECOSYSTEMS

Spatial sampling assumption for estimating costs of each potential monitoring method: 10 MPAs and 10 reference locations.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods	
	Collaborative fishing surveys (trap)	**Collaborative fishing surveys (Hook & line)**
Data collected – Vital signs	Rock crabs	Surfperch, California halibut, other flatfishes
Potential benefits of monitoring method	Wide geographic coverage feasible	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Potential biases may be introduced by gear selectivity	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$95,000 - $130,000	$95,000 - $130,000
Estimated cost to implement Ecosystem Feature Checkup = $190,000 - $260,000		

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods			
	ROV (Remotely Operated Vehicle) Surveys	**Submersible Surveys**	**Collaborative fishing surveys (trap)**	**Collaborative fishing surveys (Hook & line)**
Data collected – Attributes & indicators	All attributes and indicators	All attributes and indicators	Benthic invertebrates	Predatory fishes
Potential benefits of monitoring method	Associated habitat data can be used to interpret trends in fish populations	Associated habitat data can be used to interpret trends in population abundances	Wide geographic coverage feasible	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Requires high technical expertise Requires high data processing capacity	Requires high technical expertise Requires high data processing capacity	Potential biases may be introduced by gear selectivity	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$420,000 - $630,000	$700,000 - $840,000	$95,000 - $130,000	$95,000 - $130,000
Estimated cost to implement Ecosystem Feature Assessment = $420,000 - $630,000				

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ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: DEEP ECOSYSTEMS, INCLUDING CANYONS (>100M)

Spatial sampling assumption for estimating costs of each potential monitoring method: 10 MPAs and 10 reference locations.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

At this time, methods that would be amenable for use by citizen-scientist groups and which would give a complete picture of the condition of deep ecosystems have yet to be developed. Should this change in the future, appropriate vital signs will be developed.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods		
	ROV (Remotely Operated Vehicle) Surveys	**Submersible Surveys**	**Collaborative fishing surveys (trap)**
Data collected – Attributes & indicators	All attributes and indicators	All attributes and indicators	Benthic invertebrates
Potential benefits of monitoring method	Associated habitat data can be used to interpret trends in fish populations	Associated habitat data can be used to interpret trends in population abundances	Wide geographic coverage feasible
Potential disadvantages of monitoring method	Requires high technical expertise Requires high data processing capacity	Requires high technical expertise Requires high data processing capacity	Potential biases may be introduced by gear selectivity
Estimated cost range for each potential method	$420,000 - $630,000	$700,000 - $840,000	$95,000 - $130,000
Estimated cost to implement Ecosystem Feature Assessment = $420,000 - $630,000			

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: NEARSHORE PELAGIC ECOSYSTEMS

Spatial sampling assumption to estimate costs for each potential monitoring method: 10 MPAs and 10 reference locations.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods	
	Collaborative fishing surveys (Hook & line)	**Visual surveys –abundance**
Data collected – Vital signs	Pelagic/semi-pelagic rockfish	Marine birds
Potential benefits of monitoring method	Wide geographic coverage feasible	Fixed location and fixed-period surveys are simple and repeatable
Potential disadvantages of monitoring method	Potential biases may be introduced by gear selectivity	On-water surveys require significant vessel support
Estimated cost range for each potential method	$95,000 - $130,000	$55,000 - $85,000
Estimated cost to implement Ecosystem Feature Checkup = $150,000 - $215,000		

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods	
	Collaborative fishing surveys (Hook & line)	**Visual surveys – colony abundance/on water abundance**
Data collected – Attributes & indicators	Pelagic/semi-pelagic rockfish	Marine birds
Potential benefits of monitoring method	Wide geographic coverage feasible	Fixed location and fixed-period surveys are simple and repeatable
Potential disadvantages of monitoring method	Potential biases may be induced by gear selectivity	On-water surveys require significant vessel support
Estimated cost range for each potential method	$95,000 - $130,000	$140,000 - $280,000
Estimated cost to implement Ecosystem Feature Assessment = $235,000 - $410,000		

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: CONSUMPTIVE USES

Spatial sampling assumption to estimate costs of each potential monitoring method: 5 port/harbor complexes and identified key fisheries.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

	Potential Monitoring Methods		
	Analysis of commercial landings data (including licenses)	**Analysis of CRFS (California Recreational Fisheries Survey) data**	**Analysis of DFG lobster card data**
Data collected – Vital signs	Landings(weight & value)	Landings (number & weight), CPUE	Landings (number)
Potential benefits of monitoring method	Established data collection and archiving mechanisms Historical trends available from 1969	Data collection began in 2004 providing baseline information Consistent state-wide program	Data collection began in 2008 providing baseline information Consistent state-wide program
Potential disadvantages of monitoring method	Poor spatial resolution in collected data for detection of MPA effects		Poor spatial resolution in collected data for detection of MPA effects
Estimated cost range for each potential method	$60,000 - $185,000	$95,000 - $155,000	$15,000 - $20,000
Estimated cost to implement Ecosystem Feature Checkup = $170,000 - $360,000			

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods			
	Analysis of commercial landings data (including licenses)	**Survey program – commercial fishery information with high spatial resolution**	**Survey program – Costs and earnings for commercial fishers**	**Analysis of CRFS (California Recreational Fisheries Survey) data**
Data collected – Attributes & indicators	Number of participants Level of activity Economic value/quality of activity	Number of participants Level of activity Economic value/quality of activity	Economic value/quality of activity – ex vessel, net revenue	Number of participants Level of activity Quality of activity
Potential benefits of monitoring method	Established data collection and archiving mechanisms Historical trends available from 1969	Diverse survey techniques (e.g., telephone, online) offer opportunity to scale costs	Allows collection of a broad array of information	Data collection began in 2004 providing baseline information Consistent state-wide program
Potential disadvantages of monitoring method	Poor spatial resolution in collected data	Requires trust and effort to reduce potential/perceived bias	Requires trust and effort to reduce potential/perceived bias	Current CRFS regions do not correspond with the North Central Coast region
Estimated cost range for each potential method	$165,000 - $250,000	$415,000 - $835,000	$500,000 - $665,000	$125,000 - $210,000

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT (CONTINUED)

	Potential Monitoring Methods			
	Survey program – Supplement to CRFS data with high spatial resolution and additional key fisheries (e.g., lobster)	**Survey program – Costs for consumptive recreational users**	**Survey program – Knowledge, Attitudes, Perceptions (KAP) of Users**	**Aerial surveys/remote sensing**
Data collected – Attributes & indicators	Number of participants Level of activity Quality of activity	Quality of activity – net expenditures/costs	KAP	Number of participants Level of activity
Potential benefits of monitoring method	Expanded survey effort allows increased analysis of MPA-specific effects	Allows collection of a broad array of information	Allows collection of a broad array of information	Provides fine spatial scale data on fishing locations
Potential disadvantages of monitoring method		Requires trust and effort to reduce potential/perceived bias	Requires trust and effort to reduce potential/perceived bias	Low temporal resolution
Estimated cost range for each potential method	$250,000 - $350,000	$100,000 - $200,000	$250,000 - $300,000	$50,000 - $75,000
Estimated cost to implement Ecosystem Feature Assessment (All indicator categories) = $1,805,000 - $2,810,000[1]				

[1]The indicator framework for monitoring of Consumptive Uses is scalable to support partial implementation of this monitoring component as resources permit. Initial recommendations for partial implementation are included in Chapter 9.

ESTIMATED COSTS OF ECOSYSTEM FEATURE CHECKUP OR ASSESSMENT: NON-CONSUMPTIVE USES

Spatial sampling assumption to estimate costs for each potential monitoring method: Focus on 5 coastal counties and region-wide assessments.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE CHECKUP

There are no suitable programs at this time to estimate costs of monitoring non-consumptive uses via the Checkup option.

IMPLEMENTATION OPTION: ECOSYSTEM FEATURE ASSESSMENT

	Potential Monitoring Methods		
	Survey Program – scuba divers	**Survey program – expanded to other activities**	**Survey program – expanded to include KAP (Knowledge, Attitudes and Perceptions)**
Data collected – Attributes & indicators	Level of activity Motivation	Level of activity Motivation	KAP (Knowledge, Attitudes and Perceptions)
Potential benefits of monitoring method	Survey methods can be scaled to reflect available resources	Survey methods can be scaled to reflect available resources	Survey methods can be scaled to reflect available resources
Potential disadvantages of monitoring method	High start-up costs to design survey instruments Significant data processing capacity required	High start-up costs to design survey instruments Significant data processing capacity required	High start-up costs to design survey instruments Significant data processing capacity required
Estimated cost range for each potential method	$350,000 - $450,000	$150,000 - $250,000	$100,000 - $150,000
Estimated cost to implement Ecosystem Feature Assessment (All indicator categories) = $600,000 - $900,000[1]			

[1] The indicator framework for monitoring of Non-consumptive Uses is scalable to support partial implementation of this monitoring component as resources permit. Initial recommendations for partial implementation are included in Chapter 9.

9. Building an Effective MPA Monitoring Program

- Configuring a coherent & effective monitoring program
- Developing two example monitoring spending plans
- Next steps: guiding monitoring implementation

The preceding chapters of this plan have detailed the elements of the MPA monitoring framework developed to meet the requirements of the MLPA: Assessing Ecosystem Condition & Trends (Chapter 4); and Evaluating MPA Design & Management Decisions (Chapter 5), and how they have been applied to the South Coast region. Options for implementing each monitoring element have been described, and cost estimates have been generated for Assessing Ecosystem Condition & Trends (Chapter 8). Building and implementing an effective monitoring program will require prioritizing the monitoring elements to be implemented, identifying an appropriate monitoring and reporting cycle and developing spending plans that reflect available resources. This chapter provides specific recommendations for building a cohesive program and illustrates the application of that guidance via elaboration of two example monitoring plans that reflect two hypothetical budget scenarios.

CONFIGURING A COHERENT & EFFECTIVE MONITORING PROGRAM

This monitoring plan has been designed to be comprehensive, providing full coverage of MLPA goals and South Coast ecosystems. However, it has also been designed to be flexible, to allow tailoring to management priorities and available resources when monitoring commences. The modular structure of the monitoring framework and the implementation options (i.e. Ecosystem Feature Checkup and Ecosystem Feature Assessment) enable a variety of monitoring configurations. This section provides guidance on building a coherent and effective program, taking advantage of this flexibility within the monitoring framework.

IMPLEMENTING THE MONITORING FRAMEWORK

The MPA monitoring framework is comprised of two core monitoring elements: Assessing Ecosystem Condition & Trends and Evaluating MPA Design & Management Decisions (Figure 1-1). Ultimately, both elements are necessary to best facilitate adaptive management.

Assessment of ecosystem condition and trends provides the most basic evaluation of potential MPA effects, and focuses on many of the South Coast aspects that are of great public interest, such as the status of kelp ecosystems and selected fish and invertebrate species, or the trajectories of key consumptive and non-consumptive human uses. In an extremely austere financial environment, it is viable to delay implementation of evaluation of MPA design and management decisions, particularly in the first one or two of the recommended five-year MPA review cycles (e.g., in the first five to ten years following MPA implementation), and focus the limited available resources on assessing ecosystem condition and trends. However, delaying onset of evaluation of MPA design and management decisions should be viewed as a measure of last resort, as it will cause a corresponding delay in the availability of specific evaluations of MPA size and other design characteristics that are important to inform future management decisions.

GUIDANCE FOR SELECTING MONITORING MODULES

Each of the two core elements of the monitoring framework (i.e., Assessing Ecosystem Condition & Trends and Evaluating MPA Design & Management Decisions), is implemented through selection of modules from within each element. The modules for assessing ecosystem condition and trends are the Ecosystem Features that have been identified for a region.

The modules for evaluating MPA design and management decisions are the short-term and long-term evaluation categories. All modules have been designed to be stand-alone components of monitoring.

SETTING PRIORITIES FOR ASSESSING ECOSYSTEM CONDITION & TRENDS

Ecosystem condition assessment is conducted through monitoring the ten Ecosystem Features that have been developed to collectively represent and encompass the South Coast region for the purposes of MPA monitoring. Ultimately, to allow comprehensive evaluation of the extent to which the regional MPA network is meeting MLPA goals, all Ecosystem Features should be monitored at some scale. For each Ecosystem Feature, the implementation options for the module (i.e., Ecosystem Feature Checkup and/or Ecosystem Feature Assessment) provide a mechanism to scale implementation.

Resource limitations may require prioritizing among Ecosystem Features, particularly in the initial years of monitoring. Monitoring will generally be more effective and informative, and will better meet MLPA requirements, by selecting fewer Ecosystem Features and implementing them as designed, rather than selecting more and implementing them incompletely. If it is not possible to monitor all Ecosystem Features, priority should be accorded to those considered likely to be most responsive to potential MPA effects, and also to those that are of greatest public interest, for example because they are associated with important fisheries. The Kelp & Shallow Rock and Consumptive Uses Ecosystem Features, for example, include metrics that may respond comparatively quickly and directly to MPA implementation. In contrast, estuaries, for example, are likely to be strongly influenced by factors additional to MPAs, and many species in the Nearshore Pelagic Ecosystem Feature are highly mobile species that may be slow to show MPA effects (see Chapter 3 for additional details). These Ecosystem Features may thus be determined to be of lower priority.

The following list illustrates how Ecosystem Features might be prioritized based on the criteria above. This example of prioritization is used as the basis for building the two hypothetical spending plans in the next section of this chapter. These examples are for illustrative purposes only; decisions regarding prioritization of Ecosystem Features will reflect management priorities and resources available at the time that long-term monitoring is implemented.

First priority:

- Kelp & Shallow Rock Ecosystems
- Consumptive Uses

Second priority:

- Rocky Intertidal Ecosystems
- Mid-depth Rock Ecosystems
- Soft-bottom Intertidal & Beach Ecosystems
- Non-consumptive Uses

Third priority:

- Soft-bottom Subtidal Ecosystems

Fourth priority:

- Deep Ecosystems, including Canyons

Each selected Ecosystem Feature should be implemented through use of an Ecosystem Feature Checkup or Ecosystem Feature Assessment approach; these two modules have been designed to provide compatible information, although at different levels of resolution. Where capacity and resources permit, both implementation options may be employed. However, partial implementation, for example through choosing only some of the vital signs or indicators for the Checkup

or Assessment, will not generate an adequate condition assessment of the Feature and should be avoided. The exception to this recommendation is monitoring of Consumptive and Non-consumptive Uses via the Ecosystem Assessment option. For these Ecosystem Features, the Assessment option is explicitly designed to include scalable categories of indicators that allow partial implementation.

SETTING PRIORITIES FOR EVALUATING MPA DESIGN & MANAGEMENT DECISIONS

Evaluations of MPA design and management decisions have been organized into two monitoring modules: short-term and long-term evaluations. In Chapter 5, criteria have been developed to guide the selection and prioritization of potential evaluation questions within each of these two modules, including management urgency, applicability and feasibility. Ultimately, both modules are needed to ensure generation of conclusive, robust information suitable for informing future MPA management decisions, and an optimal monitoring program would include both modules, even if only one or a few evaluations in each module are conducted. If that is not feasible, the inventories of short-term and long-term candidate evaluations should be combined, and the overall highest priority evaluation(s) that can be feasibly conducted with available resources selected for implementation.

CHOOSING A MONITORING & REPORTING CYCLE

One of the most important considerations in building an effective monitoring program is the timing of the monitoring and reporting cycle. In the context of the MLPA, the monitoring program should be built to most effectively and efficiently gather information and report results in advance of the five-year MPA reviews recommended in the MLPA Master Plan.

A five-year monitoring cycle would allow monitoring data collection and initial analyses to be staged over four years, and the fifth (review) year allocated to preparation and dissemination of results and findings. It is not, of course, necessary for the same monitoring data to be collected every year within the monitoring cycle. Indeed, resources may be most efficiently used by staggering data collection among selected monitoring modules. In addition, components that are strongly related to one another, or which may efficiently be monitored together, can be scheduled to occur in the same year.

DEVELOPING TWO EXAMPLE MONITORING SPENDING PLANS

To illustrate application of the guidelines discussed above, and to facilitate setting of clear monitoring priorities for the South Coast regional MPA network, two example spending plans have been developed. The spending plans provide recommendations for allocating two hypothetical budgets: $1,000,000 (Spending Plan A) and $2,000,000 (Spending Plan B) annually for South Coast regional MPA monitoring.

The spending plans reflect all guidance provided in this monitoring plan. They assume implementation of MPA monitoring using the partnerships approach described in Chapter 7 and reflect the cost estimates developed in Chapter 8. These cost estimates do not include potential sources of leveraged funds. Thus, the allocated funding levels assume that opportunities for partnerships and collaborations will be sought during implementation, building on existing capacity to leverage additional resources. For example, the spending plans include allocated funding levels to implement Ecosystem Feature Checkups for some Ecosystem Features. This implementation option is tailored for community participation in monitoring, and the allocated funding levels assume leveraged support from community groups and partners that are identified to collect this monitoring information. This cost-sharing model is based on existing monitoring programs in California, as is explained in Chapter 8.

For both spending plans, the available budget is allocated to conducting monitoring, including collecting, analyzing and reporting monitoring results. The spending plans depict the choices and trade-offs involved in selecting particular

monitoring components for implementation, and explanations for these choices are provided alongside the plans. The example spending plans presented in this Chapter illustrate the approach for building an effective monitoring program. The same approach can thus be used to configure alternative monitoring programs based on either the same or different budget scenarios.

The spending plans do not include all possible costs of implementing MPA monitoring in the South Coast region. For example, costs of coordination and oversight of monitoring are not included. These costs are likely to depend on a variety of factors, including the monitoring modules to be implemented and the monitoring partnerships involved. Other implementation costs, such as Department of Fish and Game staff costs, may also be identified. These additional costs will need to be considered at the time of monitoring implementation. Nonetheless, the spending plans include the majority of anticipated new costs of MPA monitoring in the South Coast region.

ASSUMPTIONS FOR BUILDING A SPENDING PLAN

A first step in building a spending plan to implement long-term monitoring is to appropriately allocate funding and resources among the two principal monitoring elements: Assessing Ecosystem Condition & Trends; and Evaluating MPA Design & Management Decisions. In general, the majority of the available budget should be allocated to ecosystem condition assessment, especially for the first two to three of the recommended five-year review cycles. Assessment of ecosystem condition and trends is foundational for interpreting all other monitoring information. Additionally, given the highly dynamic and heterogeneous nature of South Coast ecosystems, considerable time and effort will be required to confidently detect trends.

ASSUMPTIONS FOR ALLOCATING BUDGET TO ASSESS ECOSYSTEM FEATURE CONDITION & TRENDS

In these example spending plans, Ecosystem Features are selected for implementation in accordance with the priorities described earlier in this chapter. In addition, an example implementation schedule for the Ecosystem Features has been developed. For instance, implementation of Non-consumptive Uses data collection may be most usefully synchronized with implementation of the nearshore and intertidal ecosystems, such as Soft-bottom Intertidal & Beach and Rocky Intertidal Ecosystem Features, where non-consumptive human uses are most prevalent. This facilitates integrated analyses across linked Ecosystem Features.

Both example spending plans include assessment of the condition of some, but not all, of the Ecosystem Features. Reflecting the cost estimates provided in Chapter 8, funding levels adopt the recommendation to avoid partial implementation of Ecosystem Feature Assessments or Checkups because it will result in significant loss of information. Full implementation is achieved through the selection of specific methods capable of collecting all identified vital signs or indicators within budget.

Given an annual budget of $1 million, the most effective and cohesive monitoring program is developed by implementing Ecosystem Feature Checkups, designed to facilitate monitoring through partnerships with community and citizen science group. By comparison, a $2 million annual budget allows development of a monitoring program that implements both Ecosystem Feature Checkups and Assessments. The choice between the two balances the available budget (Checkups are often, but not always, less expensive) with the degree of information resolution necessary to best assess the condition of the Ecosystem Feature. Checkups have been designed to provide adequate assessments of feature condition, but the additional detail provided through Ecosystem Feature Assessments can be useful, especially for high-priority features or immediately preceding a possible five-year review.

As discussed in Chapter 4, ecosystem condition assessments may over time be improved through targeted research and development, which is likely to be best advanced through partnerships with research entities. These partnerships may be encouraged through clear articulation and prioritization of management needs, which may assist potential partners in securing funds. If resources permit, a small percentage of the monitoring budget may be allocated to such research and development partnerships, in order to provide "seed" funding.

ASSUMPTIONS FOR ALLOCATING BUDGET TO EVALUATE MPA DESIGN & MANAGEMENT DECISIONS

It is possible to generate cost estimates for many of the monitoring components associated with assessing ecosystem condition because this monitoring element is highly structured and there is considerable relevant experience with this type of monitoring in California. In contrast, the tremendous variety of possible decision evaluations, which may cost a few thousand or a few hundred thousand dollars to implement, render cost estimations for this monitoring element less useful. Thus, in this example, budget is allocated within this element on a percentage basis, ensuring funding of both short-term and long-term evaluation modules.

IMPLEMENTING A FIVE-YEAR MONITORING & REPORTING CYCLE

The example spending plans have been designed to operate on a five-year funding cycle, explicitly allocating funding within each of four data collection years so that each year comprises a cohesive set of monitoring elements, and so that the four data collection years collectively provide the most useful information to inform the five-year reviews recommended in the MLPA Master Plan.

In the fifth (review) year, funding has not been directly allocated for monitoring data collection, analysis, and reporting. In this year, resources may be most appropriately allocated for synthesis and communication of monitoring results, and preparation for the review process. Spending plans developed when long-term monitoring is implemented may, of course, include some budget allocation for data collection in this fifth year.

Implementing a five-year monitoring cycle also allows advantage to be taken of the repetition of the cycle. Thus the spending plans should be interpreted as schedules of implementation and not as prescriptions for spending within a single funding cycle only. Each spending plan assumes repetitive five-year cycles of implementation, and this has guided the choices and trade-offs within the plans. For example, surveys designed to reveal broad perceptions and opinions of the MPA network among consumptive and non-consumptive users (technically described as knowledge, attitudes and perceptions or KAP studies) are an important component of MPA monitoring but, given the slow rate of change in these indicators and the high costs of the surveys, are typically conducted relatively infrequently. Thus, this monitoring element is included within year four of the $2 million annual budget scenario. This does not mean that this survey will only be conducted once. Rather it has been scheduled to occur every five years, in the fourth year of the funding cycle in order to provide results that will inform the five-year reviews.

MPA MONITORING BUDGET SCENARIOS & EXAMPLE SPENDING PLANS

GUIDE TO THE SPENDING PLAN TABLES

The example spending plan tables below describe monitoring programs implementing two hypothetical regional MPA monitoring budget scenarios of $1 million and $2 million annually. Both scenarios assume a five-year funding cycle, including four years of data collection activities.

The example spending plans are provided in two formats. First a summary table is provided that includes both example spending plans including the monitoring components selected and the funding level for each. Second, each spending plan is provided in a series of four tables that provide additional information. Also included with each detailed version of the spending plans are descriptions and explanations for the selections and trade-offs in selecting monitoring components.

SUMMARY OF MPA MONITORING SPENDING PLANS: 5-YEAR FUNDING CYCLE

The summary spending plan tables below describe example monitoring programs implementing two hypothetical regional MPA monitoring budget scenarios of $1 million and $2 million annually. Both scenarios assume a five-year funding cycle, including four years of data collection activities. Additional details describing the rationale for selection of monitoring elements for implementation and the allocated funding levels are available in the detailed spending plan tables on the following pages. These spending plans reflect the guidance throughout this monitoring plan but are two of many different potential monitoring program configurations.

	$1 million annual budget				**$2 million annual budget**			
	Allocated funding level				**Allocated funding level**			
	Year 1	Year 2	Year 3	Year 4	Year 1	Year 2	Year 3	Year 4
Assessing Ecosystem Condition & Trends								
Rocky Intertidal	$180,000		$180,000		$165,000		$165,000	$180,000
Kelp & Shallow Rock	$70,000	$70,000	$70,000	$70,000	$175,000	$70,000	$70,000	$175,000
Mid-depth Rock		$190,000		$190,000	$190,000	$420,000		
Estuarine & Wetland			$310,000					$310,000
Soft-bottom Intertidal	$255,000		$255,000				$305,000	$255,000
Soft-bottom Subtidal		$190,000		$190,000	$190,000	$190,000		
Deep ecosystems							$420,000	
Nearshore Pelagic		$155,000		$155,000	$155,000			$155,000
Consumptive Uses	$170,000	$170,000		$170,000	$620,000	$1,120,000	$170,000	$480,000
Non-consumptive Uses	$150,000		$150,000		$150,000		$500,000	$100,000
Evaluating MPA Design & Management Questions								
Short-term MPA management	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$200,000	$200,000
Long-term MPA design and management	$50,000	$50,000	$50,000	$50,000	$100,000	$100,000	$100,000	$100,000
Research & Development								
Advancing ecosystem monitoring				$50,000	$100,000		$100,000	
TOTAL	**$975,000**	**$925,000**	**$1,115,000**	**$975,000**	**$1,945,000**	**$2,000,000**	**$2,030,000**	**$1,955,000**

Monitoring element is implemented via the Ecosystem Feature Checkup implementation option. Monitoring element is implemented via the Ecosystem Feature Assessment implementation option. Empty cells indicate that the monitoring element is not funded for implementation.

EXAMPLE MPA MONITORING SPENDING PLAN A: $1M ANNUAL BUDGET; 5-YEAR FUNDING CYCLE

Spending Plan A is presented in four tables below, one for each data collection year.

$1M ANNUAL BUDGET – YEAR 1

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal	$180,000 - $275,000	All vital signs; Visual surveys	$180,000 - $275,000	$180,000
Kelp & Shallow Rock	$70,000 - $105,000	All vital signs; Scuba surveys	$70,000 - $105,000	$70,000
Mid-depth Rock				
Estuarine & Wetland				
Soft-bottom Intertidal & Beaches	$255,000 – $385,000	All vital signs, Multiple methods	$255,000 – $385,000	$255,000
Soft-bottom Subtidal				
Deep, including Canyons				
Nearshore Pelagic				
Consumptive Uses	$170,000 - $360,000	All vital signs; Analysis of existing data	$170,000 - $360,000	$170,000
Non-consumptive Uses	15% budget allocation	Vital signs to be determined at implementation	$150,000	$150,000
Subtotal			***$825,000 - $1,275,000***	***$825,000***
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocated funding level
Short-term Evaluations	10%			$100,000
Long-term Evaluations	5%			$50,000
Subtotal	***15%***			***$150,000***
Research & Development	Budget allocation (%)			Allocated funding level
Advancing ecosystem monitoring				
Total Expenditure				***$975,000***

Monitoring element is implemented via the Ecosystem Feature Checkup option Monitoring element is implemented via the Ecosystem Feature Assessment option

$1M ANNUAL BUDGET – YEAR 2

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal				
Kelp & Shallow Rock	$70,000 - $105,000	All vital signs; Scuba surveys	$70,000 - $105,000	$70,000
Mid-depth Rock	$190,000 - $260,000	All vital signs; Trap and Hook & line fishing surveys	$190,000 - $260,000	$190,000
Estuarine & Wetland				
Soft-bottom Intertidal & Beaches				
Soft-bottom Subtidal	$190,000 - $260,000	All vital signs; Trap and Hook & line fishing surveys	$190,000 - $260,000	$190,000
Deep, including Canyons				
Nearshore Pelagic	$155,000 - $215,000	All vital signs; Hook & line fishing, visual surveys	$155,000 - $215,000	$155,000
Consumptive Uses	$170,000 - $360,000	All vital signs; Analysis of existing data	$170,000 - $360,000	$170,000
Non-consumptive Uses				
Subtotal			***$775,000 - $1,200,000***	***$775,000***
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocated funding level
Short-term Evaluations	10%			$100,000
Long-term Evaluations	5%			$50,000
Subtotal	***15%***			***$150,000***
Research & Development	Budget allocation (%)			Allocated funding level
Advancing ecosystem monitoring				
Total Expenditure				***$925,000***

Monitoring element is implemented via the Ecosystem Feature Checkup implementation option Monitoring element is implemented via the Ecosystem Feature Assessment implementation option

$1M ANNUAL BUDGET – YEAR 3

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal	$180,000 - $275,000	All vital signs; Visual surveys	$180,000 - $275,000	$180,000
Kelp & Shallow Rock	$70,000 - $105,000	All vital signs; Scuba surveys	$70,000 - $105,000	$70,000
Mid-depth Rock				
Estuarine & Wetland	$310,000 – $495,000	All vital signs, Multiple methods	$310,000 – $495,000	$310,000
Soft-bottom Intertidal & Beaches	$255,000 – $385,000	All vital signs, Multiple methods	$255,000 – $385,000	$255,000
Soft-bottom Subtidal				
Deep, including Canyons				
Nearshore Pelagic				
Consumptive Uses				
Non-consumptive Uses	15% budget allocation	Vital signs to be determined at implementation	$150,000	$150,000
Subtotal			***$965,000 - $1,410,000***	***$965,000***
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocated funding level
Short-term Evaluations	10%			$100,000
Long-term Evaluations	5%			$50,000
Subtotal	***15%***			***$150,000***
Research & Development	Budget allocation (%)			Allocated funding level
Advancing ecosystem monitoring				
Total Expenditure				***$1,115,000***

Monitoring element is implemented via the Ecosystem Feature Checkup implementation option Monitoring element is implemented via the Ecosystem Feature Assessment implementation option

$1M ANNUAL BUDGET – YEAR 4

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal				
Kelp & Shallow Rock	$70,000 - $105,000	All vital signs; Scuba surveys	$70,000 - $105,000	$70,000
Mid-depth Rock	$190,000 - $260,000	All vital signs; Trap and Hook & line fishing surveys	$190,000 - $260,000	$190,000
Estuarine & Wetland				
Soft-bottom Intertidal & Beaches				
Soft-bottom Subtidal	$190,000 - $260,000	All vital signs; Trap and Hook & line fishing surveys	$190,000 - $260,000	$190,000
Deep, including Canyons				
Nearshore Pelagic	$155,000 - $215,000	All vital signs; Hook & line fishing, visual surveys	$155,000 - $215,000	$155,000
Consumptive Uses	$170,000 - $360,000	All vital signs; Analysis of existing data	$170,000 - $360,000	$170,000
Non-consumptive Uses			***$775,000 - $1,200,000***	***$775,000***
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocated funding level
Short-term Evaluations	10%			$100,000
Long-term Evaluations	5%			$50,000
Subtotal	***15%***			***$150,000***
Research & Development	Budget allocation (%)			Allocated funding level
Advancing ecosystem monitoring				$50,000
Total Expenditure				***$975,000***

Monitoring element is implemented via the Ecosystem Feature Checkup implementation option Monitoring element is implemented via the Ecosystem Feature Assessment implementation option

EXAMPLE SPENDING PLAN A RATIONALE

Spending plan A, described in the four tables above, incorporates specific choices and trade-offs in selected monitoring components. These include:

- *Priorities across years*
  Under this spending scenario, the most efficient and cohesive approach is to implement monitoring using the Ecosystem Feature Checkup option in which monitoring is conducted via community and citizen science groups. Using this approach, ecological vital signs will be used to identify regional trends in ecosystem condition. Likewise, for the Consumptive Uses Ecosystem Feature, because the vital signs have been selected to draw on data currently available through existing databases and programs, they are constrained by limited geographic resolution. Thus, as with the ecological vital signs, interpretation of this information with be best considered at a region-wide scale. Deep Ecosystems do not have identified vital signs and are therefore not selected.
- *Assessing ecosystem condition and trends - monitoring focus in year 1*
  In the first year of the funding cycle, the selected monitoring elements focus on priority Ecosystem Features identified in the general recommendations above. The funded Ecosystem Features are selected to link assessment of Non-Consumptive Uses with ecological information from intertidal and nearshore ecosystems by collecting data on those Features within the same year. In addition, Consumptive Uses, which is a high priority Feature, is also monitored, recognizing that information on distribution and intensity of fishing effort will be important for accurate interpretation of ecological vital signs.
- *Assessing ecosystem condition and trends – monitoring focus in year 2*
  The selected Ecosystem Features in the second year of the funding cycle provide a cohesive set of information from subtidal ecosystems, as well as the Consumptive Uses Ecosystem Feature. Implementing these Ecosystem Features in the same year will allow for integrated analyses of ecological and human use data.
- *Assessing ecosystem condition and trends – monitoring focus in year 3*
  As in Year 1, the funded Ecosystem Features are selected to link assessment of Non-Consumptive Uses with ecological information from intertidal and nearshore ecosystems by collecting data on those Features within the same year.
- *Assessing ecosystem condition and trends – monitoring focus in year 4*
  Funding decisions in Year 4 highlight particularly useful information to collect immediately preceding the expected review year (Year 5 of each cycle, reflecting the recommendation of the MLPA Master Plan). Thus, the focus is placed on the highest priority Ecosystem Features, as recommended earlier in this chapter and including the Kelp & Shallow Rock and other subtidal Ecosystem Features as well as the Consumptive Uses Ecosystem Feature.
- *Evaluating MPA design and management decisions – monitoring focus in years 1 – 4*
  Addressing priority short-term MPA design and management decisions and collecting data to contribute toward long-term design and management evaluations are both core components of monitoring, as described above and in previous chapters. The available budget allocates funding of these components at 10% each year for short-term evaluations, and 5% per year for long-term evaluations.
- *Advancing ecosystem monitoring (research & development) – monitoring focus in years 1-4*
  In the current budget scenario, funding research and development is not a priority. Research and development partnerships will be encouraged and incentivized through public dissemination of specific priorities to test and refine MPA monitoring approaches and meet other top MPA management needs. Nonetheless limited funding is provided for this element in Year 4 to facilitate advances in monitoring approaches employing community and citizen science groups.

EXAMPLE MPA MONITORING SPENDING PLAN B: $2M ANNUAL BUDGET, 5-YEAR FUNDING CYCLE

Spending Plan B is presented in four tables below, one for each data collection year.

$2M ANNUAL BUDGET – YEAR 1

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal	$165,000 - $245,000	All attributes & indicators; Visual surveys	$165,000 - $245,000	$165,000
Kelp & Shallow Rock	$175,000 - $280,000	All attributes & indicators; Scuba surveys Remote sensing	 $140,000 - $210,000 $35,000 - $70,000	$175,000
Mid-depth Rock	$190,000 - $260,000	All vital signs; Trap and Hook & line fishing surveys	$190,000 - $260,000	$190,000
Estuarine & Wetland				
Soft-bottom Intertidal & Beaches				
Soft-bottom Subtidal	$190,000 - $260,000	All vital signs; Trap and Hook & line fishing surveys	$190,000 - $260,000	$190,000
Deep, including Canyons				
Nearshore Pelagic	$155,000 - $215,000	All vital signs; Hook & line fishing, visual surveys	$155,000 - $215,000	$155,000
Consumptive Uses	$1,430,000 - $2,190,000	Number of participants & level of activity; Survey program – commercial fisheries Survey program – recreational fisheries	 $310,000 - $625,000 $310,000 - $440,000	$620,000
Non-consumptive Uses	5% budget allocation	Vital signs to be determined at implementation	$150,000	$150,000
Subtotal			$1,645,000 - $2,475,000	$1,645,000
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocating funding level
Short-term Evaluations	5%			$100,000
Long-term Evaluations	5%			$100,000
Subtotal	***10%***			***$200,000***
Research & Development	Budget allocation (%)			Allocating funding level
Advancing ecosystem monitoring	**5%**			$100,000
Total Expenditure				***$1,945,000***

$2M ANNUAL BUDGET – YEAR 2

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal				
Kelp & Shallow Rock	$70,000 - $105,000	All attributes & indicators; Scuba surveys	$70,000 - $105,000	$70,000
Mid-depth Rock	$420,000 - $630,000	All attributes & indicators; ROV surveys	$420,000 - $630,000	420,000
Estuarine & Wetland				
Soft-bottom Intertidal & Beaches				
Soft-bottom Subtidal	$190,000 - $260,000	All vital signs; Trap and Hook & line fishing surveys	$190,000 - $260,000	$190,000
Deep, including Canyons				
Nearshore Pelagic				
Consumptive Uses	$1,430,000 - $2,190,000	Number of participants & level of activity; Survey program – commercial fisheries Survey program – recreational fisheries Survey programs – costs and earnings	 $310,000 - $625,000 $310,000 - $440,000 $500,000 - $750,000	$1,120,000
Non-consumptive Uses				
Subtotal			***$1,800,000 - $2,810,000***	***$1,800,000***
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocated funding level
Short-term Evaluations	5%			$100,000
Long-term Evaluations	5%			$100,000
Subtotal	***10%***			***$200,000***
Research & Development	Budget allocation (%)			Allocated funding level
Advancing ecosystem monitoring				
Total Expenditure				***$2,000,000***

Monitoring element is implemented via the Ecosystem Feature Checkup implementation option Monitoring element is implemented via the Ecosystem Feature Assessment implementation option

$2M ANNUAL BUDGET – YEAR 3

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal	$165,000 - $245,000	All attributes & indicators; Visual surveys	$165,000 - $245,000	$165,000
Kelp & Shallow Rock	$70,000 - $105,000	All attributes & indicators; Scuba surveys	$70,000 - $105,000	$70,000
Mid-depth Rock				
Estuarine & Wetland				
Soft-bottom Intertidal & Beaches	$305,000 – $425,000	All vital signs, Multiple methods	$305,000 – $425,000	$305,000
Soft-bottom Subtidal				
Deep, including Canyons	$420,000 - $840,000	All attributes & indicators; ROV surveys	$420,000 - $630,000	$420,000
Nearshore Pelagic				
Consumptive Uses	$170,000 - $360,000	All vital signs; Analysis of existing data	$170,000 - $360,000	$170,000
Non-consumptive Uses	$600,000 – 900,000	Level of activity, survey programs	$500,000 - $700,000	$500,000
Subtotal			***$1,635,000 - $2,465,000***	***$1,630,000***
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocated funding level
Short-term Evaluations	10%			$200,000
Long-term Evaluations	5%			$100,000
Subtotal	***15%***			***$300,000***
Research & Development	Budget allocation (%)			Allocated funding level
Advancing ecosystem monitoring	5%			$100,000
Total Expenditure				**$2,030,000**

Monitoring element is implemented via the Ecosystem Feature Checkup implementation option Monitoring element is implemented via the Ecosystem Feature Assessment implementation option

$2M ANNUAL BUDGET – YEAR 4

Assessing Ecosystem Condition & Trends	Estimated cost range for full implementation	Selected monitoring metrics; Selected method(s)	Estimated cost range of selected element(s)	Allocated funding level
Rocky Intertidal	$180,000 - $275,000	All vital signs; Visual surveys	$180,000 - $275,000	$180,000
Kelp & Shallow Rock	$175,000 - $280,000	All attributes & indicators; Scuba surveys Remote sensing	 $140,000 - $210,000 $35,000 - $70,000	$175,000
Mid-depth Rock				
Estuarine & Wetland	$310,000 – $495,000	All vital signs, Multiple methods	$310,000 – $495,000	$310,000
Soft-bottom Intertidal & Beaches	$255,000 – $385,000	All vital signs, Multiple methods	$255,000 – $385,000	$255,000
Soft-bottom Subtidal				
Deep, including Canyons				
Nearshore Pelagic	$155,000 - $215,000	All vital signs; Hook & line fishing, visual surveys	$155,000 - $215,000	$155,000
Consumptive Uses	$1,430,000 - $2,190,000	Knowledge, Attitudes & Perceptions; Survey program	$310,000 - $375,000	$310,000
Consumptive Uses	$170,000 - $360,000	All vital signs; Analysis of existing data	$170,000 - $360,000	$170,000
Non-consumptive Uses	$600,000 - $900,000	Knowledge, Attitudes & Perceptions; Survey program	$100,000 - $150,000	$100,000
Subtotal			***$1,655,000 - $2,535,000***	***$1,655,000***
Evaluating MPA Design & Management Decisions	Budget allocation (%)			Allocated funding level
Short-term Evaluations	10%			$200,000
Long-term Evaluations	5%			$100,000
Subtotal	***15%***			***$300,000***
Research & Development	Budget allocation (%)			Allocated funding level
Advancing ecosystem monitoring	10%			
Total Expenditure				***$1,955,000***

Monitoring element is implemented via the Ecosystem Feature Checkup implementation option Monitoring element is implemented via the Ecosystem Feature Assessment implementation option

EXAMPLE SPENDING PLAN B: $2M ANNUAL BUDGET; 5-YEAR FUNDING CYCLE

Example Spending Plan B, described in the tables above, illustrates choices and trade-offs in selecting monitoring components assuming a $2 million annual budget allocated to each of the four data collection years of the five-year monitoring and reporting cycle.

Key differences between this spending plan and the previous plan implementing a $1 million annual budget are:

- Monitoring to assess Ecosystem Feature condition uses the Ecosystem Feature Assessment implementation option, as well as the Ecosystem Feature Checkup option.
- Evaluations of MPA design and management decisions are funded at a higher level.
- Advancing ecosystem monitoring (research & development) is funded every year.

The full rationale for the choices and trade-offs that are inherent within this spending plan is as follows:

- *Priorities across years*
  Taking into account the temporal dynamics within the ecosystem, annual assessments of Kelp & Shallow Rock ecosystems are funded, as in Spending Plan A. Given the interaction with other management priorities (such as fisheries management) together with keen public interest in MPA effects, the Consumptive Uses Ecosystem Feature is also funded annually in this scenario, unlike in Spending Plan A. However, allocated funding levels vary among years for this Ecosystem Feature to accommodate the high cost of full implementation of Ecosystem Feature Assessments. Collecting data at the spatial resolution necessary to detect changes in consumptive uses in response to MPA implementation requires new survey efforts. The implementation costs for this Ecosystem Feature provide an example of the trade-offs and prioritization exercises that are required to build an efficient and coherent monitoring program.
- *Assessing ecosystem condition and trends - monitoring focus in year 1*
  In the first year of the funding cycle, funded monitoring elements again focus on priority Ecosystem Features identified in the general recommendations above. Under this budget scenario, Ecosystem Feature Assessments are funded for Rocky Intertidal, Kelp & Shallow Rock and Consumptive Uses Ecosystem Features. The Consumptive Uses Ecosystem Feature is monitored through partial implementation of Ecosystem Feature Assessment with the funds allocated to conduct survey programs to collect information corresponding to the top two levels of the indicators identified for Consumptive Uses (number of participants and level of activity). Mid-depth Rock, Soft-bottom Subtidal, Nearshore Pelagic and Non-consumptive Uses are implemented using the Ecosystem Feature Checkup option.
- *Assessing ecosystem condition and trends – monitoring focus in year 2*
  The selected Ecosystem Features in the second year of the funding cycle provide a cohesive set of information from subtidal ecosystems. Under this budget scenario, Mid-depth Rock Ecosystems are monitored via Ecosystem Feature Assessment, while Kelp & Shallow Rock and Soft-bottom Subtidal are implemented using the Ecosystem Feature Checkup. Funding is also allocated for analysis of Consumptive Uses data, reflecting the high priority of this Ecosystem Feature, and recognizing that information on the spatial patterns and intensity of fishing at high levels of spatial resolution are necessary for accurate interpretation of ecological indicator and vital signs data from these subtidal habitats.
- *Assessing ecosystem condition and trends – monitoring focus in year 3*
  In Year 3 of the funding cycle, the funded Ecosystem Features are selected to focus on Non-consumptive Uses and link assessment of this Ecosystem Feature with ecological information from intertidal and nearshore ecosystems. Again, this reflects the stronger associations between non-consumptive uses such as wildlife viewing, scuba-diving

and tidepooling and these ecosystems. Non-consumptive Uses Ecosystem Feature Assessment is partially funded, excluding knowledge attitudes and perceptions (KAP) surveys that are funded in Year 4. The Soft-Bottom Intertidal and Rocky Intertidal Features are monitored via Ecosystem Feature Assessments, while Kelp & Shallow Rock Feature is funded for Ecosystem Feature Checkup. Consumptive Uses data collection is included but the focus in Year 3 is on analysis of existing data rather than collection of new data.

- *Assessing ecosystem condition and trends – monitoring focus in year 4*
  As in Spending Plan A, the strategy in Year 4 is to focus on the most useful information to collect immediately preceding the scheduled review year (Year 5 of each cycle). Consumptive Uses and Non-consumptive Uses are both allocated funding to conduct surveys designed to reveal knowledge, attitudes and perceptions of users and visitors to MPAs. Such survey programs are a valuable aspect of monitoring broad perceptions of the MPAs, but are required only periodically. Here, funding is allocated to conduct these surveys every five years.
- *MPA design & management evaluations – monitoring focus in years 1-4*
  As in Spending Plan A, funding is allocated for MPA design and management evaluations in each year of the funding cycle, although here at a higher level. The higher funding levels are designed to provide increased opportunities to implement data collection and analysis, including directly supporting research projects to address priority evaluations, and also leveraging the funds with larger project proposals that may span multiple years.
- *Advancing ecosystem monitoring (research & development) – monitoring focus in years 1-4*
  Research and development to advance ecosystem-based monitoring are considered an important aspect of the monitoring plan and, in this budget scenario, funding is provided in Years 2 and 4.

NEXT STEPS: GUIDING MONITORING IMPLEMENTATION

This South Coast MPA Monitoring Plan provides options and recommendations for implementation of long-term monitoring, but it is not an implementation plan. Planning long-term monitoring will involve developing an implementation plan that identifies which monitoring components to implement that reflects available resources, opportunities for collaborations and partnerships and management priorities.

DEVELOPING AN IMPLEMENTATION PLAN

The process of developing an MPA monitoring implementation plan may most usefully occur when funding levels for long-term monitoring are known, as this will inform the scale at which monitoring can be conducted. Related to this, decisions will need to be made regarding the mechanisms by which long-term monitoring will be implemented. For example, one option is to implement monitoring through a Request for Proposals (RFP) or Request of Qualifications (RFQ) process in which individuals or organizations propose to conduct the components identified as priorities for monitoring. Alternatively, partnership agreements or memoranda of understanding may be developed with monitoring partners. When the level of funding is known and the mechanism for implementing monitoring has been decided on, work to develop the content of the implementation plan can begin.

POTENTIAL CONTENT OF AN IMPLEMENTATION PLAN

An implementation plan provides specific direction on the spatial and temporal scope of monitoring that reflects the resources available for monitoring and the management priorities at the time long-term monitoring commences. Therefore, an implementation plan may include content such as:

- *Identified management priorities:*

If resources for long-term monitoring are limited, it will be necessary to prioritize the scale at which monitoring elements are implemented. For example, Assessing Ecosystem Condition& Trends may be best implemented by selecting fewer Ecosystem Features and implementing them as designed, rather than selecting more and implementing them incompletely. In this case, priority should be accorded to those considered likely to be most responsive to potential MPA effects, and also to those that are of greatest public interest, for example because they are associated with important fisheries. Prioritizing among the modules of Evaluating Design & Management Decisions should consider management urgency and applicability as well as feasibility and cost.

- *Description of implementation mechanisms:*
  A description of the mechanisms by which long-term monitoring will be implemented (e.g. RFPs, MOUs) and how the selected mechanism has informed the development of the implementation plan should be provided.
- *Identification of methods, MPAs and analytical approaches:*
  The monitoring methods to be employed in collecting data as well as the approaches to appropriately analyze and interpret those data should be identified and described. It is unlikely that resources will be available to monitor every MPA in the South Coast region, thus decisions will need to be made regarding which MPAs will be included in long-term monitoring. Selections of methods and MPAs should consider the spatial scale of data collection and statistical analysis relative to the spatial scale of decision-making (e.g., individual MPAs or the regional MPA network).
- *Lessons learned:*
  MPA monitoring should be evaluated and refined to ensure that it continues to meet management needs and to reflect increasing knowledge of marine environments and how best to monitor them. Lessons learned from previous monitoring cycles, including the South Coast MPA Baseline Program, should be considered in the development of subsequent implementation plans.

ELEMENTS OF THE IMPLEMENTATION DEVELOPMENT PROCESS

The following are key elements of the process to develop an implementation plan that should be considered:

- *Evaluation of alignment with management priorities:*
  The proposed monitoring methods, MPAs selected, and analytical approaches should be evaluated to ensure that they are closely aligned with current management priorities.
- *Identification of potential partners & collaborators*
  When long-term monitoring is being implemented, a process to identify potential monitoring partners and seek interest in contributing to monitoring should be undertaken.
- *Identification of opportunities to increase monitoring efficiency*
  Implementation of long-term monitoring provides an opportunity to seek efficiencies in data collection. For example, selected Ecosystem Features for tracking ecosystem condition and trends may be matched with particular design and management questions where data collection efforts overlap.
- *Peer review:*
  The proposed monitoring methods and the approaches to analyze and interpret monitoring data should be subject to peer-review to ensure a high standard of scientific rigor.
- *Public comment:*
  In addition to reflecting management needs, MPA monitoring should also reflect stakeholder priorities. Therefore, it may be appropriate to release an implementation plan for public comment.

APPENDICES

APPENDIX A. SUPPLEMENTAL MONITORING MODULES

Appendix A-1. Supplemental fisheries monitoring module

Appendix A-2. Supplemental water quality monitoring module

APPENDIX B. GUIDES TO MONITORING ECOSYSTEM FEATURE CONDITION & TRENDS

Appendix B-1. Guide to the metrics (vital signs) of Ecosystem Feature Checkups

Appendix B-2. Guide to the metrics (attributes & indicators) of Ecosystem Feature Assessments

APPENDIX C. BACKGROUND AND REFERENCE MATERIALS

Appendix C-1. South Coast region map including the array of MPAs adopted by the California Fish and Game Commission

Appendix C-2. South Coast MPA Baseline Program Request for Proposals (RFP)

Appendix C-3. Summary report from the South Coast MPA Monitoring Planning Workshop 1, July 19, 20, 26, 2010

Appendix C-4. Summary report from the South Coast MPA Monitoring Planning Workshop 2, November 8, 10, 15, 2010

Appendix C-5. South Coast regional goals and objectives [*information taken from MLPA Initiative documents*]

Appendix C-6. List of species likely to benefit from MPAs in the South Coast region [*information taken from MLPA Initiative documents*]

Appendix C-7. Organizations listed in the MLPA Initiative South Coast Regional Profile with a focus on coastal and marine ecosystems in the MLPA South Coast Study Region [*information taken from MLPA Initiative documents*]

Appendix C-8. Levels of protection assigned to individual MPAs and the activities associated with each level of protection in the MLPA South Coast Study Region [*information taken from MLPA Initiative documents*]

APPENDIX A. SUPPLEMENTAL MONITORING MODULES

Monitoring of the South Coast regional MPA network must reflect many different ecological and socioeconomic aspects in order to meet the broad requirements of the MLPA. The monitoring framework and approaches thus adopt an ecosystem-based approach to provide a sufficiently broad umbrella to encompass habitats, marine life populations and human uses, both consumptive and non-consumptive. This broad coverage is achieved through the use of limited sets of strategically selected monitoring indicators and other metrics designed to track the condition and trends of ecosystems through time, and to evaluate MPA design and management decisions. However, the approach also allows addition of supplemental monitoring of specific ecosystem elements, human activities, or pressures on the system, if necessary to respond to public interest or management priorities.

Such additional monitoring may be included in the monitoring framework as supplemental monitoring modules. These supplemental modules, if implemented under the umbrella of MPA monitoring, should be designed to complement and augment the main monitoring modules developed to track ecosystem condition and evaluate MPA design and management decisions. This means that any supplemental modules should link to the Ecosystem Features, be designed to be applicable to MPA management needs and decisions, generate conclusive and robust findings suitable for informing management, and take advantage of appropriate partnerships. For ease and efficiency of implementation, supplemental monitoring modules should be designed to be scalable and should provide detailed information on the chosen topics, focusing on their relationship to MPAs.

Many different topics may be appropriate for supplemental monitoring modules, and this format offers opportunity to link MPA monitoring to other management mandates including water quality monitoring, invasive species monitoring, or particular resource management plans such as for abalone. We describe below two supplemental monitoring modules - supplemental fisheries monitoring and supplemental water quality monitoring - designed to reflect current priority issues in the South Coast region and overlap with MLPA goals. The general format and approach can be applied to any other area or issue of interest.

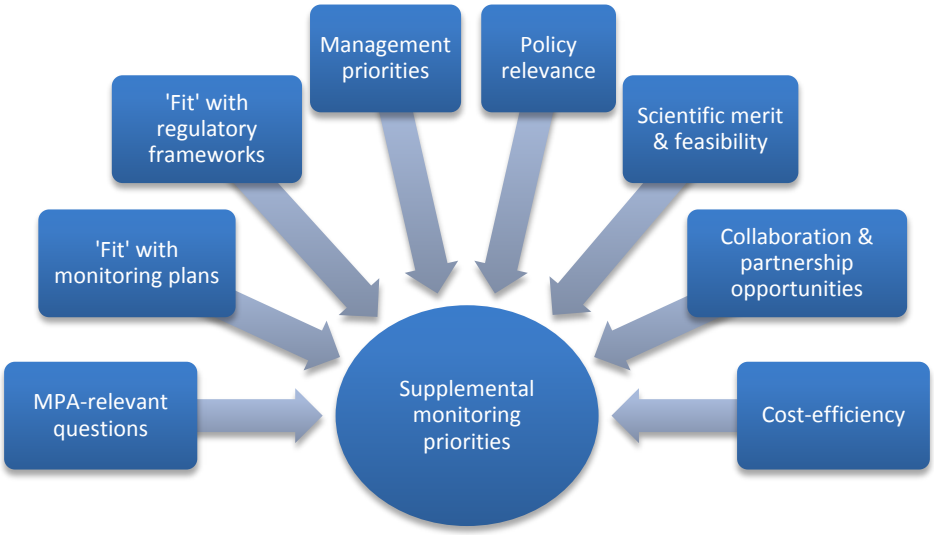
The supplemental monitoring modules focus on presenting an approach, together with key considerations and assumptions, for developing fully implementable monitoring workplans. The goal is to present a logical approach, or series of steps, to identify priority information needs, should implementation of these or other supplemental modules be desired.

DEVELOPING SUPPLEMENTAL MONITORING MODULES

To develop supplemental monitoring modules, we propose a three-tiered approach. This tiered approach is designed to create scalable implementation options, allowing a module to be tailored to available resources and capacity. The three implementation options range from basic implementation that is most closely aligned with proposed MPA monitoring, to new programs and questions explicitly targeted toward priority management questions:

- Tier 1. Existing indicators within the MPA monitoring plan
- Tier 2. Additional indicators that may be added to the existing MPA monitoring plan
- Tier 3. New research questions to address management priorities

ESTABLISHING PRIORITIES FOR SUPPLEMENTAL MONITORING



In each of the three potential tiers of supplemental monitoring, a clear method for selecting among potential indicators and questions is required, taking into account many different considerations and criteria in developing priorities. The following criteria are provided to inform this decision-making process:

- Focus on MPA-relevant questions - Programs should be directed toward issues or questions that are reasonably tied to the establishment of MPAs. General questions that would not be expected to change with MPA implementation are therefore not considered to be high priority.
- 'Fit' with existing plans - Certain species, species groups and habitats are already a focus of the MPA monitoring approaches, for example as focal species or indicators. Supplemental monitoring that focuses on these same indicators or species can be more readily linked to MPA monitoring data and analyses.
- Resource management priorities - Species that are either at risk or currently high priorities for management change should be considered first. While any number of species might be available for monitoring, the goal of this approach is to provide information that is most directly relevant to current management needs.
- Informative for existing regulatory frameworks - Certain information and questions are critical to other management, such as development of fisheries management plans pursuant to the MLMA[1] or management of water quality under the Clean Water Act.[2]
- Policy relevance - The ability to inform decision makers, as with MPA monitoring, is a key consideration. Questions that can be answered in a timeframe useful to the adaptive management process should receive the highest priority. These questions should focus on areas of concern to management agencies and decision makers.
- Scientific merit and feasibility - Monitoring should focus on questions that are both scientifically sound and feasible to implement within current budgetary and technical constraints.
- Leverage of existing programs through collaboration and partnerships - In the cases of fisheries and water quality monitoring, a large number of programs exist that may, through collaboration and partnership, help to increase the cost/benefit ratio.
- Cost-efficiency - The most cost-effective methods available to generate results on useful timescales should be employed.

[1] Additional information on the Marine Life Management Act is available at http://www.dfg.ca.gov/marine/mlma.
[2] Information about the Clean Water Act and the Act itself are available at: http://www.epa.gov/lawsregs/laws/cwa.html

APPENDIX A-1. SUPPLEMENTAL FISHERIES MONITORING MODULE

INFORMING FISHERIES MANAGEMENT THROUGH MPA MONITORING

Although MPA monitoring and fisheries monitoring clearly overlap, there are fundamental differences in the scope of monitoring and the ultimate information needs of the respective programs. As described above and elsewhere, the MPA monitoring framework focuses on ecosystem-based monitoring of individual MPAs, the regional MPA network, and the region itself. MPA monitoring seeks to determine the condition of, and trends in, overall ecosystem components as part of evaluating MPA effectiveness towards achieving MLPA goals.

In contrast, fisheries monitoring has traditionally focused on individual stocks of fished species and their status, or the status of fisheries targeting them. Thus, while MPA monitoring often takes a multi-species, place-based approach, focusing on individual MPAs and then scaling up to regional network effects, fisheries monitoring generally focuses on one or a few local target species populations and then scales up to broad regional populations or stocks. Both MPA monitoring and fisheries monitoring may include information on changes in fishing locations and impacts to fishermen, although differences of scale between the two monitoring types typically remain.

Even so, the two types of monitoring are not mutually exclusive and should be designed to be mutually reinforcing. From the perspective of ecosystem-based MPA monitoring, fisheries data are critical for interpreting changes within MPAs over time as well as for allowing comparisons between MPAs and areas that continue to be fished. This is considered more fully in Chapter 3. Similarly, MPA monitoring will generate new, detailed data on the abundance and biology of many species targeted by fisheries. Information on relative abundances and size distributions of fishery species generated through MPA monitoring may be useful as inputs for population modeling by fishery scientists. Also, fisheries managers are now examining how population status of species within MPAs can be used to help estimate unfished abundance (B_0), recruitment rates, and other key fisheries information. For example, fishery scientists have begun exploring new ways to inform fishery managers of the status of fished populations, based upon differences in species density inside and outside MPAs. Further, MPAs provide a unique reference point for how ecosystems function in the absence of fishing as well as how recovery occurs within previously fished areas.

Many fisheries policies reference ecosystem-based fishery management (EBFM). Some of the underlying data needed to support EBFM may also be obtained through MPA monitoring, such as assessments of ecosystem condition. For example, the Marine Life Management Act (MLMA) requires conservation of the health and diversity of marine ecosystems and marine living resources.[3]

When considered together, MPA and fisheries monitoring programs can be developed to maximize the utility of data collected. The supplemental fisheries monitoring module presents an approach to developing and implementing additional fisheries monitoring that builds on, and takes maximum advantage of, the MPAs for informing fisheries management.

DEVELOPING SUPPLEMENTAL FISHERIES MONITORING

To develop a supplemental fisheries monitoring module, we adopt and expand on the three-tiered approach described above:

- Tier 1. Existing fisheries indicators within the MPA monitoring plan
- Tier 2. Additional fisheries indicators that may be added to the existing MPA monitoring plan

[3] California Marine Life Management Act, Statutes 1998, Chapter 1052, Fish & Game Code section 7050(b)(1).

- Tier 3. New research questions to address fisheries management priorities

IMPLEMENTING SUPPLEMENTAL FISHERIES MONITORING

Consistent with implementation of MPA monitoring, significant opportunity exists within California to link this module with other ongoing monitoring activities. There may be opportunities to involve stakeholders in supplemental fisheries monitoring, particularly where this fits with and extends methods developed for MPA monitoring, thus leveraging further available resources.

Most existing fisheries information comes from direct monitoring of commercial and recreational fisheries by the Department of Fish & Game and the National Marine Fisheries Service. Existing data can provide broad geographic information on fisheries catch, profitability, general locations, numbers of fishermen, and other details. Basic implementation of supplemental fisheries monitoring may be best achieved through augmenting methods developed for MPA monitoring. Additional data collection may also be feasible through collaborations and partnerships with other groups and individuals, particularly fisheries participants. For example, programs may be developed that increase the resolution of spatial data recording fishing locations. With appropriate training, fishermen can also provide detailed ecological information on catch, bycatch, and other indicators. In the case of recreational fisheries, fishing groups or individuals may provide location-specific fishing information. The most intensive implementation option presented for the supplemental fisheries monitoring module will require partnerships and collaborations with additional agencies and research institutions to implement new monitoring programs and/or new research projects.

CANDIDATE SUPPLEMENTAL FISHERIES MONITORING PRIORITIES

The following fisheries monitoring recommendations present initial ideas that may form components of a program designed to answer priority fisheries management questions, focusing on relationships with MPAs and MPA monitoring. These candidate fisheries monitoring foci have been developed using the three-tiered approach outlined above, and considering the criteria identified for establishing priorities. The information developed will also be useful for other fisheries management processes and will be available for analysis in a variety of contexts. Where new questions or management issues arise, these may be evaluated using this same approach, to further refine and maximize the utility of implemented fisheries monitoring.

For each section, potential focal topics or questions are identified through application of the proposed list of considerations and criteria, and examples of appropriate indicators or approaches are identified. The intent here is to describe the application of the approach and facilitate further development of this supplemental monitoring module, should implementation be desired.

As with an ecosystem-based approach to MPA monitoring, understanding of ecosystem structure and function to support implementation of EBFM is incomplete. The three implementation options focus on monitoring metrics and questions for which data can be feasibly collected and interpreted. However, it is also possible to identify information needs that may warrant further research and development to support EBFM. Research in support of supplemental fisheries monitoring could be designed to increase our understanding of concepts such as maximum food chain length, connectance, species richness and redundancy, and how these metrics may be applied to inform EBFM. Increased understanding of these concepts may be used in the future to refine the development and implementation of this supplemental monitoring module.

TIER 1: EXISTING FISHERIES INDICATORS WITHIN THE MPA MONITORING PLAN

Although the MPA monitoring framework adopts an ecosystems approach and includes indicators that contribute to assessment of ecosystem condition, species and indicators are included that may also be informative for fisheries management. Indeed, monitoring metrics have been chosen that will benefit fisheries management as much as possible without compromising the ability to meet MLPA monitoring requirements. These include species or fisheries that are either high volume or high value in the South Coast region; that are recreationally or culturally important to the region; species that are of a key management focus; or those that are representative of the region's ecosystems. Such fisheries-informative elements of the existing monitoring plan occur within these monitoring plan components:

- Ecological indicators of ecosystem condition and trends - Many of the recommended ecological indicators are species and species groups that are targeted by commercial and recreational fisheries. Examples include spiny lobster, California sheephead, California halibut, and red urchin, among many others. Data collected on these species typically includes densities or abundances and size structure, inside and outside MPAs.
- Socioeconomic indicators of trends in consumptive use - In terms of fisheries activities, several of the metrics for assessing the Consumptive Uses Ecosystem Feature are directly tied to fisheries monitoring. These include the spatial distribution and intensity of fishing effort, level of effort, catch and economic return of important commercial and recreational fisheries.
- MPA design and management questions – Several of the questions related to evaluation of MPA design and management decisions will be directly applicable to fisheries management decisions as well, if implemented. For instance, a potential short-term MPA management question includes examining how allowed uses in SMCAs influence the distribution and intensity of fishing effort.

TIER 2: CANDIDATE FISHERIES INDICATORS TO ADD TO THE MPA MONITORING PLAN

Identification and prioritization of fisheries indicators to supplement, but fit within, the existing MPA monitoring plan, may usefully place an initial focus on local density, age and size differences inside and outside MPAs for key species. Key species, reflecting those of management and policy relevance, may include those listed within the Nearshore Fishery Management Plan[4] but not currently included in the MPA monitoring plan. Candidate species for inclusion based on these criteria include:

- Black & yellow rockfish - *Sebastes chrysomelas*
- Calico rockfish - *Sebastes dallii*
- Copper rockfish - *Sebastes caurinus*
- Grass rockfish - *Sebastes rastrelliger*
- Quillback rockfish - *Sebastes maliger*
- Treefish – *Sebastes serriceps*

TIER 3: CANDIDATE NEW RESEARCH QUESTIONS FOR FISHERIES MONITORING

The most intensive implementation option proposed for this supplemental fisheries monitoring module focuses on additional questions that may require new research or development of new methods. The following areas have been identified as candidate topics using the criteria above, and considering gaps in current knowledge regarding the interaction between MPAs and other fishery management tools. For each element, brief information is provided on what might be required to implement new supplemental monitoring. Again, the intent here is to illustrate application of the approach.

[4] See http://www.dfg.ca.gov/marine/nfmp/index.asp.

These and other potential focus areas may be further evaluated and explored, should implementation of this option be desired. Each focus area and potential questions may also be further specified by considering particular species of management interest. For example, conducting a lobster stock assessment is current management priority and new efforts are underway to support development of a lobster fishery management plan. Implementation of this supplemental monitoring, if desired, should align with such efforts.

FOCUS AREA 1 –MPA EFFECTS ON LOCAL FISHERIES

Information Need: Spatial patterns of fishing and catch, and consequences for effectiveness of fishery regulations.

- Question 1. Do MPAs concentrate fishery effort in particular areas and what effect does that have on the fish populations?
  Potential approach: Spatially explicit monitoring of fisheries activities through either logbooks, observers, vessel monitoring systems (VMS) or aerial monitoring programs.
- Question 2. Do MPAs cause serial depletion of species or geographic zones?
  Potential approach: Long-term monitoring of species abundances for individual fished species within specified zones.
- Question 3. Are there "edge effects"? (concentrated fishery activities along MPA boundaries)
  Potential approach: Spatially explicit monitoring of fisheries activities, including catch and CPUE, through logbooks or other fishery observation programs.

FOCUS AREA 2 – STOCK CONSEQUENCES OF PROTECTED SUB-POPULATION

Information Need: Adult and larval production within MPAs, and contribution to the local fishery through movement of adults and larvae from MPAs to fished areas outside MPAs.

- Question 1. Does spillover occur?
  Potential approach: Mark/recapture and sonic tagging combined with model approach/empirical data to link movement patterns to protected fish population.
- Question 2. Does spillover contribute to local fisheries?
  Potential approach: Mark/recapture and sonic tagging combined with model approach/empirical data to estimate mortality rates of fish from MPAs and contribution to total catch.
- Question 3. How does larval transport impact fisheries and fish stocks outside MPAs?
  Potential approach: This element would require the ability to track larval source and sink populations and identify the source of larvae found outside MPAs. New genetic, chemical, and other larval markers as well as oceanographic information would be needed.

Information Need: Contribution of nursery habitat protection within estuarine and shallow nearshore MPAs for key species stocks.

- Question 1. Do shallow nearshore and estuarine areas within MPAs produce greater numbers of new recruits in fished species?
  Potential approach: New methods to measure abundance of fished species in shallow nearshore habitats and estuaries and track the movements of those species to deeper areas.

Information Need: Contribution of protected adult population to stocks through increased production of young.

- Question 1. Are life-history traits (age structure, size at maturity, fecundity) different within MPAs?
  Potential approach: Long-term tracking of changes in life history traits over time inside and outside MPAs.
- Question 2. What is the spawning contribution of individuals within MPAs to areas outside?
  Potential approach: Answering this question requires the development of genetic or other markers to determine fine-scale spawning contributions to areas outside MPAs. This element may also be approached through a modeling framework.

FOCUS AREA 3 –NEW TOOLS TO ASSESS POPULATIONS AND INFORM FISHERY MANAGEMENT

Information Need: New or modified tools to assess populations (including data-poor species) and establish allowable catches and other fishery regulations.

- Question 1. How can protected sub-populations be incorporated into traditional stock assessment models and into fishery regulations?
  Potential approach: This may be approached through a two-part study that first explores the potential for MPA monitoring data to develop or refine parameter estimates in traditional stock assessment models and second evaluates opportunities to expand models with new parameters or simulation scenarios that partition populations according to protection status. This second component is likely to be a significant undertaking. For example, protected sub-populations may be estimated based on abundance or area measures, life history parameters may be modeled using different distributions of traits and management recommendations can reflect different weightings applied to the component of the stock available to the fishery.
- Question 1. Which alternative assessment tools currently being developed (e.g., length-based stock assessment, density ratio models) best align with MPA monitoring data collection and also usefully inform fisheries management? What are the limitations of existing monitoring data for this purpose?
  Potential approach: Comparative testing, using existing data, of the results from selected assessment approaches applied to priority fishery species and assessment of the utility of model outcomes as a basis for fishery regulations.

FOCUS AREA 4 – EMERGING CONCEPTS TO SUPPORT ECOSYSTEM-BASED FISHERIES MANAGEMENT

Information Need: Research into ecosystem structure and function and the interaction with fisheries management measures to support application and use of ecosystem-based fisheries metrics.

- Question 1. What metrics can be used to characterize food webs and ecosystem structure, and how can these metrics be applied to support ecosystem-based fisheries management?
  Potential approach: Investigation of concepts including maximum food chain length, connectance, species richness, and species redundancy.
- Question 2. What metrics can be used to characterize ecosystem functioning, including species interactions, and how can these metrics be applied to support ecosystem-based fisheries management?
  Potential approach: Investigation of species behaviors, diet and stable isotopes to develop management-applicable metrics informative of ecological processes.
- Question 3. What are the ecosystem-level impacts of more and larger individuals in MPAs, and how might this inform ecosystem-based fisheries management measures?
  Potential approach: Kelp-sheephead-lobster-urchin dynamics are well-documented and could provide a starting point for examining the effects of more, larger predators (e.g., sheephead) on kelp forest ecosystems. An understanding of the effects of differentially targeting larger individuals could inform fisheries management.

APPENDIX A-2. SUPPLEMENTAL WATER QUALITY MONITORING MODULE

INFORMING WATER QUALITY MONITORING THROUGH MPA MONITORING

MPA monitoring has considerable potential to inform water quality monitoring and management. In particular, MPAs may serve a valuable role as reference areas for water quality monitoring, contributing to our understanding of how water quality impairments may impact marine systems. Likewise, water quality monitoring may inform MPA monitoring by providing contextual data essential for interpreting monitoring results, and may be especially useful in determining the degree to which any changes are attributable to the MPAs themselves rather than other drivers (e.g., pollution events).

There are also, however, important differences between monitoring for MPA and water quality purposes. Under the MLPA, marine protected areas are implemented as a management tool to actively elevate or improve ecosystem condition inside protected areas and consequently across the region as a whole. MPA monitoring therefore seeks to determine the condition of, and trends in, ecosystems inside and outside MPAs as part of evaluating MPA effectiveness towards achieving MLPA goals. In contrast, a large focus of existing water quality management mandates is on restoration of water quality and/or minimization of the effects of water quality changes on ecosystems. Much water quality monitoring therefore focuses on measuring the effects of pollutants and other water quality impairments on habitats and ecosystems, and on developing and enforcing water quality objectives and implementation plans that will best protect the state's waters and associated beneficial uses.[5]

Even so, the two types of monitoring are not mutually exclusive and should be designed to be mutually reinforcing. From the perspective of ecosystem-based MPA monitoring, water quality information is important for interpreting changes within MPAs over time. In addition, agencies that monitor water quality take numerous measurements that, from an MPA perspective, provide critical contextual information, including water temperature, salinity, dissolved oxygen and others. These types of contextual information are considered more fully in Chapter 3. Similarly, MPA monitoring will generate new, detailed data on ecosystems and ecosystem processes that may usefully inform agencies responsible for meeting water quality mandates. Further, MPAs provide a unique reference point that allows the effects of water quality impairments to be teased apart from those related to extractive activities.

Agencies responsible for monitoring water quality have been monitoring the South Coast region for decades and have a wealth of information that could be applied to MPA monitoring. For example, these agencies' data could be used to understand how much monitoring is required to characterize a site. In addition, water quality monitoring agencies have developed several indices of water quality/environmental disturbance, including the Benthic Response Index (BRI), the Fish Response Index (FRI), and others. Although broadly indicative of environmental conditions, these indices are largely unrelated to the ecosystem changes that may occur in response to MPA implementation. For example, the BRI is the abundance-weighted average pollution tolerance of species in a sample, and thus is a measure of environmental disturbance rather than overall ecosystem condition. Nonetheless, the data collected to calculate these indices include measures of species abundances and individual sizes and therefore could also be used to investigate local population and community changes in response to MPA implementation.

While there are on-going monitoring and maintenance activities by water quality monitoring agencies, the effects of the employed sampling tools and methods have on marine ecosystems may not be fully understood. MPAs may play a role in allowing for assessment of the impact of these activities through, for example, comparison of rates of ecosystem change inside State Marine Reserves (SMRs), which prohibit all take of marine resources, and No-Take State Marine Conservation Areas (SMCAs), which allow operation and maintenance of wastewater outfall, oil and natural gas pipelines.

[5] State Water Resources Control Board: http://www.swrcb.ca.gov/about_us/water_boards_structure/mission.shtml.

These are just some examples of the ways in which water quality and MPA monitoring may mutually benefit each other. When considered together, MPA and water quality monitoring programs can be developed to maximize the utility of data collected. The supplemental water quality monitoring module presents an approach to developing and implementing additional water quality monitoring that builds on, and takes maximum advantage of, the MPAs for informing water quality management.

DEVELOPING SUPPLEMENTAL WATER QUALITY MONITORING

To develop a supplemental water quality monitoring module, we adopt and expand on the three-tiered approach described in the introduction to this Appendix above:

- Tier 1. Existing water quality indicators within the MPA monitoring plan
- Tier 2. Additional water quality indicators that may be added to the existing MPA monitoring plan
- Tier 3. New research questions to address water quality management priorities

IMPLEMENTING SUPPLEMENTAL WATER QUALITY MONITORING

Consistent with implementation of MPA monitoring, significant opportunity exists within California to link this module with other ongoing monitoring activities. Numerous agencies monitor water quality in the South Coast region, including State and Regional Water Quality Control Boards, Sanitation Districts, Flood Control Districts, Public Utility Departments, Southern California Coastal Water Research Project and others. Agencies such as these monitor a variety of indicators, from species assemblages to physical oceanography and water chemistry. Basic implementation of this supplemental water quality monitoring module may be best achieved through extension of existing and on-going monitoring programs managed by these agencies. The most intensive implementation option presented for the supplemental module may be best approached through partnerships and collaborations between agencies and research institutions to implement new monitoring programs and/or new research projects.

CANDIDATE SUPPLEMENTAL WATER QUALITY MONITORING PRIORITIES

The following water quality monitoring recommendations present initial ideas that may form components of a program designed to answer priority water quality management questions, focusing on relationships between water quality management, MPAs and MPA monitoring. These candidate water quality monitoring foci have been developed using the three-tiered approach outlined above, and considering the criteria identified for establishing priorities. The information obtained may also be useful for other water quality management processes and will be available for analysis in a variety of contexts. If new questions or management issues arise, these may be evaluated using this same approach, to further refine and maximize the utility of this supplemental water quality monitoring.

For each section, potential focal topics or questions are identified through application of the previously described proposed list of considerations and criteria, and examples of appropriate indicators or approaches are identified. The intent here is to describe the application of the approach and facilitate further development of this supplemental monitoring module, should implementation be desired.

TIER 1: EXISTING WATER QUALITY INDICATORS WITHIN THE MPA MONITORING PLAN

Although the MPA monitoring framework adopts an ecosystems approach and includes indicators that contribute to assessment of ecosystem condition, species and indicators are included that may also be indicative of water quality,

disturbance, and/or sediment toxicity. Where feasible, monitoring metrics have been chosen that will serve the purposes of MPA monitoring while also acting as water quality sentinels. Such water quality-informative elements of the existing monitoring plan occur within two monitoring plan components. As part of supplemental water quality monitoring, these water quality-informative elements of MPA monitoring may be selected for augmented sampling intensity. Alternatively, the data may be extracted from MPA monitoring datasets and analyzed in a way that provides the information most useful to water quality managers.

1. ECOLOGICAL INDICATORS OF ECOSYSTEM CONDITION AND TRENDS

Several of the recommended ecological indicators are species and species groups that are currently monitored by water quality agencies and have been identified as sentinel species of water quality and/or sediment toxicity. Although these species may be monitored for both MPA and water quality assessment purposes, the way in which they are monitored may significantly differ between these programs. MPA monitoring, for example, tends to focus on measuring the density and size structure of populations, whereas water quality monitoring may focus on assessing toxicity in tissue samples. Nonetheless, knowing density and size structure may inform water quality monitoring, and understanding the degree to which individuals are affected by pollutants may inform MPA monitoring. The species that are monitored for both types of programs include:

- Functional diversity of benthic infauna (feeding guilds) – Water quality monitoring agencies sample benthic infauna and use these data to compute indices, such as the Benthic Response Index (BRI), that provides a measure of environmental disturbance.
- Ridgeback prawns, *Sicyonia ingenti* – These are commonly used to test sediment toxicity and are one of many species frequently entrained in coastal power plants.
- California halibut, *Paralichthys californicus* – Recruitment of this species may be negatively affected by water quality, which could be detected by MPA monitoring of this species' density and size structure.
- California scorpionfish, *Scorpaena guttata* – Individuals living in polluted areas exhibit histological changes that may be indicative of low health, which may be observed through MPA monitoring of their density and size structure.
- Kelp bass, *Paralabrax clathratus* – This species is monitored by water quality agencies to assess bioaccumulation of toxins and risk to human consumers in the Palos Verdes area.
- Mussels, *Mytilus* spp. – NOAA has operated a program called Mussel Watch since 1986 that monitors trends in contaminants in bivalve tissue samples.[6]
- Croakers (Sciaenidae, multiple species) – Members of this family show high tolerance for pollution and their presence may indicate water quality impairment.

2. MPA DESIGN AND MANAGEMENT QUESTIONS

Several of the questions evaluating MPA design and management decisions will have direct overlap with water quality management actions, if implemented. For example, several questions investigate the ecological effects of MPA location relative to stormwater or wastewater outfalls, areas that are known to be polluted (e.g., the Palos Verdes superfund site), or areas that are maintained for water quality (i.e., Areas of Special Biological Significance).

TIER 2: CANDIDATE WATER QUALITY INDICATORS TO ADD TO THE MPA MONITORING PLAN

Sentinel species selected by water quality monitoring agencies are used as indicators of sediment toxicity, water quality, and toxin bioaccumulation. These are not necessarily the same species that could be used to indicate the effects of MPAs or

[6] For more information, see: http://ccma.nos.noaa.gov/about/coast/nsandt/musselwatch.html.

a healthy, functioning ecosystem. However, these species and indices may have a place in MPA monitoring to provide insight into the degree to which the waters and sediments inside MPAs are impacted by run-off and/or pollutants.

Benthic organisms are well-recognized as reliable indicators of environmental stress, and are frequently used as indicators of marine sediment toxicity. In the South Coast region of California, water quality monitoring agencies assess the degree to which an area is impacted using indices derived from abundances of certain benthic species, including macroinvertebrates and fishes, with known pollution tolerances. These indices include the Benthic Response Index (BRI), the Relative Benthic Index (RBI), the Fish Response Index (FRI), and others. The monitoring plan for South Coast regional MPAs recommends that the functional diversity of benthic infauna be included in an assessment of the soft-bottom subtidal ecosystem feature. Added to this could be a ratio of pollution-tolerant to pollution-sensitive species. For example, the amphipod *Monocorophium insidiosum*, the bivalve *Asthenothaerus diegensis*, and the polychaete *Goniada littorea* all indicate relatively unimpacted sediment, while the presence of the *Capitella capitata* complex and oligochaetes indicate impacted sediments.

Fish community structure may change in areas exposed to pollutants, either through the direct effects of the pollutants themselves or through the indirect effects of changes in the structure of the benthic invertebrate assemblages upon which the fishes feed. An addition to the MPA monitoring plan could, in a manner similar to that for benthic infauna, consider a ratio of pollution-tolerant species, such as white croaker (*Genyonemus lineatus*), shiner perch (*Cymatogaster aggregata*), and curlfin sole (*Pleuronichthys decurrens*) to more pollution-sensitive species, such as sand dabs (*Citharichthys* spp.) and hornyhead turbot (*Pleuronichthys verticalis*). These species are not currently included as part of MPA monitoring but could be added to increase the information available to inform water quality monitoring.

TIER 3: CANDIDATE NEW RESEARCH QUESTIONS FOR WATER QUALITY MONITORING IN MPAS

The most intensive implementation option proposed for this supplemental water quality monitoring module focuses on additional questions that may require new research or development of new methods. The following areas have been identified as candidate topics using the criteria above, and considering gaps in current knowledge regarding the interaction between MPAs and water quality. For each element, information is provided on what might be required to implement new supplemental monitoring. Again, the intent here is to illustrate application of the approach. These and other potential focal areas may be further evaluated and explored, should implementation of this option be desired. Each focal area and corresponding potential questions may also be further specified by considering particular species of management interest. Implementation of this supplemental monitoring, if desired, should align with other management priorities.

FOCUS AREA 1 – UNDERSTANDING THE EFFECTS OF WATER QUALITY IMPAIRMENT

Information Need: Both poor water quality and over-fishing have been implicated in declines in ecosystem condition or health. MPAs provide an opportunity to assess how populations respond to water quality impairment in the absence of fishing pressure.

- Question 1. Are communities inside MPAs that are not fished more resilient to water quality impairment than populations outside MPAs that are exposed to fishing pressure?
  Potential approach: Compare rates of change in community structure, rates of infection and/or numbers of lesions on marine organisms in areas proximate to wastewater and stormwater outfalls inside and outside of MPAs.
- Question 2. Are estuarine and wetland ecosystems protected in MPAs more effective at filtering pollutants?
  Potential approach: Compare water quality in estuaries inside and outside of MPAs to understand estuarine and wetland ecosystems' capacities for filtering pollutants.

- Question 3. Are populations in MPAs more resistant to invasive species than populations outside MPAs as a result of reduced anthropogenic influence?
  Potential approach: Compare the rates of invasive events and their influence on community structure inside and outside MPAs with different levels of water quality to begin to understand the effect of water quality impairment on communities' abilities to resist invasion.

FOCUS AREA 2 – UNDERSTANDING ECOSYSTEM RESPONSES TO WATER QUALITY IMPAIRMENT

Information Need: As water quality monitoring has typically focused on the toxicity of individuals, there is the potential to "scale up" understanding of water quality impairment effects to both the population- and ecosystem-levels.

- Question 1. Are there measurable, cumulative, population-level effects of different individual toxin loadings?
  Potential approach: Investigations of this question could explore whether thresholds or discontinuities exist in population-level effects as a function of either the total toxin load of individuals or the percentage of the population with measurable toxin loads.
- Question 2. What effect does water quality impairment have on species' population growth rates, for example, through the effects of endocrine disruptors?
  Potential approach: An initial approach may first compare reproductive output across different individual loadings of e.g., endocrine disruptors and then extend to identify population level effects.
- Question 3. Do effects of water quality impairments on individuals and populations lead to detectable differences in ecosystem structure or functioning?
  Potential approach: Compare ecosystem responses inside SMRs with varying degrees of water quality impairment to increase our understanding of the mechanisms by which water quality changes may be manifest at an ecosystem-wide scale.

FOCUS AREA 3 – NATURAL WATER QUALITY

Information Need: Identification of reference areas that approximate natural water quality.

- Question 1. Can MPAs serve as reference sites for natural water quality?
  Potential approach: Compare water quality inside and outside MPAs.
- Question 2. Are there different ecosystem responses (e.g., types and rates of changes) between MPAs that are and are not co-located with Areas of Special Biological Significance (ASBSs)?
  Potential approach: Monitoring of ecosystem response in MPAs that are and are not co-located with ASBSs.

Information Need: To understand how marine life responds to water quality impairment. The definition of natural water quality specifies that in areas of natural water quality, "any detectable human influence on the water quality must not hinder the ability of marine life to respond to natural cycles and processes."[7]

- Question 1. What are "natural processes and cycles"?
  Potential approach: Descriptive assessments of community processes inside SMRs, in which anthropogenic influence is limited, may provide insight into 'natural' community processes.
- Question 2. How do community processes and cycles differ in areas that are impacted by water quality impairment?
  Potential approach: Compare ecosystem response (e.g., types and rates of changes) among MPAs with known differences in the magnitudes of water quality impairment.

[7] ASBS Natural Water Committee: Definition of Natural Water Quality, March 2008.

APPENDIX B. GUIDES TO ASSESSING ECOSYSTEM CONDITION & TRENDS

B-1. GUIDE TO THE METRICS (VITAL SIGNS) OF ECOSYSTEM FEATURE CHECKUPS

As described in Chapter 4, Ecosystem Feature Checkup is an implementation option for tracking the condition and trends of Ecosystem Features that is designed to facilitate community participation in monitoring. The metrics for the Ecosystem Feature Checkup are referred to as vital signs. The following guide to the vital signs is provided to supplement the summary information listed in Chapter 4 for each Ecosystem Feature.

The vital signs have been separated into ecological and socioeconomic vital signs, and are listed in alphabetical order within each section. Each vital sign description includes a list of the Ecosystem Features to which it applies, a rationale for the selection of the vital sign, including the proposed contribution of the vital sign to a coarse assessment of ecosystem condition, and brief consideration of other factors that will influence the interpretation of vital signs data.

DESCRIPTIONS OF ECOLOGICAL VITAL SIGNS

VITAL SIGN: ABALONE ABUNDANCE & SIZE FREQUENCY

Ecosystem Features: Kelp & Shallow Rock Ecosystems

Abalone (*Haliotis* spp.) are important herbivores and detritivores within Kelp & Shallow Rock Ecosystems, and also serve as important prey items for a range of other fish and invertebrates. Abalone populations in California have experienced significant population declines in the last century.

The pelagic larval duration of abalone is only a few days and larvae typically disperse only short distances. Thus, changes in the abundance and size structure of local populations are predicted to occur in response to MPA implementation although changes may take many years to detect. However, over longer time periods, population trends may also reflect changing sea temperatures. During El Niño periods, reductions in growth and decreases in settlement and recruitment have been observed. Some evidence indicates that increasing frequency of warm temperatures may also be leading to increased incidence and spread of withering foot disease. Trends in abalone abundance will be interpreted in the context of information on oceanographic conditions, such as sea surface temperature.

VITAL SIGN: ARTHROPOD BIOMASS

Ecosystem Feature: Estuarine & Wetland Ecosystems

Arthropods such as insects and spiders are an important source of food in estuarine and wetland ecosystems and provide an important link between terrestrial and marine ecosystems. Thus, measures of arthropod biomass can indicate food availability for birds and other organisms that forage in estuaries and wetlands. Recent studies in wetlands in southern California have shown that arthropod biomass is related to wetland system productivity such that increases in arthropod biomass indicate increases in productivity. Additional information on the applicability of this vital sign through estuarine habitats will be useful to assess the strength of this vital sign in providing insight into Ecosystem Feature condition.

VITAL SIGN: BEACH WRACK COMPOSITION & ABUNDANCE

Ecosystem Feature: Soft-bottom Intertidal & Beach Ecosystems

Beach wrack is composed of kelp, plant and animal remains that are deposited in the intertidal zone and thus serves as an important link between nearshore and intertidal ecosystems. This wrack provides microhabitats and food for macroinvertebrates that are themselves important food sources for foraging shorebirds and nearshore fishes and thus is an important indicator of productivity in soft-bottom intertidal ecosystems. Monitoring results will be interpreted considering oceanographic conditions, which can have strong impacts on macroalgal abundance in nearshore environments, as well as human activities, such as the occurrence of beach grooming.

VITAL SIGN: BLACK ABALONE ABUNDANCE

Ecosystem Feature: Rocky Intertidal Ecosystems

Black abalone (*Haliotis cracherodii*) are rare within the South Coast region, but previously played an important grazing role in rocky intertidal habitats. This species is typically observed under rocks and in crevices, from the high intertidal to six meters depth – higher in the intertidal than any other California abalone species. Populations are severely depressed in the South Coast region and the black abalone was listed as an endangered species under the Endangered Species Act in 2009.

Increases in the abundance of this species would indicate improved ecosystem condition. However, interactions with other species may affect the rates and magnitudes of observable population changes. Population trends are also likely to reflect changing sea temperatures, and the increasing frequency of warm temperatures along the South Coast may also be leading to increased incidence and spread of withering foot disease in this species. Monitoring results will be interpreted considering oceanographic information and disease incidence reports to elucidate MPA-related changes in abundance and population size structure.

VITAL SIGN: CALIFORNIA HALIBUT ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Estuarine & Wetland Ecosystems, Soft-bottom Subtidal Ecosystems

In soft-bottom subtidal ecosystems within the South Coast region, California halibut (*Paralichthys californicus*) are an abundant benthic predator. Adults feed largely on Pacific sardine, northern anchovy, squid and other nearshore nektonic fishes. Shallow subtidal waters are also an important juvenile habitat. Halibut also represent a significant proportion of the commercial and recreational fishery in the region. As with many other fish species, average fish size and population abundance may be expected to increase in response to MPA implementation, however the magnitude and timing of responses are unknown. Data interpretation will consider information on the spatial distribution of fishing mortality, and will be primarily used in region-wide evaluations of Ecosystem Feature condition.

VITAL SIGN: CALIFORNIA SCORPIONFISH ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Mid-depth Rock Ecosystems

California scorpionfish are a warmer-water associated species that range from Monterey Bay, CA to southern Baja California, Mexico. They feed primarily on small fishes and invertebrates in mid-depth rocky habitats. In late spring and early summer they form large spawning aggregations, often in the same areas from year to year. Scorpionfish are an important part of the commercial and recreational fisheries in southern California. As with many other fish species, average

fish size and population abundance may be expected to increase in response to MPA implementation. Interpretation of monitoring results will consider information on the spatial distribution of fishing mortality as well as drivers such as oceanographic conditions.

VITAL SIGN: CASSIN'S AUKLET BREEDING SUCCESS

Ecosystem Feature: Nearshore Pelagic Ecosystems

Populations and annual breeding success of many seabirds fluctuate annually in response to prey availability and prey quality. Hence, seabirds are frequently used as indicators of food web changes in marine ecosystems. Cassin's auklet (*Ptychoramphus aleuticus*) is a small diving seabird that feeds primarily on krill, mysids, and some larval fish. In the South Coast region, breeding colonies of this species occur in the northern Channel Islands. This species has recently been chosen as a key biological indicator of climate change within California (http://www.oehha.org/multimedia/epic/climateindicators.html). The existing historical record establishes a robust baseline for this vital sign, and average number of offspring per year from each breeding pair is a reliable indicator of prey availability within the ecosystem during the summer breeding season. Given the large geographic scale over which forage fish and krill populations range, interpretation of this vital sign will focus on regional-scale trends in the Nearshore Pelagic Ecosystem Feature condition.

VITAL SIGN: CLAM ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Estuarine & Wetland Ecosystems

Within estuarine ecosystems, clams together with other shellfish form an important habitat for multiple species and play a particularly important role in the uptake and recycling of energy and nutrients. These filtering and recycling processes are critical in regulating ecosystem condition; uptake of organic matter can control phytoplankton levels, improve water clarity and allow greater light penetration for the growth of seagrasses.

Recreational clamming is popular throughout the South Coast region and commonly targeted species include common littleneck clams (*Protothaca staminea*), gaper clams (*Tresus nuttalli*) and Washington clams (*Saxidomus nuttali*). Reduced take following MPA implementation may lead to population increases in MPAs. Monitoring clam abundances will provide insight into their role in maintaining ecosystem condition, and also offers the opportunity to track the interactions between recreational fishing (clamming) take and population sizes. Data interpretation will incorporate information on the spatial distribution of fishing mortality and fishery regulations.

VITAL SIGN: CROAKER ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Estuarine & Wetland Ecosystems, Soft-bottom Intertidal & Beach Ecosystems

Croakers are found in nearshore soft-bottom ecosystems as well as in estuaries and wetlands in the South Coast region. These fishes are a target in the recreational fishery in this region. Generally, increases in fish size, abundance and biomass are predicted following MPA implementation; however, the timing and magnitude of responses are unknown. Data interpretation will consider information on the spatial distribution of fishing mortality, and will be primarily used in region-wide evaluations of Ecosystem Feature condition.

VITAL SIGN: DWARF ROCKFISH ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Mid-depth Rock Ecosystems

In rockfish communities, fishing disproportionally affects larger, slow growing and late maturing species. By comparison, the so-called dwarf rockfish (generally comprised of halfbanded (*S.semicinctus*), pygmy (*S. wilsoni*), squarespot (*S. hopkinsi*), stripetail (*S. saxicola*), and swordspine (*S.ensifer*)) are relatively unfished. These dwarf rockfish are an important prey source for the larger rockfish species and may also compete with juveniles of the larger, competitively dominant species for habitat and prey resources. Historically, competition and predation are likely to have constrained population densities of the dwarf species, except in sub-optimal habitats. Overfishing of the larger species has substantially reduced their population densities and consequently reduced the predation and competition pressures on dwarf rockfish, which now dominate the rockfish community in some locations. Trends in the relative abundance of dwarf rockfish at sites inside and outside of MPAs are indicative of shifting community structure in response to protection. This vital sign will thus provide useful insight into effects of MPAs that extend beyond single species responses.

VITAL SIGN: EELGRASS AREAL EXTENT

Ecosystem Feature: Estuarine & Wetland Ecosystems

In temperate marine ecosystems, loss of biogenic habitat (i.e., habitat formed by the growth and architecture of particular species) has contributed to declines in fish and invertebrate populations and loss of species diversity. In estuarine ecosystems in the South Coast region, habitat provisioning by eelgrass (*Zostera marina*) is critical to maintaining the ecological roles played by these estuaries as nursery and foraging habitats.

Although habitat quality may vary within eelgrass beds, the total area of eelgrass is a fundamental measure of habitat provisioning. Broad environmental changes including physical disturbance, poor water quality and high turbidity can result in loss of eelgrass habitat. In protected locations, increases in the areal extent of eelgrass have occurred where protection reduces physical habitat damage (for example, via a reduction in bottom contact fishing gear or propeller disturbance). In locations without existing physical damage, trends in eelgrass areal extent may be predicted to stay stable or increase slowly as an indirect response to ecosystem protection.

VITAL SIGN: FLATFISH TOTAL ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Soft-bottom Subtidal Ecosystems

This vital sign includes species such as California halibut (*Paralichthys californicus*), Dover sole (*Microstomus pacificus*) and sanddab (*Citharichthys sordidus*), and provides a broad assessment of ecosystem productivity. Generally, increases in fish size, abundance and biomass are predicted following MPA implementation; however, the timing and magnitude of responses are unknown. Data interpretation will consider information on the spatial distribution of fishing mortality, and will be primarily used in region-wide evaluations of Ecosystem Feature condition.

VITAL SIGN: GHOST & MUD SHRIMP ABUNDANCE

Ecosystem Feature: Estuarine & Wetland Ecosystems

Ghost shrimp and mud shrimp play an important ecological role in estuarine environments, filtering large volumes of water as they forage for planktonic food. These species themselves are also important prey for many different birds and fishes.

Although relatively simple methods exist to monitor local abundances, interpretation of this information is more challenging and is likely to reflect a broad array of environmental factors. Mud shrimp populations have recently been decimated by an invasive parasitic isopod and both species are harvested in the region as bait. To interpret trends in abundance, information on these broader influences will be considered in analyses of monitoring data.

VITAL SIGN: GIANT SEA BASS ABUNDANCE

Ecosystem Feature: Kelp & Shallow Rock Ecosystems

Giant sea bass were once common along the California coast and played an important role as top-predators, but populations have declined and the species is currently designated as critically endangered by the IUCN. They are slow growing and late to mature, life history characteristics which typically slow rates of population recovery. There is currently no fishery for giant sea bass, although commercial fishers may keep one if caught incidentially. Trends in population abundance will be interpreted at the region-wide scale and will incorporate contextual information such as oceanographic conditions and water quality.

VITAL SIGN: GRUNION, NUMBER AND STRENGTH OF SPAWNING RUNS

Ecosystem Feature: Soft-bottom Intertidal & Beach Ecosystems

Grunion are found from central California to Baja California, although they are most common in the South Coast region. These fish spawn on beaches and are prey for fishes, invertebrates and birds, and are targeted by recreational fishers. The number and strength (i.e duration, number of spawners) of spawning runs may be predicted to increase in MPAs as a result of reduced fishing take. Interpretation of trends in abundance and will consider available fisheries information to assess potential MPA-specific effects.

VITAL SIGN: KELP BASS ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Kelp & Shallow Rock Ecosystems

Loss of predators is a frequent indicator of declining ecosystem condition. In rocky habitats, predatory fishes play a key role in regulating populations of species lower in the food chain and consequently are key drivers of community structure. Kelp bass (*Paralabrax clathratus*), predators that feed primarily on fishes and invertebrates, are an important target of recreational fishing in the South Coast region. Previous studies have shown that these fish have relatively small home ranges, and thus populations are likely to show increases in size and abundance in response to MPA implementation. Information on the spatial distribution of catch will be considered when interpreting monitoring results.

VITAL SIGN: LINGCOD ABUNDANCE & SIZE FREQUENCY

Ecosystem Features: Mid-depth Rock Ecosystems

Loss of predators is a frequent indicator of declining ecosystem condition and predators in rocky ecosystems frequently play an important role in food web structuring. Lingcod (*Ophiodon elongatus)*, which occupy rocky reefs in the South Coast region, are important predators, feeding on demersal fishes, squid, octopi and crabs.

Several life history characteristics of lingcod render the species a valuable choice for a vital sign of increasing predator abundance within mid-depth rock habitats. Increased fish size and abundance in response to MPA implementation are most

frequently observed in fished species, and particularly in relatively sedentary species. Lingcod are an important recreational and commercial catch within the region. They also occupy relatively small home ranges (~1500 to 2500 m^2) and actively guard egg nests spawned on shallow rocky reefs. Existing evidence suggests that lingcod populations may respond rapidly to protection (within 5-10 years), although this may reflect movement of individuals into MPAs as well as decreased mortality of adult fish. Data interpretation will consider information on the spatial distribution of fishing catch.

VITAL SIGN: MARINE BIRD RICHNESS & ABUNDANCE

Ecosystem Feature: Rocky Intertidal Ecosystems, Estuarine & Wetland Ecosystems, Soft-bottom Intertidal & Beach Ecosystems

Coastal bays, estuaries, beaches and rocky shores in the South Coast region are an important part of the Pacific Flyway and host thousands of migrating shorebirds annually. In addition, several of the estuaries in the region are important foraging and nesting areas for resident bird populations. Piscivorous birds and shorebirds across all these habitats forage on a wide range of fish and invertebrate prey. Increased total abundance and diversity of these bird species can therefore be indicative of an abundant and diverse prey population.

Monitoring may be focused on colony abundances as well as on-water foraging abundances. Implementation of this vital sign will require additional specificity regarding appropriate species to include within the richness and abundance measures. Additional data from the region may also support using particular species as a vital sign of ecosystem condition across or within different habitats. Information from the South Coast MPA Baseline Program projects will be used to refine this indicator for implementation.

VITAL SIGN: MUSSEL BED COVER

Ecosystem Feature: Rocky Intertidal Ecosystems

A suite of different species plays a key role in rocky intertidal ecosystems as biogenic habitat, offering refuge from predators and exposure while increasing rugosity and space. Intertidal biogenic habitats are thus critical in regulating community structure and food web dynamics. Among these species, mussels (*Mytilus* spp.) are common in the mid- to lower intertidal, where they often dominate the substrate in wave exposed areas. Mussels provide habitat for many invertebrate species and are prey for sea stars, birds and mammals.

Unlike many subtidal ecosystems, biogenic habitats in the rocky intertidal, including mussels, may directly respond to MPA designation if implementation results in increased or decreased human disturbance such as trampling or harvesting. However, these potential MPA effects will also occur in the context of natural variations in population sizes and complex patch dynamics. Analyses of monitoring results will include assessment of effects at a range of spatial scales to separate potential MPA effects from broader temporal dynamics.

VITAL SIGN: OCHRE SEA STAR ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Rocky Intertidal Ecosystems

Ochre sea stars (*Pisaster ochraceus*) are common in intertidal habitats, occurring in the mid- to low-intertidal throughout California, especially in exposed locations with high mussel (*Mytilus* spp.) growth. In a now classic experiment, ecologist Robert Paine demonstrated that the ochre sea star plays an important role in maintaining species diversity within mussel-dominated intertidal habitats. Although subsequent experiments have demonstrated that the strength of this keystone

predator effect varies according to the hydrographic regime influencing mussel recruitment and abundance, sea stars remain an appropriate vital sign of a functioning ecological community within this habitat.

VITAL SIGN: OWL LIMPET ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Rocky Intertidal Ecosystems

Owl limpets (*Lottia gigantea*) are distributed throughout California, occurring in the mid- to high-intertidal zones, on cliff faces and rocks of wave-exposed shores. Females maintain territories on rocks by grazing or bulldozing other competitors such as mussels and barnacles for rock space. This species thus plays an important ecological role, clearing space and promoting algal growth, and is a valuable vital sign of ecosystem function.

Owl limpets can live as long as 50 years and have a short pelagic larval duration (< 1 week). MPA implementation may therefore be predicted to lead to localized increases in abundance. Such strong local effects of protection have previously been demonstrated within longstanding protected areas in southern California, particularly Cabrillo National Monument. However this species is also sensitive to trampling disturbance, which may also affect observed abundances. Owl limpets are sequential hermaphrodites, beginning life as males and then switching to females as they become older and larger. Collection of this species frequently targets the largest individuals within the populations, mostly females. As a result, populations may become dominated by smaller males, skewing the gender ratio and decreasing reproductive capacity. Interpretation of monitoring results will include information on trampling and collection, in part, through links to the Non-consumptive and Consumptive Uses monitoring results as well as contextual information about compliance.

VITAL SIGN: PINNIPED ABUNDANCE (COLONY SIZE)

Ecosystem Features: Rocky Intertidal Ecosystems, Estuarine & Wetland Ecosystems, Soft-bottom Intertidal & Beach Ecosystems

Harbor seals, sea lions and elephant seals are important apex predators that feed on a diverse range of fish and invertebrates in nearshore waters, including herring, anchovies, sardines, hake, flounder, sole, octopus, squid and crabs. Abundances of these species declined early in the century but have since stabilized. However, pinnipeds are vulnerable to human disturbance when they are on land at haulout sites. In the South Coast region, pinniped haulout sites are widely distributed along the mainland and on offshore islands, in estuarine habitats, intertidal sand bars, rocky shores and beaches. Individuals haulout on land for rest, thermal regulation, social interaction and to give birth. Haulout sites thus offer an opportunity to conduct local sub-population assessments. Interpretation of data on this vital sign will consider additional information including evidence of disturbance as well as oceanographic data.

VITAL SIGN: PISMO CLAM ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Soft-bottom Intertidal & Beach Ecosystems

Pismo clams are filter-feeders that live in sandy intertidal and shallow subtidal zones. Population abundance is highly variable and recruitment success seems to be influenced by oceanographic conditions. Pismo clams are target of recreational fishing in Southern California and thus MPA effects may be observed in locations where MPAs reduce fishing take. Monitoring results will consider the spatial distribution of fishing effort as well as oceanographic data when analyzing data and interpreting results.

VITAL SIGN: PURPLE SEA URCHIN ABUNDANCE & SIZE FREQUENCY

Ecosystem Features: Rocky Intertidal Ecosystems, Kelp & Shallow Rock Ecosystems

Purple sea urchins (*Strongylocentrotus purpuratus*) are the most abundant sea urchin in rocky intertidal habitats along the California coast, although they also occur in subtidal habitats. Like the red sea urchin, this species is an important grazer, feeding on drift algae and kelp. In intertidal habitats in the South Coast, this species also plays an important role as a bioeroder, boring holes into the rock.

Trends in abundance of purple sea urchins are likely to reflect a complex interplay between ecological interactions and oceanographic conditions. Recruitment pulses are sporadic and unpredictable, owing partly to changing currents, and shifting ocean temperatures have a strong influence on kelp productivity and growth, indirectly influencing urchin populations. Monitoring results will be interpreted using additional oceanographic information as well as information about key species with which purple urchins interact.

VITAL SIGN: RED SEA URCHIN ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Kelp & Shallow Rock Ecosystems

Red sea urchins (*Strongylocentrotus franciscanus*) are the most abundant sea urchin species in kelp and shallow rock subtidal habitats along the California coast. This species is an important grazer feeding on drift algae and giant kelp. A delicate balance between sea urchin grazing and kelp forest productivity leads to stable states that alternate between species-rich kelp forests and relatively species-depauperate sea-urchin barrens.

In 1990, landings of red sea urchins peaked at 27 million pounds annually, but have since declined to 10 million pounds. Trends in abundance of this species are likely to reflect a complex interplay between ecological interactions, including predation by spiny lobster and sheephead, oceanographic conditions affecting recruitment and fishing intensity. These factors will be considered in analysis of vital signs data.

VITAL SIGN: ROCK CRAB ABUNDANCE & SIZE FREQUENCY

Ecosystem Features: Mid-depth Rock Ecosystems

Three species of rock crab occur in the South Coast region: yellow (*Cancer anthonyi*), brown (*C. antennarius*) and red (*C. productus*) with brown and red most commonly associated with rocky substrates. Rock crabs are both predators and scavengers feeding on a wide range of other invertebrates. As juveniles they are preyed upon by fish including cabezon, barred sand bass and several rockfish species. Monitoring rock crab numbers will provide useful insight into the trophic structure of mid-depth reefs within MPAs. Rock crabs do not appear to migrate or to undertake large-scale movements; effects of MPA implementation may therefore be observable as changes in local population abundances. There is an active commercial fishery for rock crab in the South Coast region, with landings averaging over 1 million pounds annually. Data interpretation will consider information on the spatial distribution of fishing and fishery regulations.

VITAL SIGN: ROCKFISH ABUNDANCE & SIZE FREQUENCY

Ecosystem Features: Kelp & Shallow Rock Ecosystems, Mid-depth Rock Ecosystems

Removal of individuals from fish populations has led to the decline in average size of many reef-associated fishes. However, MPAs generally lead to increases in the size and local density of protected fish populations. Fish size in particular is expected to change in response to protection more rapidly than other population characteristics (such as density), as fewer individuals are removed from the population and more individuals survive to larger sizes. Ecologically, increasing individual size within fish populations is an important vital sign of ecosystem condition. For individual species, larger females are typically more fecund and contribute to increased production of juvenile individuals. At the ecosystem scale, shifts in the diet of larger individuals can contribute to the restoration of previously observed predator-prey relationships. Increasing evidence suggests that such relationships are an important determinant of trophic and ecosystem stability.

In the South Coast region, rockfishes (*Sebastes* spp.) are both an ecologically important species group as well as an important fishery resource. Individual species differ in their life history characteristics; however rockfishes are typically long-lived and slow-growing species. Model predictions suggest that population recovery of these species is likely to take many decades. However, existing data indicate that fish size differences inside and outside MPAs may be detectable within 5-10 years. Implementation of this vital sign will require some additional specification of comparable species for inclusion and will most usefully focus on trends within a sampling location rather than differences between locations, which will be confounded by differing species assemblages between locations. Data from the South Coast MPA Baseline Program will be analyzed to refine this vital sign for implementation.

VITAL SIGN: ROCKWEED COVER

Ecosystem Features: Rocky Intertidal Ecosystems

Together with other species of macroalgae, rockweeds play important roles in rocky intertidal ecosystems. As primary producers, they are critical components of food webs in these systems. In addition, they provide habitat that can be a refuge from predation and desiccation. Rockweed cover in rocky intertidal ecosystems may directly respond to MPA designation if implementation results in increased or decreased human disturbance such as trampling. Interpretation of trends in rockweed cover will be aligned with data on non-consumptive uses to examine potential MPA effects, taking into account visitation rates and allowed uses.

VITAL SIGN: SAND CRAB ABUNDANCE

Ecosystem Feature: Soft-bottom Intertidal & Beach Ecosystems

Sand crabs (*Emerita analoga*) are common beach residents through the South Coast region. Sand crab abundance may indicate a beach with sufficient nutrient input, and the size of beach populations has previously been related to the richness of inshore waters. This species forms an important link within the food web in beach habitats as prey for a diverse range of fish, birds and mammals.

Populations are generally robust, though they fluctuate annually depending on oceanic and climatic conditions. More importantly populations naturally vary between beaches, thus trends through time offer the greatest insight into changing ecosystem condition inside and outside MPAs.

VITAL SIGN: SEMI-PELAGIC/PELAGIC ROCKFISH AVERAGE & MAXIMUM SIZE

Ecosystem Feature: Nearshore Pelagic Ecosystems

As with the 'rockfish average & maximum size' vital sign within Kelp & Shallow Rock and Mid-depth Rock Ecosystems, semi-pelagic and pelagic rockfish size in pelagic environments offers insight into ecosystem condition and the effects of MPA implementation. Pelagic or semi-pelagic species in the South Coast region include widow (*Sebastes entomelas*), blue (*S. mystinus*) and shortbelly (*S. jordani*) rockfish. The most effective mechanism to target comparable species across locations is likely to be employment of a consistent fishing methodology that can effectively sample fish in the water column. Given variable fish community structure between locations, change through time offers the strongest insight into the effects of MPA implementation.

VITAL SIGN: SHEEPHEAD ABUNDANCE, SIZE FREQUENCY & SEX RATIO

Ecosystem Feature: Kelp & Shallow Rock Ecosystems

Sheephead (*Semicossyphus pulcher*) are strong ecological interactors, and are thus functionally important, in kelp & shallow rock ecosystems. In the South Coast region, large red and purple urchin populations may exert strong control over the kelp abundance. Sheephead are an important predator of urchins (together with spiny lobster) and thus may contribute to a trophic cascade in which control of urchin populations results in higher abundance of kelp. These fish are protogynous hermaphrodites; all fish start life as females and turn into males as they grow. Targeting of large trophy males by recreational fishers has resulted in females changing sex when they are younger and smaller, which leads to lower reproductive output of the population.

Increases in the local abundance of sheephead populations are expected to occur following MPA implementation and may occur relatively rapidly (possibly within five years). Monitoring over longer time periods may also reveal changing population size structure as larger individuals are no longer removed from the population.

VITAL SIGN: SPINY LOBSTER ABUNDANCE & SIZE FREQUENCY

Ecosystem Feature: Kelp & Shallow Rock Ecosystems

Spiny lobsters are strong ecological interactors, and are thus functionally important, in kelp & shallow rock ecosystems. In the South Coast region, large red and purple urchin populations may exert strong control over the kelp abundance. Together with sheephead, spiny lobsters are important predators of urchins and thus may contribute to a trophic cascade in which control of urchin populations results in higher abundance of kelp.

Increases in the local abundance of spiny lobster populations are expected to occur following MPA implementation and evidence from the Channel Islands suggests that these increases may occur relatively rapidly (possibly within five years). Monitoring over longer time periods may also reveal changing population size structure as larger individuals persist within MPAs.

VITAL SIGN: SURFGRASS COVER

Ecosystem Feature: Rocky Intertidal Ecosystems

Biogenic habitat, such as surfgrass, plays a key role in providing refuge from predators and exposure in rocky intertidal ecosystems. In addition, surfgrass is an important indicator of primary productivity in the systems and provides a source of food for herbivores. Unlike many subtidal ecosystems, biogenic habitats in the rocky intertidal, including surfgrass, may directly respond to MPA designation if implementation results in increased or decreased human disturbance such as trampling. However, these potential MPA effects will also occur in the context of natural variation in these ecosystems. Analyses of monitoring results will include assessment of effects at a range of spatial scales to separate potential MPA effects from broader temporal dynamics.

VITAL SIGN: SURFPERCH ABUNDANCE & SIZE FREQUENCY (MULTIPLE SPECIES)

Ecosystem Feature: Soft-bottom Intertidal & Beach Ecosystems, Soft-bottom Subtidal Ecosystems

Nearshore shallow-water habitats are home to a range of fish species, including juveniles that seek refuge from predators in the shallow water as well as resident species that forage in the surf zone on fish and invertebrate prey. Surfperch play a major link in trophic transfer in the near-shore: their diets consist of isopods, amphipods, copepods, molluscs and polychaete worms. They, in turn, are prey for larger fish such as kelp bass, California halibut, sturgeon, rockfishes and salmon and are also eaten by harbor seals and birds. Both fishery-dependent and fishery-independent data suggest that populations of surf perches may be declining in California. Interpretation of trends in abundance and size structure will consider available fisheries information to assess potential MPA-specific effects.

DESCRIPTIONS OF SOCIOECONOMIC AND HUMAN-USE VITAL SIGNS

VITAL SIGNS: LANDINGS (WEIGHT & VALUE) OF KEY SPECIES PER FISHING BLOCK & PORT FOR THE COMMERCIAL FISHERY

Ecosystem Feature: Consumptive Uses

Key fishery species:

- Nearshore rockfishes (*Sebastes* spp.)
- Spiny lobster (*Panulirus interruptus*)
- Red sea urchin (*Strongylocentrotus franciscanus*)
- Market squid (*Loligo opalescens*)
- California halibut (*Paralichthys californicus*)

Commercial fishing is an important component of the economy in coastal communities in the South Coast region with average annual landings exceeding 253 million pounds and ex-vessel revenue nearing $68 million (based on data from 1998 to 2007).

Numbers of fishing vessels, trips and landings of key species illustrate the intensity of fishing efforts. This information is currently collected by the Department of Fish & Game through landing receipts. This information provides a valuable historical baseline from which to measure changing Ecosystem Feature condition. Species that are an important component of the fishery, play key ecological roles and are likely to respond to MPAs are the most informative for MPA monitoring.

These include nearshore rockfish, spiny lobster, red urchin, California halibut and market squid. Currently collected information has only broad spatial resolution and interpretation will focus on fishing block and port information. Interpretation of trends in commercial fishery landings will consider additional ecological and economic information including changes in fisheries regulations, economic indices and climate and oceanographic trends, and will primarily contribute to region-wide evaluations of Ecosystem Feature condition.

VITAL SIGNS: LANDINGS (NUMBER & WEIGHT) OF KEY SPECIES PER FISHING BLOCK & PORT BY COMMERCIAL PASSENGER FISHING VESSELS (CPFVS)

Ecosystem Feature: Consumptive Uses

Key fishery species:

- Nearshore rockfishes (*Sebastes* spp.)
- Kelp bass (*Paralabrax clathratus*)
- Barred sand bass (*Paralabrax nebulifer*)
- Pacific barracuda (*Sphyraena argentea*)

CPFVs – Commercial Passenger Fishing Vessels, also called party boats – are an important component of consumptive use within the South Coast region. Comparable to landings from commercial operators, angler numbers and landings from CPFVs coarsely illustrate the intensity of fishing effort. Key species groups for monitoring include nearshore rockfishes, kelp bass, barred sand bass and Pacific barracuda. This information is currently collected as part of the Department of Fish & Game CPFV logbook program and the California Recreational Fisheries Survey (CRFS). In both cases the spatial resolution in the data limits detection of individual MPA effects. Landings will therefore be used in region-wide evaluations of Ecosystem Feature condition.

VITAL SIGNS: CATCH PER UNIT EFFORT (CPUE) OF KEY SPECIES PER FISHING BLOCK & PORT BY COMMERCIAL PASSENGER FISHING VESSELS (CPFVS)

Ecosystem Feature: Consumptive Uses

Key fishery species:

- Nearshore rockfishes (*Sebastes* spp.)
- Kelp bass (*Paralabrax clathratus*)
- Barred sand bass (*Paralabrax nebulifer*)
- Pacific barracuda (*Sphyraena argentea*)

CPFVs – Commercial Passenger Fishing Vessels, also called party boats – are an important component of consumptive use within the South Coast region. Catch per unit effort (CPUE) allows for standardization of catch data based on the amount of effort, often measured in terms of gear type and size and angler hours, taken to land the catch. With measures of landings of key species, this can provide valuable information about relative abundance of fished species. Key species groups for monitoring include nearshore rockfishes, kelp bass, barred sand bass and Pacific barracuda. This information can be derived from data currently collected as part of the Department of Fish & Game CPFV logbook program and the California Recreational Fisheries Survey (CRFS). In the case of CPFV logbook information, the spatial resolution in the data limits detection of individual MPA effects. While the CRFS data is more spatially resolved, CPUE may most appropriately be used in region-wide evaluations of Ecosystem Feature condition.

VITAL SIGN: NUMBER OF LOBSTER CAPTURED PER FISHING TRIP AND LOCATION BY RECREATIONAL FISHERS

Ecosystem Feature: Consumptive Uses

Spiny lobsters are an important target in both recreational and commercial fisheries in the South Coast region. In the recreational fishery, lobster are caught diving or through the use of hoop nets. Spiny Lobster Report Cards are currently used to collect information on how many lobsters are being caught and from where. Trends in this vital sign will provide insight into changes in the fishery in response to MPA implementation as well as information on linkages to ecological changes in these populations.

VITAL SIGN: NUMBER OF BOAT-BASED WILDLIFE VIEWING TRIPS AND VISITORS PER PORT AND VIEWING LOCATIONS

Ecosystem Feature: Non-consumptive Uses

Vital signs monitoring of the level of boat-based wildlife viewing trips is important for tracking trends in recreational use, and the data also provide important insight into MPA management questions such as disturbance effects of visitors on nesting bird colonies. Interpretation of trends in boat trips will take into account the effects of broader economic indices.

VITAL SIGN: NUMBER OF DIVING TRIPS AND DIVERS PER ACCESS POINT AND DIVE SITE

Ecosystem Feature: Non-consumptive Uses

Scuba diving is a popular non-consumptive recreational activity within the South Coast region. Annual numbers of divers to specific locations provides insight into this level of recreational use and also may be used to coarsely infer potential economic benefits to coastal communities. Interpretation of trends in diver numbers will take into account broader economic indices.

VITAL SIGN: NUMBER OF SHORELINE WILDLIFE VIEWERS IN ESTUARINE, WETLAND AND BEACH ECOSYSTEMS

Ecosystem Feature: Non-consumptive Uses

Shore-based wildlife viewing is distinguished here from tidepooling and encompasses bird and mammal viewing (e.g., pinniped haulouts) along rocky shores, beaches and estuaries. Long-term trends in this vital sign provide insight into levels of recreational use as well as ecosystem condition. This information will also be used in integrated analyses with ecological vital signs (e.g., pinniped abundance) where feasible to monitor the potential disturbance effects of visitation.

VITAL SIGN: NUMBER OF VISITORS ENGAGING IN RECREATIONAL BEACH USE

Ecosystem Feature: Non-consumptive Uses

Coastal recreation in California generates significant economic benefits for coastal communities, and a broad spectrum of residents visit the coast and beaches each year. Monitoring recreational beach use is an important element of patterns of human use in the coastal environment. Trends in the number of visitors are likely to vary in response to a complex suite of

economic and environmental variables. Distinguishing potential MPA effects is challenging, particularly at broader regional scales, but will be approached through collection and analysis of time-series data.

VITAL SIGN: NUMBER OF VISITORS TO ROCKY INTERTIDAL ECOSYSTEMS FOR TIDEPOOLING

Ecosystem Feature: Non-consumptive Uses

Tracking numbers of visitors to rocky shores is important for monitoring recreational use within and outside MPAs, and also provides important insight into MPA management issues concerned with potential ecological damage caused by trampling within these habitats. Interpretation of trends in visitation will consider additional influences such as seasonality and access.

B-2. GUIDE TO THE METRICS (ATTRIBUTES & INDICATORS) OF ECOSYSTEM FEATURE ASSESSMENT

Ecosystem Feature Assessments are one implementation option for tracking the condition and trends of Ecosystem Features. As described in Chapter 4, a set of key attributes are identified as important ecosystem aspects required to maintain a functioning ecosystem through time. This set is considered adequate to collectively assess the condition and trends of the Ecosystem Feature and comparably feasible to implement and interpret. Each key attribute is assessed using three to five indicators or, where appropriate, focal species that collectively provide an indication of the condition and trends of the attribute. The following guide to the attributes and indicators is provided to supplement the summary information listed for each Ecosystem Feature in Chapter 4.

The key attribute and indicator descriptions include an overarching rationale for the collective set of attributes, rationale for selection of each individual attribute, and a brief consideration of other factors that will influence the interpretation of trends in attributes and indicators. Optional add-ons to the Ecosystem Feature Assessment are also included. This information may provide additional insights, but the metrics are more difficult or expensive to implement, and more challenging to interpret. Thus, these optional supplemental metrics should be added to monitoring only to the extent that resources permit.

ROCKY INTERTIDAL ECOSYSTEMS

At the upper end of the intertidal, physical processes primarily regulate community composition and species distribution, thus the key attributes at the upper limits of the Rocky Intertidal Ecosystem Feature may provide insights into ecosystem responses to physical drivers such as sea level rise or storm events. On the other extreme, the lower distributional limits of many intertidal organisms are regulated primarily by biological processes such as competition and predation. Thus the lower limits of many of the key attributes presented here provide insights into trophic and ecosystem structure and function. Analyzed together, trends in key attributes will reveal key ecosystem changes that may follow MPA implementation and will provide insights into the mechanisms underlying changes in species/functional groups.

ECOSYSTEM FEATURE ASSESSMENT

BIOGENIC HABITAT

Indicator/Focal Species:

- Percent cover of focal species/group
  - Mussel (*Mytilus* spp.)
  - Barnacles (*Balanus* spp., *Chthamalus dalli*)
  - Feather boa kelp *(Egregia menziesii*)
  - Rockweed (Fucaceae, multiple species)
  - Surfgrass (*Phyllospadix* spp.)

Biogenic habitats in intertidal ecosystems play a key role in providing refuge from predators and exposure while increasing rugosity and space. In addition, plant and algal species are indicators of primary productivity in the system and provide a source of food for intertidal herbivores. Thus, intertidal biogenic habitats are critical in regulating community structure and food web dynamics. Unlike many subtidal ecosystems, biogenic habitats in the rocky intertidal may directly respond to MPA designation if implementation results in increased or decreased human disturbance such as trampling, harvesting or illegal

take. Interpretation of trends in biogenic habitat will be aligned with data on non-consumptive and consumptive uses to examine potential MPA effects, taking into account visitation rates and allowed uses.

TROPHIC STRUCTURE: PREDATORS

Indicator/Focal Species:

- Ochre sea star (*Pisaster ochraceus*) density & size
- Piscivorous bird richness & abundance
- Shorebird richness & abundance

Predators can play important roles in structuring communities through top-down control of their prey; this is especially true of the sea star, *Pisaster ochraceus*, which plays an important role in maintaining species diversity within mussel-dominated intertidal habitats. By preying on mussels, the competitive dominant for space, *Pisaster* frees space that can be settled by other invertebrate and algal species.

Rocky intertidal ecosystems are important foraging habitats for resident and migratory bird populations. Piscivorous birds and shorebirds forage on a wide range of fish and invertebrate prey. Although population abundances vary dramatically in response to external drivers, including climate and oceanographic variation and trends, over long time periods trends such as increased total abundance and richness of bird species will be indicative of an abundant and diverse prey population.

TROPHIC STRUCTURE: HERBIVORES

Indicator/Focal Species:

- Density & size structure of focal species/group
  - Black abalone (*Haliotis cracherodii*)
  - Purple sea urchin (*Strongylocentrotus purpuratus*)
  - Owl limpet (*Lottia gigantea*)
  - Turban snails (*Tegula* spp.)

Species such as limpets, snails, urchins and abalone provide a prey base for many higher trophic level organisms including other larger invertebrates, birds and humans. Importantly, invertebrates are also critical bio-regulators of community structure in intertidal habitats; abalone, limpets and snails are grazers that create space among the rocky substrate for new organisms to settle. Many intertidal invertebrates, such as owl limpets and turban snails, are harvested while others are affected by various factors ranging from human disturbance to climate change. Trends in densities of these species will be interpreted in the context of trends in ecologically associated species (e.g., habitat-forming species) and, when appropriate, will consider information on the spatial distribution and intensity of fishing take.

OPTIONAL ADD-ONS FOR ECOSYSTEM FEATURE ASSESSMENT

BIOGENIC HABITAT: MACROALGAE

Indicator/Focal Species:

- Percent cover of focal groups
  - Turf algae

- Foliose red algae
- Encrusting algae

This optional add-on can provide additional information about the condition and trends of biogenic habitat in rocky intertidal ecosystems. Macroalgae play important roles as primary producers that provide food for a diverse suite of herbivorous invertebrates and fishes and through provision of habitat that can be a refuge from predation and desiccation. Macroalgal abundance in rocky intertidal ecosystems may directly respond to MPA designation if implementation results in increased or decreased human disturbance such as trampling, or through harvesting or illegal take of species that graze on macroalgae. Interpretation of trends in macroalgal cover will be aligned with data on non-consumptive and consumptive uses to examine potential MPA effects, taking into account visitation rates and allowed uses.

DIVERSITY

Indicator/Focal Species:

- Species richness (algae & invertebrates)
- Species diversity (functional groups of algae & invertebrates)

Direct measurements of species richness may provide further insights into the ecological mechanisms underlying potential ecosystem change following MPA implementation. However, there are many challenges in collecting and correctly interpreting diversity data. By definition, measurement of diversity is relatively resource-intensive as all, or nearly all, species must be included. Some survey efforts may collect a subset of species information that can provide some insight into diversity changes. Interpretation of diversity measures must proceed with caution. Both increases and decreases in diversity can signify improved or declining ecosystem condition. For example, increases in diversity may result from natural or anthropogenic disturbance effects, or may be accounted for entirely by invasive species.

In rocky intertidal ecosystems, species diversity may fluctuate dramatically as a result of natural and anthropogenic disturbances. Indeed, physical disturbance results in complex and patchy species distributions in this ecosystem complicating detection of potential MPA-related effects. Monitoring diversity may provide insight into the frequency and intensity of disturbance effects, providing information that can assist in interpreting trends in individual species.

KELP & SHALLOW ROCK ECOYSTEMS (0-30M)

The collective set of key attributes identified for the Kelp & Shallow Rock Ecosystem Feature has been chosen to capture the breadth of ecosystem structure, function and landscape context necessary to track the condition and trends of this Ecosystem Feature. The architecture formed by kelp growth, where it occurs, creates foraging and nursery habitat (i.e., biogenic habitat) for many of the other species found in these environments. The remaining key attributes identify critical components of the food web and trophic structure associated with kelp and shallow rock ecosystems. Integrated analyses of changes in attributes will provide insight into ecosystem changes following MPA implementation, taking into account ecological interactions and relationships among species in this ecosystem.

ECOSYSTEM FEATURE ASSESSMENT

BIOGENIC HABITAT: MACROALGAE

Indicator/Focal Species:

- Giant kelp (*Macrocystis pyrifera*) areal extent of surface canopy

Canopy-forming kelp species are primary producers and provide habitat by serving as surface area for sessile organisms and refuges for young fish. This habitat provisioning role is therefore important for structuring the food web within the ecosystem. In the South Coast region, *Macrocystis pyrifera* is the dominant canopy-forming kelp and serves as a key foraging habitat for fish and invertebrates. Measurement of the areal extent of surface canopy can provide insight into the amount of primary production in the system as well as the amount of habitat provided. Trends in areal extent can be indicative of changes in ecosystem condition and provide information useful for interpreting changes in fish and invertebrate populations. Kelp populations fluctuate seasonally and inter-annually in response to changing oceanographic conditions as well as the intensity of herbivory. Interpretation of trends in kelp cover will consider additional information about physical drivers such as temperature and swell height.

STRONG ECOLOGICAL INTERACTORS

Indicator/Focal Species:

- Density & size structure of focal species/group:
  - Red sea urchin (*Strongylocentrotus franciscanus*)
  - Purple sea urchin (*Strongylocentrotus purpuratus*)
- Spiny lobster (*Panulirus interruptus*) abundance & size structure
- California sheephead (*Semicossyphus pulcher*) density, size structure & sex ratio

Strong ecological interactors are individual species that play key roles as herbivores or predators and are thus functionally important within an ecosystem. In the South Coast region, large red and purple urchin populations may exert strong control over the kelp abundance. Sheephead and spiny lobsters are important predators of urchins and thus may contribute to a trophic cascade in which control of urchin populations results in higher abundance of kelp.

Understanding changes in these key species will provide insight into the mechanisms of ecosystem change following MPA implementation. Sheephead, sea urchins and spiny lobsters are important components of commercial and recreational fisheries in the South Coast region. Increases in the local abundance of these populations are expected to occur following MPA implementation and may occur relatively rapidly (possibly within five years). Monitoring over longer time periods may also reveal changing population size structure as larger individuals persist within MPAs.

TROPHIC STRUCTURE: PREDATORY FISHES

Indicator/Focal Species:

- Density & size structure of focal species:
  - Kelp bass (*Paralabrax clathratus*)
  - Olive rockfish(*Sebastes serranoides*)
  - Kelp rockfish (*Sebastes atrovirens*)
  - Cabezon (*Scorpaenichthys marmoratus*)

This guild of predatory fishes encompasses species that feed at multiple levels with the food web in kelp & shallow rock ecosystems. In general, increased abundances of these higher level predators are indicative of the presence and functioning of multiple lower trophic levels. Monitoring predatory fish populations can provide information about the degree to which

top-down processes are important in structuring food webs in this ecosystem and can also give insight into energy inputs from the pelagic environment as predatory fishes can consume transient coastal pelagic species.

The focal species selected encompass a range of life history characteristics and prior levels of take. Existing evidence suggests that relatively sedentary fished predators, such as cabezon, may respond rapidly to MPA implementation. Fish size in particular is expected to change in response to protection more rapidly than other population characteristics (such as density), as fewer large individuals are removed from the population. Monitoring at the Channel Islands following MPA implementation indicates that the biomass of fished species, such as kelp bass, olive rockfish and kelp rockfish, is higher in reserves. However, model predictions suggest that population recovery of long-lived and slow growing species is likely to take many years. Long-term tracking of this Ecosystem Feature will be required to assess these potential MPA effects.

TROPHIC STRUCTURE: PREDATORY INVERTEBRATES

Indicator/Focal Species:

- Density & size structure of focal species:
  - Kellet's whelk (*Kelletia kelletii*)
  - Sea stars (*Pisaster* spp.*, Pycnopodia helianthoides*)

In kelp & shallow rock ecosystems, predatory invertebrates can play key roles within the food web, and their presence indicates a functioning food web. Predatory sea stars feed primarily on mollusks and crustaceans and can exert strong top-down control on community structure. Kellet's whelks are important predators of herbivorous snails, such as turban snails, in this system and are the target of a growing fishery in the South Coast region. In addition to providing insight into ecosystem condition, monitoring of the trends in populations of Kellet's whelks inside and outside MPAs may provide valuable information for fisheries managers as no formal stock assessments have been conducted for this species.

TROPHIC STRUCTURE: PLANKTIVOROUS FISHES

Indicator/Focal Species:

- Density & size structure of focal species:
  - Blacksmith (*Chromis punctipinnis*)
  - Señorita (*Oxyjulis californica*)
  - Blue rockfish (*Sebastes mystinus*)

Measures of planktivore abundance and size structure are indicative of the ability of the system to capture nutrients provided by the influx of plankton. The focal species in this key attribute include both fished and unfished species, which can help provide insight into the role of the MPAs in observed ecological trends, and encompass species that are both warm (e.g., Señorita) and cold water (e.g., blue rockfish) associated. Monitoring this key attribute will provide important insight into a key component of the food web within this ecosystem.

TROPHIC STRUCTURE: HERBIVOROUS INVERTEBRATES

Indicator/Focal Species:

- Density & size structure of focal species:
  - Abalone (*Haliotis* spp.)

- Giant keyhole limpet (*Megathura crenulata*)
- Wavy turban snail (*Megastraea undosa*)

Herbivorous invertebrates provide important links in kelp & shallow rock food webs. The focal species for monitoring include abalone, the giant keyhole limpet and the wavy turban snail. Historically, abalone played important ecological roles as consumers of algae, both live and drift. Populations of these species are currently well below historic levels due to a combination of factors including heavy fishing pressure, disease and oceanographic conditions. Little is known about the population dynamics of giant keyhole limpets, but there is some concern about the potential impacts of a growing fishery as a biotechnology company is currently investigating the use of the hemolymph of this species in the development of a cancer vaccine. Wavy turban snails are the target of a small commercial fishery, but as with giant keyhole limpets, very little is known about their population dynamics. Monitoring results will be interpreted in consideration of consumptive uses as well as oceanographic conditions.

OPTIONAL ADD-ONS TO ECOSYSTEM FEATURE ASSESSMENTS

BIOGENIC HABITAT

Indicator/Focal Species:

- Giant kelp (*Macrocystis pyrifera*) stipe density
- Sub-canopy & turf algae percent cover
- Surfgrass (Phyllospadix spp.)
- Sessile invertebrate percent cover

Stipe density of *Macrocystis pyrifera* can provide additional information about the characteristics of the habitat provided and thus of the species assemblages associated with it. Sub-canopy and turf forming algae and surfgrass may play especially important roles in habitat provisioning in areas where *Macrocystis* is absent. In addition, sessile invertebrates may be dominant space occupiers in some areas and thus also provide biogenic habitat. While direct effects of MPA designation may not occur, understanding the relative percent cover of these groups will be important for interpreting trends in other species.

TROPHIC STRUCTURE: STRONG ECOLOGICAL INTERACTORS

- Sea otter abundance (*Enhydra lutris*)

Sea otters are keystone predators in kelp & shallow rock ecosystems and through control of sea urchin populations can have positive impacts on kelp abundance. While historically sea otters were present in the South Coast region, there are currently only small populations at San Nicholas Island and near Gaviota State Park in Santa Barbara County. Should otter populations increase in number or geographic extent, monitoring their populations will be important to correctly interpret trends in community structure.

DIVERSITY

Indicator/Focal Species:

- Species richness (invertebrates & fishes)
- Species diversity (functional groups of invertebrates & fishes)

Direct measurements of species richness in kelp & shallow rock ecosystems can provide further insights into the ecological mechanisms underlying potential ecosystem change following MPA implementation. However, as noted for other Ecosystem Features, collecting information to calculate diversity metrics is resource-intensive and many of the same caveats apply – both increases and decreases in diversity may indicate increasing or declining ecosystem condition, so care in interpreting observed changes is essential.

MID-DEPTH ROCK ECOSYSTEMS (30-100M)

The collective set of attributes selected to track the condition of the Mid-depth Rock Ecosystem Feature are conceptually similar to those identified for the Kelp & Shallow Rock Ecosystem Feature. A fundamental aspect of the ecosystem is the habitat provisioning role played by many species. In mid-depth rock ecosystems, the dominant component of biogenic habitat is sessile invertebrates. The remaining attributes identify core components of the community composition and trophic structure of mid-depth rock reefs. Inclusion of both fished and unfished sections of the community can provide insight into the role of the MPAs in observed ecological trends. Again, integrated analyses incorporating multiple attributes will provide greater insight into the mechanisms underlying observed species trends.

ECOSYSTEM FEATURE ASSESSMENT

BIOGENIC HABITAT: SESSLE INVERTBRATES

- Structure forming invertebrate cover and height

Sessile invertebrates encompass a wide range of species with dramatically different body types and ecologies. Common to many of these species is the role played in providing habitat. Although biogenic habitat is a key attribute of the ecosystem, potential changes in response to MPA designation may only occur through cascading interactions with other components of the food web or over longer time scales in response to changing oceanographic and climate conditions. However, this remains a key attribute to monitor in order to interpret changes seen in fish and invertebrate populations. Data collected as part of the South Coast MPA Baseline Program will be used to refine and improve this broad indicator.

TROPHIC STRUCTURE: MOBLIE INVERTEBRATES

Density of focal species:

- Rock crab (*Cancer* spp.)
- Urchin (Echinidae, multiple species)

As in Kelp & Shallow Rock Ecosystems, many of the most abundant invertebrates in Mid-depth Rock Ecosystems play key roles as predators and detritivores within the food web. Because primary producers are less abundant than in shallower ecosystems, detritivores, such as urchins, provide an important link in mid-depth rock food webs and are an indication of the capture of nutrients and productivity from sources both internal and external to the system. Increases in the density of rock crabs, which are targeted by the commercial fishery, may be predicted with MPA implementation; however limited existing knowledge of the effectiveness of spatial closures for mobile species renders prediction of the timing and magnitude of population responses uncertain. Regardless, monitoring population trends may provide insight into the role of the regional MPA network in increasing species abundances.

TROPHIC STRUCTURE: PREDATORY FISHES

Indicator/Focal Species

- Density & size structure of focal species:
  - Bocaccio (*Sebastes paucispinis*)
  - Vermilion rockfish (*Sebastes miniatus*)
  - Lingcod (*Ophiodon elongatus*)
  - Ocean whitefish (*Caulolatilus princeps*)
  - California scorpionfish (*Scorpaena guttata*)
- Rockfish (*Sebastes* spp.) size structure

Many predatory fish within the South Coast region are also key target fish within commercial and recreational fisheries. In the absence of fishing following MPA implementation, the size and abundance of focal species is predicted to increase, first inside MPAs and subsequently both inside and outside MPAs. The species included here as focal species encompass a range of life history characteristics and are subject to differing levels of fishing take. In particular, the slow growth and late maturation of rockfish species renders detection of MPA effects unlikely within five to ten years. By comparison, bocaccio are relatively fast growing and lingcod are relatively sedentary – both characteristics which may reduce the time necessary to detect potential changes in response to MPA implementation. In all cases, interpretation of trends in predatory fish density and size structure will consider information on the spatial distribution and intensity of fishing effort and any associated changes in fishery regulations.

COMMUNITY STRUCTURE: DWARF ROCKFISHES

- Total dwarf rockfishes abundance (multiple species)

In rockfish communities, fishing disproportionally affects larger, slow growing and late maturing species. By comparison, the so-called dwarf rockfish (generally comprised of halfbanded (*S.semicinctus*), pygmy (*S. wilsoni*), squarespot (*S. hopkinsi*), stripetail (*S. saxicola*), and swordspine (*S.ensifer*)) are relatively unfished. These dwarf rockfish are an important prey source for the larger rockfish species and may also compete with juveniles of the larger, competitively dominant species for habitat and prey resources. Historically, competition and predation are likely to have constrained population densities of the dwarf species, except in sub-optimal habitats. Overfishing of the larger species has substantially reduced their population densities and consequently reduced the predation and competition pressures on dwarf rockfish, which now dominate the rockfish community in some locations. Trends in the relative abundance of dwarf rockfish at sites inside and outside of MPAs are indicative of shifting community structure in response to protection. This attribute will provide useful insight into the effects of MPAs that extend beyond single species responses.

OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

BIOGENIC HABITAT

Indicator/Focal Species

- Cover of focal species:
  - *Metridium* spp. bed cover
  - Purple hydrocoral (*Stylaster californicus*)

- Elk kelp (*Pelagophycus porra*)

Metridium farcimen and *Metridium senile* are two prominent anemones, the former of which is best known and can grow to nearly 1 m in height. Understanding the distribution and extent (cover) of *Metridium* spp. beds provides an insight into nursery habitats for many species of fish in deep water environments. In general *Metridium* are long lived and affected by water quality, therefore large beds also suggest some measure of environmental stability. Similarly, the hydrocoral *Stylaster californicus* is slow growing, fragile and generally found in areas of clear water. Elk kelp, *Pelagophycus porra*, is a deeper-water kelp species that commonly occurs to depths of 50m. Interpretation of trends in these focal species requires adequately accounting for implementation conditions, since low initial densities may reflect habitat suitability and not current condition.

Assessing the condition of these focal species will require more detailed survey efforts. Where feasible, this information can provide increased insights into the dynamics of community change, strengthening interpretation of changes in key fish and invertebrate species.

DIVERSITY

Indicator/Focal Species

- Species richness (invertebrates & fishes)
- Species diversity (functional groups of invertebrates & fishes)

As in other Ecosystem Features, direct measurements of species richness and diversity in mid-depth rock ecosystems can provide further insights into the ecological mechanisms underlying ecosystem change following MPA implementation. However, there are many challenges in collecting and correctly interpreting diversity data. By definition, measurement of diversity is relatively resource-intensive as all, or nearly all, species must be included. Some survey efforts may collect a subset of species information that can provide some insight into diversity changes. Interpretation of diversity measures must proceed with caution. Both increases and decreases in diversity can signify improved or declining ecosystem condition. For example, increases in diversity may result from natural or anthropogenic disturbance effects, or may be accounted for entirely by invasive species.

ESTUARIES & WETLANDS

Estuarine & wetland ecosystems within the South Coast region encompass soft sediment habitats, including open water, tidal mudflats and eelgrass beds. Estuaries play a key role as nursery habitat for many invertebrates and fish. In addition, these habitats host thousands of migratory shorebirds and waterfowl and provide important foraging habitat for both migratory and resident bird populations. The attributes selected to track the condition of estuarine & wetland ecosystems reflect these key ecological roles as well as components of the associated food web structure that create a functioning estuarine & wetland ecosystem.

ECOSYSTEM FEATURE ASSESSMENT

BIOGENIC HABITAT

Indicator/Focal Species:

- Areal extent of focal species

- Eelgrass (*Zostera marina*)
- Pickleweed (*Salicornia* spp.)

Biogenic habitat is critical in maintaining the ecological roles of estuaries as nursery and foraging habitat. Eelgrass provides important nearshore habitat for a diverse assemblage of aquatic organisms and these habitats typically support higher diversity and biomass than surrounding unvegetated areas. Common pickleweed is a California native that is the dominant vascular plant of many saline marshes on the west coast, and it is commonly found in bays and estuaries where it is protected from wave action. Increases in areal extent of these species in response to MPA designation are predicted in locations where protection results in decreases in physical habitat disturbance (for example, via a reduction in bottom contact fishing gear or propeller disturbance). Trends in areal extent are also important to interpret changes observed in other components of the estuarine food web. Interpretation of these trends will also incorporate contextual information such as water quality information to determine potential MPA-effects.

TROPHIC STRUCTURE: INFAUNAL ASSEMBLAGE

Indicator/Focal Species:

- Abundance of focal species
  - Mud shrimp (*Upogebia* spp.)
  - Ghost shrimp (*Neotrypaea* spp.)
  - Pacific gaper clam (*Tresus nuttalli*)
  - Washington clam (*Saxidomus nuttalli*)
  - Common littleneck clam (*Protothaca staminea*)

The infaunal species assemblage encompasses multiple species and functional groups with important ecological roles, including bioturbators, filter-feeders and tube-builders. In addition to the breadth of ecological roles, the recommended focal species also vary in life history characteristics, allowing detection of potential MPA effects at a range of temporal and spatial scales. Further, species including gaper, Washington and littleneck clams are also subject to recreational fishing take within the South Coast region. Although the timing and magnitude of potential responses to MPA implementation are uncertain, increases in local abundance are predicted where MPA implementation results in reduced habitat disturbance and reduced take. Interpretation of monitoring results will consider information on the spatial distribution of recreational harvest to assess potential MPA-effects.

TROPHIC STRUCTURE: PREDATORY BIRDS

Indicator/Focal Species:

- Piscivorous birds richness & abundance
- Shorebird richness & abundance

Coastal bays, estuaries and beaches in the South Coast region are an important part of the Pacific Flyway and host thousands of migrating shorebirds. In addition, several of the estuaries in the region are important foraging and nesting areas for resident bird populations. Increased total abundance and richness of these bird species is indicative of an abundant and diverse prey population. Individual populations are sensitive to habitat modification (for example, loss of foraging or nesting habitat or decreased water quality) and also fluctuate naturally in response to climate and oceanographic variation. Thus, while MPA implementation may rapidly result in increased bird populations due to reduced disturbance, long time-series data will be collected to detect overarching trends in diversity and abundance.

TROPHIC STRUCTURE: PREDATORY FISHES

Indicator/Focal Species

- Density & size structure of focal species
  - Leopard shark (*Triakis semifasciata*)
  - California halibut (*Paralichthys californicus*)

Apex predators, by virtue of their position at the top of the food web within estuarine environments, are indicative of the presence and functioning of multiple lower trophic levels. Both leopard sharks and California halibut are seasonally abundant in bays and estuaries within the South Coast region, where they feed on a diverse range of prey items including clams, shrimp, crabs and polychaete worms. Both species also form a component of the recreational fishery in the region and their numbers may be expected to increase with decreased take, decreased disturbance and decreased take of benthic and infaunal species resulting in increased prey populations. Integrated analyses of multiple attributes will be used to reveal indirect ecological changes that may follow MPA implementation.

TROPHIC STRUCTURE: RESIDENT FISHES

Indicator/Focal Species

- Density & size structure of focal species/groups
  - Spotted sand bass (*Paralabrax maculatofasciatus*)
  - Gobies (Gobiidae, multiple species)
  - Topsmelt (*Atherinops affinis*)
  - Croaker abundance & size structure (Sciaenidae, multiple species)

Resident fish populations within estuarine environments serve as important energy linkages within a naturally functioning food web. Population abundances are broadly indicative of available prey and habitat condition. Increases in resident fish populations may be expected in direct response to reduced fishing as well as indirect responses to increased prey availability and reduced habitat disturbance. The focal species and groups selected for monitoring are subject to varying levels of take. For example, some gobies are collected for the aquarium trade or for use as baitfish, and spotted sand bass are important in the recreational fishery and have experienced increased fishing pressure in the past decade.

Analysis of monitoring results will consider information on the spatial distribution of fishing to interpret potential MPA effects. Trends in adult abundance of both species following MPA implementation will also reflect a combination of changing fishing pressure and oceanographic conditions and this contextual information will be considered in analyses of this data.

PRODUCTIVITY

Indicator/Focal Species:

- Arthropod biomass

Arthropods such as insects and spiders are an important source of food in estuarine and wetland ecosystems and provide an important link between terrestrial and marine ecosystems. Thus, measures of arthropod biomass can indicate food availability for birds and other organisms that forage in estuaries and wetlands. Recent studies in wetlands in southern California have shown that arthropod biomass is related to wetland system productivity such that increases in arthropod

biomass indicate increases in productivity. Additional information on the applicability of this vital sign through estuarine habitats will be useful to assess the strength of this vital sign in providing insight into Ecosystem Feature condition.

OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSMENT

TROPHIC STRUCTURE: BENTHIC INFAUNA

Focal species/Indicators:

- Abundance & foraging rates of shorebirds

Infaunal species in estuarine intertidal flats are often exploited by humans, shorebirds and wading birds. The harvesting of shellfish has been shown to affect shorebird foraging rates by changing the sediment composition and reducing the abundance of food items. Increases in the total abundance and foraging rates of shorebirds may be predicted in areas under MPA designation with reduced harvest of prey items and decreased disturbance of foraging areas. This metric will require dedicated survey methods to measure foraging rates. In addition, altered foraging rates are likely to be an indirect effect of MPA implementation. Thus it is most appropriate to include as an optional metric, added where resources permit.

TROPHIC STRUCTURE

Indicator/Focal Species

- Parasite diversity

Parasites generally have complex life cycles that depend on one or more hosts to complete. In estuarine ecosystems these hosts are often animals such as birds, invertebrates, fishes and mammals. Recent studies have demonstrated that the diversity of trematodes species that parasitize snails is an indicator of an estuary that supports diverse and functioning food web.

DIVERSITY

Indicator/Focal Species

- Species richness (invertebrates & fishes)
- Species diversity (functional groups of invertebrates & fishes)

As in many of the other Ecosystem Features, monitoring species diversity may provide useful insight into ecosystem stability (through monitoring fluctuations in diversity). However, this information is challenging to collect; data collection is resource-intensive as all, or nearly all, species must be included. Also, interpretation of diversity measures must proceed with caution as both increases and decreases in diversity can signify improved or declining ecosystem condition.

SOFT-BOTTOM INTERTIDAL & BEACH ECOSYSTEMS

Communities inhabiting sandy beaches are supported almost entirely by external inputs of nutrients and energy, as little primary production occurs on the beach itself. In addition, beach morphodynamics and swash climate have an important influence on community structure. In some locations beach habitats are highly dynamic and variable environments that change significantly with wind and waves. The key attributes identified below encompass key functional groups in this

ecosystem, focusing on those species more likely to respond to MPA designation through reduced human impact or indirect ecological interactions. Given the spatial variability among beaches, trends through time will offer the greatest insight into potential MPA effects.

ECOSYSTEM FEATURE ASSESSMENT

TROPHIC STRUCTURE: SUSPENSION FEEDERS

Indicator/Focal Species

- Density & size structure of focal species
  - Sand crab (*Emerita analoga*)
  - Pismo clam (*Tivela stultorum*)
  - Bean clams (*Donax gouldii*)

Suspension feeders play an important role in ecosystems, rapidly converting phytoplankton to biomass and, as prey organisms, making energy available to higher trophic levels. The focal species offer insight into the functioning of this component of the food web and also are important for interpretation of the condition and trends of higher trophic level predators, such as predatory shore birds.

The presence of sand crabs may indicate a beach with sufficient nutrient input, and the size of beach populations can be closely related to the richness of inshore waters. Sand crab populations are generally robust, though they fluctuate annually depending on oceanic and climatic conditions. Both Pismo and bean clam populations show high spatial and temporal variation. Long time-series data will be most useful in assessing potential MPA effects on this key attribute.

PRODUCTIVITY: BEACH WRACK

Indicator/Focal Species:

- Wrack composition and abundance

Beach wrack is composed of kelp, plant and animal remains that are deposited in the intertidal zone and thus serves as an important link between nearshore and intertidal ecosystems. This wrack provides microhabitats and food for macroinvertebrates that are themselves important food sources for foraging shorebirds and nearshore fishes and thus is an important indicator of productivity in soft-bottom intertidal ecosystems. Monitoring results will be interpreted considering oceanographic conditions, which can have strong impacts on macroalgal abundance in nearshore environments, as well as human activities, such as the occurrence of beach grooming.

PRODUCTIVITY: SURF ZONE FISH ASSEMBLAGE

Indicator/Focal Species:

- Surfperch abundance and size structure(Embiotocidae, multiple species)
- Croaker abundance & size structure (Sciaenidae, multiple species)
- Grunion (*Leuresthes tenuis*), number and strength (i.e. duration, # of spawners) of spawning runs

Nearshore shallow-water habitats are home to a range of fish species, including juveniles that seek refuge from predators in the shallow water as well as resident species that forage in the surf zone on fish and invertebrate prey. Surfperch and croaker play a major link in trophic transfer in the near-shore: their diets consist of isopods, amphipods, copepods, molluscs and polychaete worms. They, in turn, are prey for larger fish such as kelp bass, California halibut, sturgeon, rockfishes and salmon and are also eaten by harbor seals and birds. Both fishery-dependent and fishery-independent data suggest that populations of surf perches may be declining in California. Grunion are found from central California to Baja California, although they are most common in the South Coast region. These fish spawn on beaches and are prey for fishes, invertebrates and birds, and are targeted by recreational fishers. Interpretation of trends in abundance and size structure will consider available fisheries information to assess potential MPA-specific effects.

TROPHIC STRUCTURE: PREDATORY BIRDS

Indicator/Focal Species

- Piscivorous bird richness & abundance
- Shorebird species richness & abundance

Coastal bays, estuaries and beaches in the South Coast region are an important part of the Pacific Flyway and host thousands of migrating shorebirds. In addition, beaches and estuaries in the region are important foraging and nesting areas for resident bird populations. Individual populations are frequently sensitive to changing prey abundance as well as broader habitat modification (for example, loss of foraging habitat or decreased water quality). Broad metrics that capture the total abundance and diversity of these bird populations are thus indicative of the overall condition of the habitat and the supporting food web structure. Population and diversity trends will be interpreted in the context of information on climatic and oceanographic drivers as well as other contextual information.

OPTIONAL ADD-ONS FOR ECOSYSTEM FEATURE ASSESSMENT

PRODUCTIVITY

Indicator/Focal Species

- Wrack invertebrate richness and biomass

Invertebrates that live in and feed on beach wrack are an important food source for shorebirds and surfzone fishes. Monitoring the species richness and biomass of wrack invertebrates can provide additional information about food availability in soft-bottom intertidal ecosystems. This may be useful in the South Coast region where many beaches are groomed seasonally and where the recovery time of wrack-dependent invertebrates may be relatively slow . Interpretation of this metric will consider they types and intensities of beach grooming and other activities, such as berm building and nourishment.

DIVERSITY

Focal species/Indicators:

- Species richness (fish & invertebrates)
- Species diversity (functional groups of fish & invertebrates)

As in many of the other Ecosystem Features, monitoring species diversity may provide useful insight into ecosystem stability (through monitoring fluctuations in diversity) but this information is challenging to collect, and challenging to interpret in terms of MPA effects on ecosystem condition. Thus, diversity is currently included as an optional attribute.

SOFT-BOTTOM SUBTIDAL ECOSYTEMS (0-100M)

Soft-bottom ecosystems can be highly dynamic and experience significant changes in response to wave action and ocean currents. Significant aspects of the ecological structure and functioning of these ecosystems remain unknown. However, these habitats frequently support a relatively simple community structure dominated by invertebrates and fishes living both within and closely associated with the substrate. The key attributes below encompass these dominant macrofaunal groups within these habitats.

ECOSYSTEM FEATURE ASSESSMENT

BIOGENIC HABITAT

Indicator/Focal Species

- Eelgrass (*Zostera* spp.) bed extent
- Brittle star (Ophiuroidea, multiple species) bed extent

While eelgrass beds are typically found in bays and estuaries, in southern California they also occur on the outer coast around the northern Channel Islands and along the mainland coast. Eelgrass beds are an important source of primary production in these ecosystems, provide essential habitat for fishes and invertebrates and can act to stabilize the substrate.

An important epifaunal member of shallow west coast exposed sand habitats are brittle stars, which can occur in immense numbers and stabilize the substrate and provide structure for a diverse community of organisms. Brittle stars are primarily scavengers, and serve as prey for multiple predators.

TROPHIC STRUCTURE: BENTHIC INFAUNA

Indicator/Focal Species

- Functional diversity of benthic infauna (feeding guilds)

The infaunal species assemblage (species living within the substrate) in soft-bottom subtidal habitats include multiple species with diverse ecological roles. Very little is known about many of these species within the region, including the spatial scale and mechanisms of population regulation. In the context of MPA monitoring, where MPAs are designed to protect habitats and ecosystems, the most informative species may be those likely to respond to reductions in physical habitat disturbance. Trends in functional diversity may indicate changing ecosystem condition and may also serve a sentinel function to detect emerging stresses or threats associated with changing sediment quality or disturbance.

TROPHIC STRUCTURE: MOBILE INVERTEBRATES

Indicator/Focal Species

- Density & size structure of focal species/groups

- Rock crab (*Cancer* spp.)
- Sea star (*Astropecten* spp.)
- Ridgeback prawn (*Sicyonia ingentis*)
- Sea cucumber (*Parastichopus californicus*)

Many of the most abundant macro-invertebrates in soft-bottom subtidal habitats are important predators and detritivores within the food web. Collectively, the recommended focal species encompass a range of functional roles and include species that have experienced differing prior levels of take, as well as unfished species. Increases in the density of each species may be predicted with MPA implementation, however lack of existing knowledge of the effectiveness of spatial closures for mobile species renders prediction of the timing and magnitude of population responses uncertain. Regardless, monitoring population trends may provide insight into the role of the regional MPA network in increasing species abundances.

TROPHIC STRUCTURE: PREDATORY FISHES

Indicator/Focal Species

- Density & size structure of focal species/groups
  - California halibut (*Paralichthys californicus*)
  - Bat ray (*Myliobatis californica*)
  - Angel shark (*Squatina californica*)
  - Barred sand bass (*Paralabrax nebulifer*)
  - Surfperch abundance (Embiotocidae, multiple species)

In soft-bottom habitats, predatory fish may play important roles in structuring community composition. These focal species feed on a range of prey species, and thus can indicate the presence of multiple functioning trophic levels. Many of these predators are both highly mobile and subject to fishing pressure. Trends in abundance and sizes will be interpreted in the context of additional information, including the spatial distribution of fishing effort.

OPTIONAL ADD-ONS FOR ECOSYSTEM FEATURE ASSESSMENT

TROPHIC STRUCTURE: PREDATORY FISHES

Indicator/Focal Species

- Density & size structure of focal species/groups
  - Shovelnose guitarfish (*Rhinobatos productus*)
  - Leopard shark (*Triakis semifasciata*)
  - Sanddab (*Citharichthys* spp.)

This optional add-on can provide additional information about the condition and trends of predatory fishes in soft-bottom subtidal ecosystems. These focal species feed on a range of prey species, and thus can indicate the presence of multiple functioning trophic levels. Trends in abundance and sizes will be interpreted in the context of additional information, including the spatial distribution of fishing effort.

SPECIES DIVERSITY

Indicator/Focal Species:

- Species richness (invertebrates & fishes)
- Species diversity (functional groups of invertebrates & fishes)

There are few existing measures of diversity in soft bottom ecosystems and thus little existing knowledge on which to base interpretation of changing diversity metrics. Monitoring species richness and diversity, when feasibly implemented, can provide an additional source of information to increase our understanding of the factors maintaining a resilient soft-bottom ecosystem.

DEEP ECOSYSTEMS, INCLUDING CANYONS (>100M)

The collective set of attributes selected to track the condition of Deep Ecosystems are conceptually similar to those identified for the Mid-depth Rock Ecosystem Feature. A fundamental aspect of the ecosystem is the habitat provisioning role played by many species. As in mid-depth rock ecosystems, in deep ecosystems the dominant component of biogenic habitat is sessile invertebrates. The remaining key attributes identify core components of the community composition and trophic structure of deep ecosystems, such as predatory fishes and detritivores. Again, integrated analyses incorporating multiple attributes will provide greater insight into the mechanisms underlying observed species trends.

ECOSYSTEM FEATURE ASSESSMENT

BIOGENIC HABITAT: SESSILE INVERTEBRATES

Indicator/Focal Species

- Structure-forming invertebrate cover and height

Sessile invertebrates encompass a wide range of species with dramatically different body types and ecologies. Common to many of these species is the role played in providing habitat. Although biogenic habitat is a key attribute of the ecosystem, potential changes in response to MPA designation may only occur through cascading interactions with other components of the food web or over longer time scales in response to changing oceanographic and climate conditions. However, this remains a key attribute to monitor in order to interpret changes seen in fish and invertebrate populations. Data collected as part of the South Coast MPA Baseline Program will be used to refine and improve this broad indicator.

TROPHIC STRUCTURE: PREDATORY FISHES

Indicator/Focal Species

- Density & size structure of focal species:
  - Cowcod (*Sebastes levis*)
  - Bocaccio (*Sebastes paucispinis*)
  - Bank rockfish (*Sebastes rufus*)
  - Sablefish (*Anoplopoma fimbria*)

These fishes are important predators of other fishes within deep ecosystems and play important roles as regulators of community structure. The species included here as focal species encompass a range of life history characteristics and are subject to differing levels of fishing take. In the absence of fishing following MPA implementation, the size and abundance of focal species is predicted to increase. In all cases, interpretation of trends in predatory fish density and size structure will consider information on the spatial distribution and intensity of fishing effort and any associated changes in fishery regulations.

TROPHIC STRUCTURE: DETRITIOVERS

Indicator/Focal Species:

- Abundance of focal species/groups
  - Sea urchin (Echinoidea, multiple species)
  - Hagfish (*Eptatretus stoudii*)
- Spot prawns (*Pandalus platyceros*) abundance, size structure & sex ratio

As in mid-depth rock ecosystems, in deep ecosystems, detritivores play an important role in structuring food webs and indicate the capture of nutrients and productivity from sources both internal and external to the system. The focal species and groups encompass those that are fished and unfished. Hagfish and spot prawns are both targets of commercial fisheries. Interpretation of trends in abundance will consider information on the spatial distribution and intensity of fishing effort.

COMMUNITY STRUCTURE: DWARF ROCKFISH

Indicator/Focal Species

- Total dwarf rockfish abundance (multiple species)

In rockfish communities, fishing disproportionally affects larger, slow growing and late maturing species. By comparison, the so-called dwarf rockfish (generally comprised of halfbanded (*S.semicinctus*), pygmy (*S. wilsoni*), squarespot (*S. hopkinsi*), stripetail (*S. saxicola*), and swordspine (*S.ensifer*)) are relatively unfished. These dwarf rockfish are an important prey source for the larger rockfish species and may also compete with juveniles of the larger, competitively dominant species for habitat and prey resources. Historically, competition and predation are likely to have constrained population densities of the dwarf species, except in sub-optimal habitats. Overfishing of the larger species has substantially reduced their population densities and consequently reduced the predation and competition pressures on dwarf rockfish, which now dominate the rockfish community in some locations. Trends in the relative abundance of dwarf rockfish at sites inside and outside of MPAs are indicative of shifting community structure in response to protection. This attribute will provide useful insight into the effects of MPAs that extend beyond single species responses.

OPTIONAL ADD-ONS FOR ECOSYSTEM FEATURE ASSESSMENT

DIVERSITY

Indicator/Focal Species

- Species richness (invertebrates & fishes)
- Species diversity (functional groups of invertebrates & fishes)

As in other Ecosystem Features, direct measurements of species richness and diversity in deep ecosystems can provide further insights into the ecological mechanisms underlying ecosystem change following MPA implementation. However, there are many challenges in collecting and correctly interpreting diversity data. By definition, measurement of diversity is relatively resource-intensive as all, or nearly all, species must be included. Some survey efforts may collect a subset of species information that can provide some insight into diversity changes. Interpretation of diversity measures must proceed with caution. Both increases and decreases in diversity can signify improved or declining ecosystem condition. For example, increases in diversity may result from natural or anthropogenic disturbance effects, or may be accounted for entirely by invasive species.

NEARSHORE PELAGIC ECOSYSTEMS

As noted in Chapter 3, the Nearshore Pelagic Ecosystem Feature is defined for the purposes of MPA monitoring as the water column habitat greater than 30m depth within state waters. The selected key attributes identify key components of the trophic structure within pelagic environments, focusing particularly on upper level predators that may be expected to benefit from MPA implementation, specifically piscivorous fish and seabirds. These key attributes also offer opportunities to gain insight into benthic – pelagic links, which may be important in interpreting and understanding the condition of, and change in, both benthic and pelagic habitats.

TROPHIC STRUCTURE: PREDATORY FISHES

Indicator/Focal Species

- Density & size structure of focal species
  - Widow rockfish (*Sebastes entomelas*)
  - Shortbelly rockfish (*Sebastes jordani*)
  - Pacific barracuda (*Sphyraena argentea*)
  - Pacific mackerel (*Scomber japonicas*)

Increased abundance of high trophic level predators is indicative of the presence and functioning of multiple lower trophic levels. The focal species encompass differing life history characteristics and prior levels of take. Density or population responses within the semi-pelagic rockfish included here may also be dependent on ecological changes within reef and deep soft-bottom habitats. Integrated analyses using long time-series data from pelagic and benthic habitats will be used to assess potential MPA effects on this key attribute.

TROPHIC STRUCTURE: PREDATORY BIRDS

Indicator/Focal Species

- Abundance (colony size) & fledgling rate of focal species
  - Brown Pelican (*Pelecanus occidentalis*)
  - Sooty shearwater (*Puffinus griseus*)
  - Cassin's auklet (*Ptychoramphus aleuticus*)

A diverse group of seabird species forage in nearshore pelagic waters and many seabird populations fluctuate significantly in response to broad oceanographic and climatic changes. Long-term changes in population sizes thus integrate changing marine ecosystem condition together with broader physical environmental changes. The focal species encompass a range

of foraging, nesting and other life history variables and interpretation of trends in abundance and fledging rates will consider information on broader system drivers.

OPTIONAL ADD-ONS FOR ECOSYSTEM FEATURE ASSESSMENT

PRODUCTIVITY: ICHTYOPLANKTON

Indicator/Focal Species:

- Total ichthyoplankton abundance
- Total abundance of rockfish (*Sebastes* spp.) larvae
- Ratio of fished species to unfished species

Ichthyoplankton (the eggs and larvae of fish) can be an accurate indicator of the transient spawning population size of adults. On small spatial scales, it is unclear whether ichthyoplankton abundance is informative about ecosystem condition or the ecosystem effects of MPA implementation because it is challenging to disentangle the effects of larval transport from local production. However, on larger scales, trends in species abundances as recorded in ichthyoplankton samples can indicate the broader effects of climate and oceanographic effects on fish distribution and abundance. If implemented, this attribute will contribute information towards a region-wide assessment of Ecosystem Feature condition.

TROPHIC STRUCTURE

Indicator/Focal Species:

- Total jellyfish biomass

Increases in jellyfish biomass may be associated with ecological changes in response to human activities such as fishing, climate change and eutrophication. Elucidating the mechanisms that drive the changes in jellyfish biomass, and related shifts in community structure in marine systems is an area of active and on-going research. If monitoring of this attribute is implemented, results will be interpreted in consideration of fishing activity as well as oceanographic conditions.

TROPHIC STRUCTURE: FORAGE BASE

Indicator/Focal Species:

- Forage fish biomass (sardines, anchovies, other schooling bait fish)
- Market squid (*Loligo opalescens*) biomass

The presence of an abundant forage base provides a critical link in nearshore pelagic food webs, supporting populations of predators, such as fishes, birds and mammals. Forage fish include species such as sardine, anchovies and other school bait fish. Fluctuations in population sizes of these species may occur in response to changes in productivity associated with changing oceanographic conditions. In addition to being an important component of the forage base in nearshore pelagic ecosystems, market squid is also the largest commercial fishery in the South Coast region in terms of average annual landings and ex-vessel revenue. Interpretation of trends in forage base will consider oceanographic conditions as well as information on fishing spatial distribution & intensity.

CONSUMPTIVE USES

INDICATORS

For each consumptive use or activity, the indicators follow a similar overarching structure. The indicator categories are also ranked and can be implemented as resources allow.

1. Number of people or vessels engaged in the activity
2. Level of activity
    a. Number of fishing trips per fishing location, vessel, port and region
    b. Landings of key species per trip, fishing location, vessel, port and region
    c. CPUE (catch per unit effort) of key species per trip, fishing location, vessel, port and region
3. Economic value or quality of activity
    a. Landings value of key species per trip, fishing location, vessel, port and region
    b. Ex-vessel value of key species (commercial fisheries)
    c. Net revenue (commercial fisheries) or expenditures (recreational fisheries)
4. Knowledge, Attitudes and Perceptions (KAP) of participants
    a. Motivation
    b. Satisfaction

MPA monitoring of consumptive uses is focused on detecting the changes in consumptive uses following MPA implementation. To achieve this, survey and other data collection programs will collect data at high spatial resolution, detailing the specific locations of fishing effort. This therefore extends data collection beyond most existing monitoring of consumptive uses, which generate data at lower spatial resolutions, making evaluation of MPA effects problematic. Long-term MPA monitoring of consumptive uses is also complicated by many other factors. These include changing fishing effort inside and outside MPAs, changes in fisheries regulations, climate and oceanographic shifts causing natural fluctuations in fish stocks, and the broader economic environment. In all cases accurate interpretation of the attributes and indicators will include integrated analyses that consider this broad range of contextual information. Further, long-term trends in consumptive uses depend, in part, on the trends and condition of the ecological ecosystem features. Data collection and analyses will be aligned to facilitate these interpretive links between the ecological and human uses Ecosystem Features.

CONSUMPTIVE USES TO BE MONITORED

For each consumptive use or activity, key species for MPA monitoring are noted. These are species which form an important component of the fishery, play important ecological roles, and are likely to benefit from MPAs. The indicators above can be applied to each consumptive use and associated fishery species.

COMMERCIAL FISHING

Key fishery species:

- Nearshore rockfish (*Sebastes* spp.)
- Spiny lobster (*Panulirus interruptus*)
- California halibut (*Paralichthys californicus*)
- Red sea urchin (*Strongylocentrotus franciscanus*)
- Market squid (*Loligo opalescens*)

- Crab (*Cancer* spp.)

Commercial fishing contributes significantly to coastal community economies in the South Coast region. Trends in the number of individuals or vessels engaged in commercial fishing activity and the number of fishing trips per vessel indicate the level of commercial fishing activity. These metrics may be applied at varying spatial scales including inside and outside of specific MPAs and at key ports. Landings of key species (measured by the total pounds of key species and including available size information) and CPUE illustrate the intensity of fishing efforts and also provide informative links to ecological indicators, such as fish biomass and density within MPAs. Where resources and capacity permit, data collection may also be extended to incorporate economic valuations including ex-vessel value, and ultimately net revenue. The latter is dependent upon many different factors and will primarily contribute to region-wide assessments of Ecosystem Feature condition.

RECREATIONAL FISHING – COMMERCIAL PASSENGER FISHING VESSELS (CPFVS)

Key fishery species:

- Nearshore rockfish (*Sebastes* spp.)
- Kelp bass (*Paralabrax clathratus*)
- Barred sand bass (*Paralabrax nebulifer*)
- Pacific barracuda (*Sphyraena argentea*)
- California scorpionfish (*Scorpaena guttata*)

CPFVs, also called party boats, are an important component of consumptive use within the South Coast region. The number of active CPFVs, along with the number of trips these boats make, provides a metric for evaluating the level of supply for the industry. Comparably, the number of clients per vessel and total number of clients is an indicator of consumer demand. Trends for this indicator will be closely linked to public attitudes and perception about the MPAs. Landings of key species by CPFVs, measured by the total pounds of key species and including available size information, illustrate the intensity of CPFV efforts and also provide informative links to ecological indicators, such as fish biomass and density within MPAs. Landings will be highly dependent on yearly ecological conditions for the area and other fishery management regulations and this information will be used to interpret results and assess MPA-specific effects. In all cases, highly spatially resolved data, including specific fishing locations, will be collected to reliably detect MPA-specific effects.

RECREATIONAL FISHING – PRIVATE VESSELS, INCLUDING KAYAKS

Key fishery species:

- Nearshore rockfishes (*Sebastes* spp.)
- Kelp bass (*Paralabrax clathratus*)
- Barred sand bass (*Paralabrax nebulifer*)
- Spiny lobster (*Panulirus interruptus*)
- California halibut (*Paralichthys californicus*)

Recreational fishing employing private vessels, including kayaks, is popular in the South Coast region. Some of the important fisheries targeted by fishing from private vessels include rockfishes, basses, spiny lobster and California halibut. Information collected about the level of activity and spatial distribution of fishing effort can be used to document shifts in fishing activity in response to MPA implementation. Additionally, information about landings of key species can provide informative links to ecological changes in fish populations.

RECREATIONAL FISHING – SHORE-BASED

Key fishery species:

- Surfperches (Embiotocidae, multiple species)
- Croakers (Scianidae, multiple species)
- Silversides (Atherinopsidae, multiple species)

Shore-based angling includes fishing access from beaches, rocky shores and man-made structures, such as piers and jetties and is one of the most popular forms of recreational fishing in the South Coast region. As with the other Consumptive Uses to be monitored, the indicators for shore-based recreational fishing will provide important information about changes in fishing activity in response to MPA implementation.

RECREATIONAL FISHING – DIVING, SCUBA AND FREE-DIVING

Key fishery species:

- White sea bass (*Atractoscion nobilis*)
- Yellowtail (*Seriola lalandi*)
- Sheephead (*Semicossyphus pulcher*)
- Kelp bass (*Paralabrax clathratus*)
- Spiny lobster (*Panulirus interruptus*)

Consumptive diving is a common form of recreational fishing in the South Coast region. Access to dive sites may be from CPFVs, private vessel or shore-based and includes diving using SCUBA as well as free-diving. Information about trends in consumptive diving will be used with information on other consumptive activities to provide insight in to changes in response to MPA implementation as well as information on linkages to ecological changes in fished populations.

OPTIONAL ADD-ONS FOR ECOSYSTEM FEATURE ASSESSMENT

RECREATIONAL FISHING – CLAMMING

Key fishery species:

- Pacific gaper clams (*Tresus nuttalli*)
- Pismo clams (*Tivela stultorum*)
- Washington clam (*Saxidomus nuttalli*)
- Common littleneck clam (*Protothaca staminea*)

Within the South Coast region, clam harvesting targets common littleneck clams, gaper clams, Pismo clams and Washington clams. Although data are limited, significant annual harvests have previously been recorded. If implemented, monitoring of recreational clam harvest will be aligned with ecological monitoring in estuaries and beaches to assess the specific effects of MPA implementation.

SCIENTIFIC COLLECTING

The redesign of California's MPA network has lead to increased interest and opportunity for research. Scientific collecting may occur for a variety of reasons both inside and outside MPAs, and include education, research, MPA monitoring, and restoration activities. Scientific collecting is regulated and tracked by DFG through a permitting process. Tracking scientific collecting will provide additional contextual information on MPAs and will be useful in gauging the level of interest and opportunity provided by MPAs for each of the above activities. Data collection for this consumptive use will be most efficiently implemented with DFG's scientific collection permitting and reporting process.

NON-CONSUMPTIVE USES

INDICATORS

For each non-consumptive use or activity, indicators follow a similar overarching structure. This structure also indicates increasing implementation intensity:

1. Level of activity
    a. Number and location of trips (spatial use and intensity)
2. Knowledge, Attitudes and Perceptions (KAP) of participants
    a. Motivation – including MPAs
    b. Satisfaction – e.g., travel distance, travel and activity costs, likelihood of return

NON-CONSUMPTIVE USES TO BE MONITORED

SCUBA DIVING

Scuba diving is a popular activity within the study region, especially around the Channel Islands, and recreational scuba divers provide valuable economic contributions to coastal communities. Here the focus is on non-consumptive scuba diving. The recommended indicator structure provides a means to track the spatial and temporal patterns in recreational diving opportunity following MPA implementation. Evaluating the number of divers in an MPA and the number of trips that an individual diver engages in within in an MPA provides a means of monitoring the level of diving activity in an MPA. This can be combined with assessment of diver motivation and level of satisfaction to determine the role of the MPA in diving site choice. Level of satisfaction may be indicated by metrics such as travel distance or costs. Interpretation of these data will incorporate consideration of weather and seasonality effects that could affect diving visitation rates, as well as historical trends in diving site popularity.

RECREATIONAL BEACH USE

Coastal recreation in California generates significant economic benefits for coastal communities, and a broad spectrum of residents visit the coast and beaches each year. Monitoring recreational beach use is an important element of patterns of human use in the coastal environment. However, trends in the spatial distribution or intensity of use are likely to vary in response to a complex suite of economic and environmental variables. Distinguishing potential MPA effects is challenging, particularly at broader regional scales, but will be approached through collection and analysis of time-series data.

TIDEPOOLING

Tracking numbers of visitors to rocky shores is important for tracking recreational use within and outside MPAs and also provides important insight into MPA management issues, such as those concerned with potential ecological damage caused by trampling within these habitats or those focused on educational and outreach programs to build MPA awareness.

WILDLIFE VIEWING – BOATING, INCLUDING KAYAKING

Boating and kayaking is a popular non-consumptive recreational activity and provides important economic input throughout the South Coast region. Monitoring the level of this activity is important for tracking trends in recreational use, and the data can also provide important insight into MPA management questions such as disturbance effects of visitors on nesting bird colonies.

WILDLIFE VIEWING – SHORE-BASED

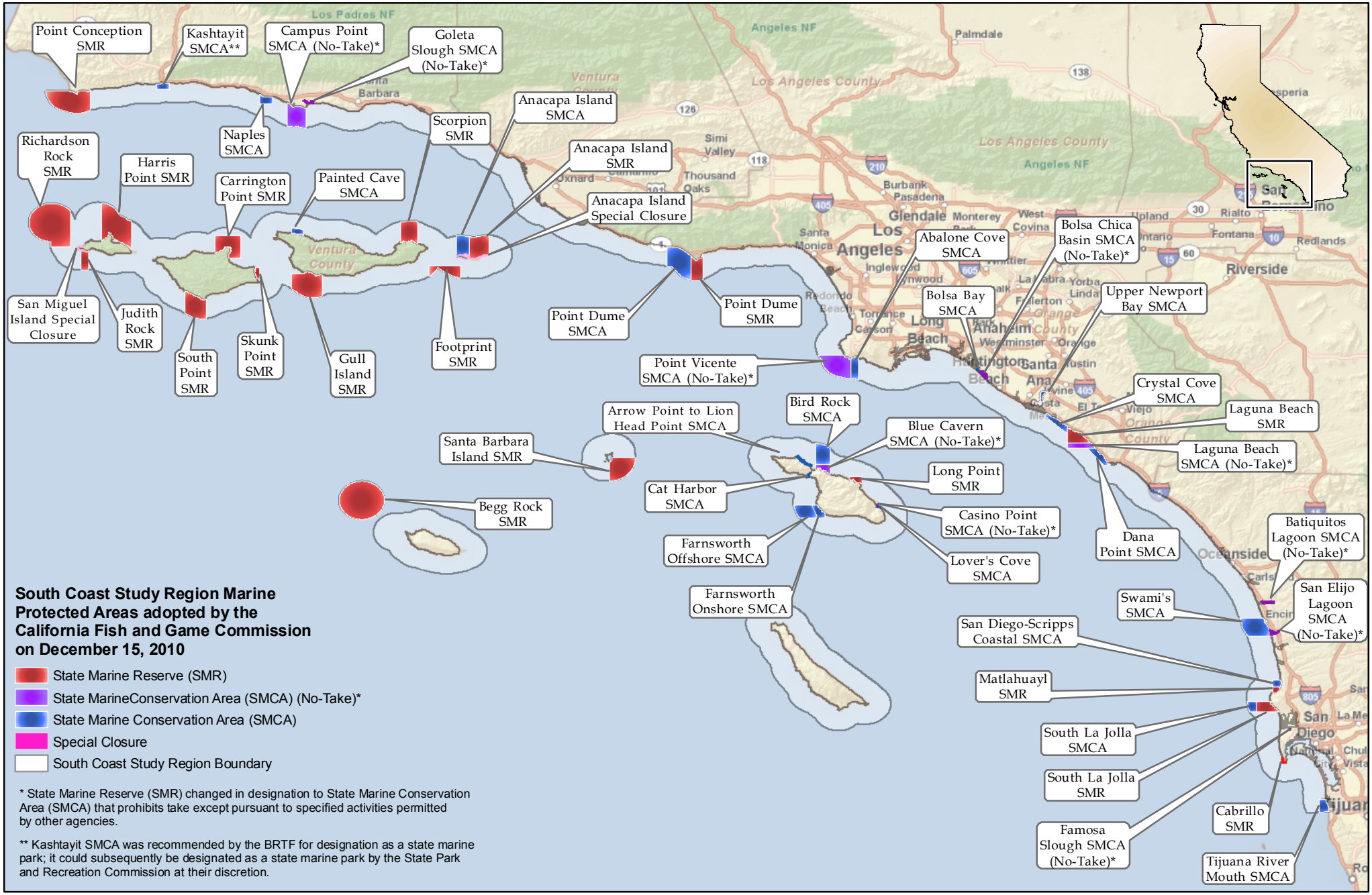
Shore-based wildlife viewing is distinguished here from tidepooling and encompasses bird and mammal viewing (e.g., at harbor seal haulouts) along rocky-shores, beaches and estuaries. Long-term trends in this vital sign provide insight into levels of recreational use as well as ecosystem condition. Monitoring efficiencies can be obtained by linking data collection to MPA design and management evaluations pertaining to disturbance effects, where these are prioritized for implementation.

EDUCATIONAL USE

MPAs offer both education and study opportunities, through a potentially broad range of mechanisms. Grade school and high school visits to intertidal environments within MPAs offer opportunities to learn about marine ecosystems as well as potential resource management options. Students can also become involved in monitoring themselves through carefully designed community monitoring projects. Similarly, MPAs offer opportunities to increase our scientific understanding of the marine environment and of the ways in which MPAs work to enact changes in marine ecosystems.

APPENDIX C-1. SOUTH COAST REGION MAP INCLUDING THE ARRAY OF MPAS ADOPTED BY THE CALIFORNIA FISH AND GAME COMMISSION

This plan has been designed for the monitoring of MPAs implemented in the South Coast study region, which includes all state waters along the California coastline from Point Conception to the California/Mexico border, including the Channel Islands. The regional MPA network adopted for the region includes 36 new MPAs, and 12 pre-existing MPAs and 2 special closures at the Channel Islands that were incorporated unchanged into the regional network.



South Coast Study Region Marine Protected Areas adopted by the California Fish and Game Commission on December 15, 2010

- State Marine Reserve (SMR)
- State MarineConservation Area (SMCA) (No-Take)*
- State Marine Conservation Area (SMCA)
- Special Closure
- South Coast Study Region Boundary

* State Marine Reserve (SMR) changed in designation to State Marine Conservation Area (SMCA) that prohibits take except pursuant to specified activities permitted by other agencies.

** Kashtayit SMCA was recommended by the BRTF for designation as a state marine park; it could subsequently be designated as a state marine park by the State Park and Recreation Commission at their discretion.

Projection Information:
Geographic Coordinate System
North American Datum 1983

N

0 12.5 25 50 Miles

1:1,500,000

December 15, 2010
For complete MPA information including [illegible] regulations, please go to
http://www.dfg.ca.gov/mlpa

APPENDIX C-2. SOUTH COAST MPA BASELINE PROGRAM REQUEST FOR PROPOSALS (RFP)

The approaches described in this plan are designed to guide, and then build on, the foundation of knowledge to be generated through the South Coast MPA Baseline Program. The Baseline Program has two purposes:

1. **Baseline Characterization** – A summary description, assessment and understanding of ecological and socioeconomic conditions in the South Coast region, inside and outside MPAs, at or near the time of MPA implementation.

2. **Assessment of Initial Ecological and Socioeconomic Changes** - Measurement of initial ecological changes and the short-run net benefits or costs to consumptive and non-consumptive user groups following MPA implementation.

The South Coast MPA Baseline Program is being implemented through a Request for Proposals (RFP) process in collaboration with California Sea Grant, the Department of Fish and Game and the Ocean Protection Council. The full RFP text is provided in this appendix.

Request for Proposals

South Coast Marine Protected Areas (MPA) Baseline Program

I. Funding Opportunity Description

The South Coast Marine Protected Areas (MPA) Baseline Program (Baseline Program) is a collaborative effort among the State Coastal Conservancy, Ocean Protection Council (OPC), Department of Fish and Game (DFG), MPA Monitoring Enterprise (Monitoring Enterprise), a program of the Ocean Science Trust, and California Sea Grant. The OPC has authorized $4,000,000 to support the Baseline Program. Proposals are requested for projects that contribute to meeting the purposes of the Baseline Program, which are:

1. To provide a summary description, assessment and understanding of ecological and socioeconomic conditions in the South Coast region, inside and outside MPAs designated under the Marine Life Protection Act (MLPA), at or near the time of MPA implementation; and
2. To measure initial ecological changes and the short-run net benefits or costs to consumptive and non-consumptive user groups following MPA implementation.

Project proposals are due no later than 5:00 pm PDT April 7, 2011. Awards are expected to be made in early July 2011. Proposals will be accepted for projects of any duration, but to be completed no later than March 31, 2014. Selected projects may begin any time after award contracts have been fully executed, but must commence within one year of the date of adoption of new MPA regulations by the California Fish and Game Commission (FGC) and preferably near the time of implementation of the MPA regulations. MPAs in the South Coast region are expected to take effect in mid-2011.

Proposals will be evaluated using a two-step independent peer review process, and considering multiple criteria including alignment with program purposes, technical merit, partnerships, costs and funding leveraging. All proposals will be sent out for independent, external, mail-in reviews by subject-matter experts selected by California Sea Grant in collaboration with staff of DFG, OPC, and the Monitoring Enterprise. Following the mail-in review process, a Baseline Panel, composed of additional subject-matter experts, will be convened to review all proposals and recommend the specific proposals or proposal elements to fund (and the level of funding for each) based on the mail-in reviews, their own reviews and the Panel deliberations. Final decisions will be made jointly by staff of DFG, OPC and the Monitoring Enterprise. Additional information and proposal requirements are provided below.

In association with the release of this Request for Proposals (RFP), the Monitoring Enterprise will host an informational webinar to provide additional information and answer questions. The webinar will be held on March 1, 2011 and further details will be available soon on the Sea Grant website at http://www.csgc.ucsd.edu/. In addition, a bidders conference will be held on March 8, 2011 at the Radisson Hotel Los Angeles Westside to provide more information to potential applicants, and to facilitate partnerships and information exchange among applicants and collaborators, including those involved in ongoing monitoring in the region. RSVPs for the bidders conference should be made to tlarson@ucsd.edu and are requested no later than 5:00pm on March 2, 2011. Sea Grant will also host an on-line bulletin board to facilitate information exchange among potential proposers, collaborators and resource-holders in the region. Questions relating to proposal requirements should be directed to Sea Grant, Monitoring Enterprise or DFG (see page 15 for guidance and contact information). The bulletin board, answers to frequently asked questions, additional details regarding the bidders conference, and any updates relating to this RFP will be available on the California Sea Grant website. Persons intending to submit proposals in response to this RFP should consult this website frequently for updates and additional information.

A. Background

The 1999 Marine Life Protection Act (Chapter 10.5 of the California Fish and Game Code, §2850-2863) directs the state to reevaluate and redesign California's system of MPAs to meet the following goals:

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

The MLPA further requires monitoring of MPAs, specifically "monitoring, research, and evaluation at selected sites to facilitate adaptive management of MPAs and ensure that the [MPA] system meets the goals stated in this chapter."[1] The MPA Monitoring Enterprise has been established under the auspices of the California Ocean Science Trust to lead development of MPA monitoring that will meet MLPA requirements efficiently and cost-effectively. The Monitoring Enterprise works closely with DFG, the agency with statutory authority for implementing the MLPA. The 'Marine Life Protection Act Master Plan for Marine Protected Areas' directs that MPA monitoring programs be developed sequentially as planning is completed for each of five regions.[2] MPAs in the South Coast region were adopted by the FGC on December 15, 2010 and are anticipated to take effect in mid-2011. Accordingly, the Monitoring Enterprise, in collaboration with DFG and in consultation with stakeholders, scientists and others, is leading the design and implementation of MPA monitoring in the South Coast region.

The Monitoring Enterprise has developed a scientific framework for MPA monitoring that is designed to meet MLPA requirements efficiently and cost-effectively. The framework will guide MPA monitoring in each MLPA region, allowing tailoring of monitoring to reflect the unique characteristics of each region while ensuring sufficient consistency to make comparisons among regions and assess the performance of the MPAs statewide. The framework has been adopted by the FGC. The MPA monitoring framework, as applied to the South Coast region, has guided the design of this South Coast MPA Baseline Program, and will form the core of the South Coast MPA Monitoring Plan, which provides guidance for long-term MPA monitoring in the region.

B. Program Purposes

The South Coast MPA Baseline Program has two purposes:

1. **Baseline Characterization** - A summary description, assessment and understanding of ecological and socioeconomic conditions in the South Coast region, inside and outside MPAs established under the MLPA, at or near the time of their implementation. Baseline characterization provides a frame of reference to support

[1] California Marine Life Protection Act, Fish and Game Code section 2853(c)(3). See also sections 2852(a), and 2856(a)(2)(H).
[2] California Marine Life Protection Act Master Plan for Marine Protected Areas. California Department of Fish and Game. Revised Draft. January 2008, http://www.dfg.ca.gov/mlpa/masterplan.asp.

subsequent assessment of MPA network performance against MLPA goals and facilitate future adaptive management.

2. **Assessment of Initial Ecological and Socioeconomic Changes** - Measurement of initial ecological changes and the short-run net benefits or costs to consumptive and non-consumptive user groups following MPA implementation.

Priorities for data collection and/or analyses to achieve each program purpose are described below in Section D.

C. Program Scope

Alignment with the MPA Monitoring Framework

In order to provide a robust foundation for long-term MPA monitoring, proposed projects should align with the MPA monitoring framework as it applies to the South Coast region. The framework is anchored by the South Coast Ecosystem Features, chosen to collectively represent and encompass the region's ecosystems, including humans, for the purposes of MPA monitoring.

Ten Ecosystem Features have been identified for the South Coast region. These are:

- Rocky Intertidal Ecosystems
- Kelp & Shallow (0-30m depth) Rock Ecosystems
- Mid-depth (30-100m depth) Rock Ecosystems
- Estuarine & Wetland Ecosystems
- Soft-bottom Intertidal & Beach Ecosystems
- Soft-bottom Subtidal (0-100m depth) Ecosystems
- Deep (>100m) Ecosystems, including Canyons
- Nearshore Pelagic Ecosystems (the water column habitat within state waters deeper than 30m)
- Consumptive Uses
- Non-consumptive Uses

Proposed projects should identify one or more Ecosystem Features on which to focus data collection and/or analyses. The Baseline Program accords all Ecosystem Features equal priority. Note that this does not mean that funding will be distributed equally among Ecosystem Features as some are more resource-intensive for data collection, but rather that the Baseline Program seeks to provide the most comprehensive coverage possible across all Ecosystem Features.

A core long-term monitoring element includes assessing the condition and trends of each Ecosystem Feature. Two approaches or options for monitoring Ecosystem Features are being developed: Ecosystem Feature Checkups and Ecosystem Feature Assessments. Draft metrics to implement each option have been identified and are included in Appendix 1. It is not intended that Baseline Program be limited only to focusing on the draft metrics. Rather, the intent is that the Baseline Program will include these metrics and others, in order both to provide a comprehensive foundation for long-term monitoring and to help test and refine these metrics for use in long-term monitoring. Thus, for each Ecosystem Feature, data collection and/or analyses should incorporate but extend beyond the corresponding draft monitoring metrics listed in Appendix 1. Projects including initial testing of the draft long-term monitoring metrics are encouraged and should articulate how this testing will be accomplished.

Geographic Scope

The Baseline Program encompasses the South Coast region, which extends along the California coastline from Point Conception in Santa Barbara County to the California border with Mexico and includes all state waters within this region, including the Channel Islands.

A network of MPAs was established in the northern Channel Islands in 2003. Baseline monitoring of these MPAs was conducted between 2003 and 2008, and a five-year review performed in 2008.[3] These MPAs are included, unaltered, in the South Coast regional MPA network adopted by the FGC, and are therefore within the geographic scope of the Baseline Program. Proposals that include new data collection at the northern Channel Islands will be considered. However, given that significant baseline data were collected for northern Channel Islands MPAs following their implementation, proposals should clearly articulate the need for new data collection to meet the purposes of the Baseline Program and to incorporate the northern Channel Islands into an integrated regional picture of ecological and socioeconomic conditions. In addition, such proposals should also demonstrate that new data collection in the existing northern Channel Islands MPAs will be cost-efficient through resource leveraging, economies-of-scale and/or partnerships.

The MPA network for the South Coast region currently includes MPAs of two different types (state marine reserves and state marine conservation areas; see Supporting Information, South Coast Final Environmental Impact Report for definitions and more information). Some of these areas may later be converted into state marine parks. All of these are included within the Baseline Program.

During the planning process for the South Coast regional MPA network particular locations (e.g., Rocky Point and other waters around the Palos Verdes Peninsula) and individual MPA proposals were the subject of significant analysis and discussion. The Baseline Program considers all MPAs in the region to be important and does not prioritize specific locations or MPAs for data collection and/or analysis. Rather, for each Ecosystem Feature within the scope of the proposed project, applicants should clearly articulate how the MPAs selected for data collection and/or analysis best contribute towards meeting the Baseline Program purposes. Proposals should clearly articulate how data collection and/or analyses will result in MPA- or site-specific assessments and how results from individual MPAs will be integrated to provide a robust characterization of regional implementation conditions and/or assessment of initial socioeconomic changes.

Temporal Scope

Proposals will be accepted for projects of any duration, but to be completed no later than March 31, 2014. However, applicants should carefully consider the project duration necessary to achieve stated project goals and should articulate the need for, and benefits of, multi-year approaches, where proposed.

Analysis of Existing Data

Numerous on-going monitoring programs, as well as extensive historical data sets, exist in the South Coast region, including programs and data sets associated with water quality programs. Projects should incorporate analysis and interpretation of existing data. Proposals should highlight the way in which these programs and data will be incorporated into analyses to achieve one or both purposes of the Baseline Program.

[3] Report of the First 5 Years of Monitoring in the northern Channel Islands: 2003-2008. Available on-line at: http://www.dfg.ca.gov/marine/channel_islands/fiveyears.asp.

D. Program Priorities

Project Goals & Objectives

The Baseline Program seeks to implement the projects that will, collectively, best address the program purposes in the most cost-effective, efficient, and scientifically rigorous way. Proposed projects should include project goals that are explicitly linked to one or both of the Baseline Program purposes and will be evaluated on their individual and collective contribution towards these program purposes. Proposals addressing multiple purposes and/or Ecosystem Features are encouraged. Priorities to achieve the two purposes of the Baseline Program are described below.

1. **Priorities for Baseline Characterization**
   A proposal submitted to contribute to Baseline Characterization should be structured to address the following priorities for each South Coast Ecosystem Feature included in the scope of the proposed project:
   a. Description of the Ecosystem Feature(s) inside and outside MPAs
   Collection and/or analysis of data on the metrics in Appendix 1 together with additional metrics as needed to describe the Ecosystem Feature, including description of habitats, species assemblages, trophic structure, key ecosystem processes, consumptive and non-consumptive activities as appropriate for the selected Ecosystem Feature inside and outside MPAs, and across the South Coast region.
   b. Assessment and interpretation of the condition of the Ecosystem Feature(s) at the time of MPA implementation
   Analysis and interpretation of data and results using:
      i. Historical data (i.e., any data collected prior to MPA implementation) and/or data from other locations to illuminate trends prior to MPA implementation; and
      ii. Contextual information such as oceanographic data (e.g., the location and strength of upwelling events; the status of oceanographic cycles such as the El Niño Southern Oscillation and the Pacific Decadal Oscillation), water quality data, and economic data to understand the drivers and correlates of ecosystem condition.

2. **Priorities for Assessment of Initial Ecological and Socioeconomic Changes**
   A proposal submitted to contribute to assessment of initial ecological and socioeconomic changes in the 2-3 years following MPA implementation should address one or more of the following priorities:
   a. *Assessment of initial ecological changes*
   Description of changes (or lack of changes) observed inside and outside MPAs in selected habitats, species or other ecosystem components, emphasizing those that may be expected to be sensitive and rapid in responding to MPA implementation. Ecosystem components for data collection and/or analysis should be drawn from the draft metrics identified in Appendix 1. Proposals extending beyond these metrics will be considered but applicants should clearly articulate the rationale for selection of ecosystem components. Assessments should include interpretation of observed initial ecological changes incorporating historical data and contextual information (e.g., oceanographic or water quality information) to evaluate the extent to which the observed changes may be attributable to MPA implementation.
   b. Assessment of initial effects of MPA implementation on consumptive and non-consumptive user groups
   Identification and measurement of the short-run net benefits or costs of MPA implementation to consumptive and non-consumptive user groups likely to be most affected by the establishment of the MPAs, paying careful attention to controlling for potential confounding factors. User groups selected for assessment should be drawn from those listed in Appendix 1. A project need not consider all user groups but the proposed research should employ quantitative methods and address how the project outputs and data may be used in a broader analysis that considers the net benefits or costs across multiple user

groups. Assessments should also analyze and describe the degree to which any observed changes are attributable to MPA implementation.

Project Characteristics & Components

To address the priorities identified above and to provide a foundation for a subsequent synthesis of results across all projects and topic areas, all proposed projects should include the following elements:

1. *Inclusion of multiple MPAs and, where appropriate, reference or control sites outside MPAs to provide generalized regional results and conclusions in addition to MPA- or location-specific analyses and conclusions*
   For some Ecosystem Features and/or ecosystem components it may be feasible to collect and/or analyze data inside and outside all MPAs in the South Coast region. If this is not feasible, proposals should include rationale for selected MPAs (and reference or control sites) that contribute to a region-wide baseline characterization or assessment of initial changes.
2. *Interpretation of results through incorporation of historical trend data and contextual information*
3. *Details of how the project's data and analyses will be amenable to inclusion in long-term MPA monitoring*
   When applicable, standardized or established methods should be employed to provide a robust foundation for long-term monitoring. In all cases, applicants should describe how the proposed approach, methods and analytical tools facilitate implementation of long-term monitoring.
4. *Details of long-term monitoring recommendations that can be provided on the basis of the project findings*
   Recommendations to inform long-term monitoring planning and implementation, for example through:
   a. *Testing the draft metrics for long-term monitoring*
      Initial evaluation of the draft monitoring metrics developed to focus long-term monitoring (Appendix 1) and recommendations for refinements or alternatives to these metrics; this may include recommendations to prioritize among metrics (e.g., attributes, indicators, vital signs, specific user groups).
   b. *Providing recommendations for long-term monitoring methods and sampling design*
      Recommendations for efficient long-term monitoring methods, including spatial and temporal sampling designs that are amenable to synthesis and analysis over long time periods; this may include recommendations for appropriate test and reference, or control, sites for long-term ecological monitoring, and/or an efficient sampling design for long-term monitoring of consumptive or non-consumptive user groups. Recommendations will be most useful if they contribute to the development of standardized methods and protocols for long-term MPA monitoring.

Partnerships

To have the selected projects be as cost-effective as possible and contribute as much as possible to achieving overall Baseline Program purposes, partnerships are encouraged to leverage and take best advantage of existing resources (including physical resources such as boats and survey equipment) and on-going programs in the region (e.g., water quality monitoring programs). Proposals that include partnerships should describe the rationale for the partnership, the intended benefits of the partnership and, if appropriate, how existing data will be used.

Integrative Multi-project Proposals

Proposals to integrate analyses and results across two or more individual Baseline Program projects are also encouraged. Integrative multi-project proposals should link individual projects that focus on different disciplines, Ecosystem Features or ecosystem components, and/or different geographic areas of the South Coast region with the goal of providing a more comprehensive assessment of socioeconomic and ecological conditions in the region at the time of MPA implementation or

more robust exploration of initial changes following MPA implementation. Integrative multi-project proposals should clearly describe the activities to achieve the integration and the benefits of the additional integration project, including how results integrated across the specified individual projects will be more informative and a greater contribution to achieving Baseline Program purposes than the individual projects alone.

An integrative multi-project proposal should be submitted as an additional, separate, full proposal with clearly identified Project Leader(s). The unifying proposal should describe the benefits of integration and clearly identify the individual projects to be integrated.

E. Project Deliverables

Primary Investigators are responsible for the production and delivery of the following project products: 1) data and metadata; 2) annual progress report(s) for projects exceeding 16 months duration; and 3) final report.

Data and Metadata

Data and associated metadata must be delivered to DFG, OPC and the Monitoring Enterprise before or as part of the completion of the project. Final project payment will not be made until data and metadata have been received.

All projects should employ a standardized reporting protocol. Data deliverables may include still or video images, text reports, databases, spreadsheets, maps and GIS layers. We anticipate that projects may develop multiple data deliverables; each should be clearly identified in the proposal. Sufficient metadata should also be provided to fully describe the data, collection methods and data reporting structure. Ecological Metadata Language (EML) is adopted here as a minimum metadata reporting standard. Projects not employing this standard should include justification and description of how their alternative standard meets the minimum requirements.

Upon delivery to DFG, OPC and the Monitoring Enterprise and thereafter, all data and metadata will be widely available to the public and other researchers. Investigators, however, will retain the right to publish results before and after project completion. Project data may be used to support additional analyses, and may be included or summarized in subsequent reports and other materials, in print and/or electronically.

Where privacy issues or other sensitivities will or may arise, these must be noted explicitly in project proposals, and a remedy proposed to enable delivery of data with appropriate accommodations to account for the sensitivity. This may include, for example, delivering data only to DFG and under protection of a signed non-disclosure agreement, or developing a protocol to anonymize observations as needed to enable sharing collected data with researchers and government agencies.

Annual Progress Reports

For projects exceeding 16 months duration, progress reports are required at 12-month intervals following the contract start date. Annual progress reports should briefly describe progress towards specified project goals, and provide timelines (progress in meeting milestones) for work completed and remaining. They should also provide updated financial information including budgeted costs and actual expenditures and justifications for variances. Incurred or anticipated budget (positive or negative) variances in excess of 10% of the budgeted amount must be approved by the Sea Grant Office.

Final Reports

Each project is required to produce and deliver a final report to California Sea Grant. Final reports must include the following sections:

1. A narrative accounting of the project's progress towards Baseline Program purposes and project goals.
2. A financial report showing budgeted and actual costs and variances, with explanations of any positive or negative variances of greater than 10% of the budgeted amount.
3. For projects including baseline characterization components, a technical report, which should include appropriate descriptions of methods, data summaries, analyses and interpretation to describe, assess and understand implementation conditions. Reports should include explicit reference to the baseline characterization purposes and priorities and the supporting results, analyses and interpretation required to meet each program priority. Reports should also include MPA- or site-level characterizations and a regional assessment.
4. For projects including assessment of initial ecological or socioeconomic changes following MPA implementation, a technical report, which should include clear descriptions of methods, data summaries, analyses and interpretation to describe initial ecological changes and/or the short-run net benefits or costs to consumptive and non-consumptive users.
5. An Executive Summary, summarizing methods, key findings and conclusions in 1-2 pages of text and, if needed, an additional 1-2 pages of figures. The Executive Summary should be written to be appropriate for broad public release (e.g., posting on the Monitoring Enterprise website, provision to the FGC).

Final reports will be reviewed by California Sea Grant, DFG and the Monitoring Enterprise. The sections of final reports consisting of baseline characterization reports and/or reports of initial changes following MPA implementation will also be subject to scientific peer review. Final reports should be revised in accordance with reviewer comments before final submission and acceptance by California Sea Grant. Final project payments will be made following receipt and acceptance of all deliverables.

Following completion of all projects and receipt and acceptance of all final project reports, a synthesis of major findings will be prepared and a final public summary report will be produced. Project Leaders will be given the opportunity to review a draft of the summary report.

F. Supporting Information

South Coast MPA monitoring planning process (including information on workshops and other consultations to develop the monitoring metrics in Appendix 1)
http://www.monitoringenterprise.org

MLPA Master Plan
http://www.dfg.ca.gov/mlpa/masterplan.asp

South Coast Regional Profile
http://www.dfg.ca.gov/mlpa/regionalprofile_sc.asp

South Coast Final Environmental Impact Report (includes detailed descriptions, maps, objectives, and rationale for proposed MPAs)
http://www.dfg.ca.gov/mlpa/finalimpact_sc.asp

Additional background information for the South Coast MLPA planning and regulatory processes
http://www.dfg.ca.gov/mlpa/southcoast.asp

II. Award Information

Approximately $4,000,000 is available to support the South Coast MPA Baseline Program. Funding is available for projects of any duration but all projects must be completed no later than March 31, 2014. Funds are expected to be awarded in July 2011. Full payment of awards may be contingent on continued availability of state funding.

Partial Funding of Selected Projects

Proposals may be selected to receive partial funding, i.e., less than was originally requested in the proposal. This includes both individual projects, and integrative multi-project proposals. Additionally, Project Leaders may be requested to consider changing aspects of their proposals to better contribute to achieving the Baseline Program purposes.

III. Eligibility Information

A. Eligible Applicants

Individuals, institutions of higher education, nonprofit organizations, commercial organizations, and federal, state, local, and tribal governments are all eligible to submit proposals.

B. Cost-sharing or Match Requirement

Projects must include at least a 25% match (cash and/or in-kind) from applicants. In-kind contributions must be documented and auditable. Larger matches or additional cost-sharing arrangements are encouraged and will be taken into consideration when evaluating proposals (see Evaluation Criteria for more information).

IV. Application and Submission Information

A. Application Package

The entire application package, including the documents referenced below, is available online through California Sea Grant's website: http://www.csgc.ucsd.edu/

If you do not have internet access, please contact Carol Bailey-Sumber at 858-534-7855.

B. Content and Form of Application Submission

Preliminary proposals are *not required*. Only full proposals will be considered. Proposals should include all required elements; incomplete proposals may not be accepted.

Please submit an electronic copy of the full proposal (see Submission Information and Dates). The number of pages must be in accordance with the page limitation specified under "Required Elements." All files in the full proposals when printed must measure 8.5" x 11" with an 11 point, san serif font (Arial or Helvetica).

C. Required Elements

Cover Sheet

A cover sheet template is located on the California Sea Grant website. Please provide all requested information and obtain the required signatures. If you are applying from an academic institution, send your original proposal to your campus research office for local campus approval. If your proposal encompasses more than one campus, please obtain approval from each campus and all required signatures. Make sure to send your original, signed coversheet with your full proposal.

Percentage of time should be shown for the Project Leader and the Co-Project Leader. This should agree with the amount shown on the Sea Grant Project Summary Form and should be converted to "Months of Effort." (Example: 10 percent time=1.2 months of effort.) Please leave the trainee section blank.

Project Summary

A project summary form is located on the California Sea Grant website. The form is a PDF that can be filled out electronically. You may save your information at any time. In addition, there are detailed instructions available that should help you to accurately complete the form. Please follow them carefully - the project summary is the most widely consulted description of your project.

Narrative

Proposal format may vary, however proposals should include all the information listed below. The proposal narrative should not exceed 15 pages (excluding references, illustrations, charts, tables, and figures). Applicants submitting integrative multi-project proposals are required to submit full proposals for individual projects to be included in the proposed integration and an additional full proposal that describes the integrative component. (Individual projects proposed for inclusion in a multi-project integration need not be submitted together; the integration project must clearly specify the individual projects proposed for inclusion.)

All proposals should use the following format:

- *Project Title* – Project titles should be constructed to provide as much information as possible but must not exceed two lines (approximately 16 words).
- *Project Leader(s) and Associated Staff* - The roles of the project leader(s) and associated staff should be included.
- *Project Goals and Objectives* – This section should identify the scope of the proposed project in relation to the Baseline Program purposes and priorities identified above.
- *Rationale* – The project rationale should articulate the significance of the proposed project in contributing towards the Baseline Program purposes. Proposals that include partnerships should clearly describe the rationale for the partnership and the intended benefits of the partnership. Integrative multi-project proposals should clearly describe the benefits of the integration, including how results integrated across the specified individual projects will be more informative, robust, and a greater contribution to achieving Baseline Program purposes.
- *Approach to be Used (Plan of Work)* – This section should clearly detail and justify the proposed methods and analytical approaches, and should explicitly consider the utility of existing information and the need for new data collection (if proposed). Where projects propose new data collection, a rationale for the proposed temporal and spatial scale of sampling should be provided, including rationale for MPA selection. Where existing data will be incorporated to facilitate interpretation of results, these data should be explicitly identified and their use explained. A description of the intended mechanism or analytical framework to provide a regional assessment of the studied Ecosystem Feature or Feature component should also be included.
- *Outcomes and Deliverables* – Project outcomes should be clearly related to the initial project goals, which in turn should be linked to the Baseline Program purposes and priorities. A clear description of the intended project deliverables should be provided, including description of final reports, data and other products, and associated timelines for development and delivery.
- *Milestones Chart* – Projects may be proposed for any duration within the time period between July 2011 and March 2014. A graphical representation of the total project duration and sequence of key steps or tasks over the

course of the project, with associated timing, should be provided with clear justification for the duration of each key step or task (see example on Sea Grant website).

- References – List all included references alphabetically following the list format from the Chicago Manual of Style.

Note: Project Leader(s) will be required to execute a non-disclosure agreement with DFG for awarded projects that require DFG confidential information (e.g., landings, license information) and/or may be asked to sign a mutually agreed-upon memorandum of understanding regarding data expectations (e.g. data housing, maintenance, protection) for awarded projects that generate their own confidential information as part of the scope of work.

Budget and Budget Justification

Applicants are strongly encouraged to use the California Sea Grant budget form, available to download from the California Sea Grant proposal web page. Applicants may use their own form as long as it includes the same information as the California Sea Grant form. Each budget should include a separate budget justification page that itemizes all budget items in sufficient detail to enable reviewers to evaluate the appropriateness of the funding requested. Please see the California Sea Grant website for detailed instructions.

Research conducted with OPC funds must limit the indirect cost (F&A; facilities & administrative) rate to 25% or less. However, UC institutions should use a 15% SWB (salaries, wages and benefits) rate per waiver 07R-202.

Current and Pending support

Applicants must provide information on all current and pending support where this is relevant to conducting the proposed project. Please use the Current and Pending Research form on the California Sea Grant website.

Vitae

Curriculum vitae should include relevant experience, skills and publications. Publications should be provided in reverse chronological order. A complete list is not required; however, applicants should include those publications that are relevant to the proposal. Full vitae should not exceed two single-spaced pages per individual.

Project Permits and Permissions

It is the responsibility of Project Leaders to determine what, if any, permits or permissions are required to carry out the proposed work. For example, project proposals that require the handling of organisms, disturbing or placing sampling equipment on the seafloor, or require entry into special closures, must acquire the appropriate state, local or federal permits. If your proposed project is likely to require state and/or federal permits or other permissions, please note that these can take considerable time to obtain. We encourage you to apply for any necessary permits in advance, e.g., at or near the time of proposal submission. For more information about permits that may be required by the California Department of Fish and Game, please visit the special permits section of the California Department of Fish and Game's website http://www.dfg.ca.gov/licensing/forms/forms.html.

D. Submission Information and Date

Proposals are due in the California Sea Grant office by 5:00 pm (PDT) on Thursday, April 7, 2011. Late proposals will not be accepted.

Please upload an electronic copy of all proposal items, with required signatures. The electronic version of your proposal must be submitted as PDFs using the California Sea Grant proposal submission link:

https://csgc.ucsd.edu/wpe/SUBMISSIONS/PILogin.php

IMPORTANT: Contact sgmpaproposal@ucsd.edu to obtain a password to use the website link BEFORE submitting any files.

Please include your last name in the file name for each section of the proposal (e.g., Smith_budget.pdf or Smith_cv.pdf). Once submitted through the website, PDFs may not be edited. To change a PDF, it must be deleted and resubmitted. The maximum size of a PDF submitted online is 6 MB. To submit larger files, please contact sgmpaproposal@ucsd.edu.

For questions regarding the proposal submission website itself, please contact Roberto Chavez at: (858) 534-4441 or rachavez@ucsd.edu.

E. Funding Restrictions

There are no funding restrictions.

F. Informational Webinar, Bidders Conference & On-line Bulletin Board

Informational webinar

The Monitoring Enterprise will host an informational webinar to describe the purposes, scope and priorities of the Baseline Program and answer questions. The webinar will be held on March 1, 2011 and further information will be available soon on the Sea Grant website. An announcement with details on how to register and participate in the webinar will also be released on the Monitoring Enterprise listserv. (For more information and to sign up to receive Monitoring Enterprise listserv postings, please visit www.monitoringenterprise.org.)

In addition, answers to frequently asked questions about the Program scope, priorities and proposal submission process will be available on the Sea Grant website.

Bidders Conference

A bidders conference will be held on March 8, 2011 at the Radisson Hotel Los Angeles Westside. Staff from California Sea Grant, the Monitoring Enterprise and DFG will use this opportunity to discuss more fully the objectives of the program with participants. The conference will be an opportunity for applicants to ask specific questions or request additional information.

All potential applicants are strongly encouraged to attend. Potential public partners, including fishermen and other citizens interested in taking part in monitoring efforts, are also encouraged to attend to explore potential partnership opportunities. Individual applicants may also use the conference as an opportunity to form collaborations with the objective of submitting integrative multi-project proposals.

RSVPs for the bidders conference should be made to tlarson@ucsd.edu and are requested no later than 5:00pm on March 2, 2011. Additional information about the conference, including location and time, will be posted soon on the California Sea Grant website.

On-line Bulletin Board

California Sea Grant will host an on-line bulletin board to facilitate information exchange among potential proposers, partners and resource-holders in the region. This approach is designed to facilitate partnerships by providing a forum for sharing information about potential resources (e.g., boats, survey equipment), existing data, and interest in participating in the Baseline Program. The bulletin board may be accessed through https://csgc.ucsd.edu/wpe/EXCHANGE/index.php. Resource-holders, including those with access to data, are encouraged to share their information on the bulletin board. Potential applicants are strongly encouraged to use the bulletin board to ensure that their proposals are cost-effective, efficient and not duplicative of existing monitoring efforts.

V. Proposal Review Information

A. Evaluation Criteria

Proposals will be evaluated against the following criteria:

1. *Relevance and applicability to the purposes and priorities of the South Coast MPA Baseline Program*
   Assessment of alignment of project goals and objectives with the Baseline Program purposes and priorities, including efficiencies in data collection to address multiple program priorities.
2. *Scientific/technical merit*
   Assessment of the conceptual framing and technical approaches proposed to achieve project goals.
3. *Project costs and funding leverage*
   Cost-effectiveness, including project cost relative to Baseline Program purposes. Projects must include at least a 25% match (cash and/or in-kind) from applicants. In-kind contributions must be documented and auditable. Larger matches or additional cost-sharing arrangements are encouraged and will be considered during proposal evaluation.
4. *Partnerships and integrative multi-project proposals*
   Projects that address multiple Baseline Program purposes through partnerships and/or integrative multi-project proposals. Integrative multi-project proposals will be evaluated on how well the component projects fit together to provide more information collectively than each project otherwise would if conducted alone.
5. *Qualifications of investigator(s)*
   Assessment of whether the applicants possess the necessary knowledge, experience, training, facilities and resources to complete the project.
6. *Project management experience, expertise, and skills*
   Assessment of multiple facets of project management, including a proven track record in completing contracts on time and within budget, experience managing and working in multi-party, multidisciplinary teams, and communication skills. Communication skills include the ability to provide clear and effective communication of project goals, approaches and results to diverse audiences interested in monitoring information.
7. *South Coast region knowledge, capacity and experience*
   Projects that take best advantage of the knowledge and capacity existing within the South Coast region, through demonstrated knowledge, partnerships, collaborations or other mechanisms.

B. Review & Selection Process

Applications must be submitted to the California Sea Grant College Program Office no later than 5:00pm (PDT) on April 7, 2011 in order to be considered. Selection is competitive. Proposals will be subject to independent peer-review on the basis of the criteria described above. A two-step independent peer review process, led by California Sea Grant, will be employed to develop recommendations for project selection and funding. Independent mail-in, peer reviews will be sought to provide input into the scientific and technical merit of individual proposals and alignment with the criteria above. A review panel (6-8 additional independent experts) will then be convened to review all proposals, consider the input received from the mail-in reviews and recommend the projects or project components for funding, and the funding level for each. Reviewers will be subject-matter experts selected by Sea Grant, in consultation with staff of OPC, DFG, and the Monitoring Enterprise. Project selection will consider the individual and collective contribution of each project to achieving the Baseline Program purposes. Final funding decisions will be made jointly by staff of OPC, DFG and the Monitoring Enterprise. All applicants will be notified of the selection decision in June 2011.

C. Selection Factors

The Baseline Program management team shall award in rank order based on the peer review recommendations unless the proposal is justified to be out of rank order based on any of the following criteria: availability of funds, cost-effectiveness, duplication of other projects, program priorities, and applicant's prior performance.

Applicants may be asked to modify objectives, work plans, or budgets prior to award funding. Applications must reflect the total budget necessary to accomplish the project. Applicants will be bound by the percentage of cost sharing reflected in the grant award.

D. Announcement & Award Dates

April 7, 2011 (5:00 pm PDT) - Applications due at California Sea Grant College Program
June 27, 2011 (approximate) - Applicants notified of selection results
July 11, 2011 (approximate) - Funds awarded for selected applicants

VI. Award Administration

A. Award Notices

A member of the Baseline Program management team will notify successful applicants by email shortly after decisions are made, likely in June 2011.

B. Reporting

Applicants who receive a grant award will be responsible for submitting both financial and technical (progress and final) reports to California Sea Grant, as described above.

VII. Program Contacts

Questions about the proposal submission requirements or other aspects of the RFP process should be directed to the individuals listed below. Answers to frequently asked questions will be posted on the Sea Grant website. Persons intending to submit proposals in response to this RFP should check the Sea Grant website frequently for any additional information.

A. California Sea Grant

Assistance with overall RFP process and information about the bidders conference

- Shauna Oh, Assistant Director, California Sea Grant College Program
  Phone: (858) 822-2708
  Email: sgmpaproposal@ucsd.edu

General Proposal Help (assistance with forms, format and submission)

- Carol Bailey-Sumber, Grants Specialist
  Phone: (858) 534-7855
  Email: sgmpaproposal@ucsd.edu

Budget Help

- Catherine Hughes, Business Office
  Phone: (858) 534-4440
  Email: sgbudget@ucsd.edu

Computer/Internet-related Help

- Roberto Chavez , Programmer
  Phone: (858) 534-4441
  Email: webhelp@seamail.ucsd.edu

B. MPA Monitoring Enterprise

Assistance with Baseline Program purposes and priorities and additional information on South Coast MPA monitoring planning

- Liz Whiteman, Interim Director
  Phone: (510) 251-8317
  Email: mpamonitoring@calost.org

C. Department of Fish and Game

Assistance with DFG programs, priorities, or data

- Jason Vasques, Associate Marine Biologist, MPA Project
  Phone: (650) 631-6759
  Email: jvasques@dfg.ca.gov

Appendix 1: Draft South Coast MPA Monitoring Metrics for Assessing Ecosystem Condition & Trends

The following pages contain the draft metrics for long-term assessments of the condition and trends of ecosystems, including human activities, inside and outside MPAs in the South Coast region. These metrics are subject to ongoing review and revision in consideration of comments received during agency and public review.

Assessment of ecosystem condition and trends is implemented by monitoring the South Coast Ecosystem Features**,** chosen to collectively represent and encompass the region's ecosystems, including humans, for the purposes of MPA monitoring. Ten Ecosystem Features have been identified for the South Coast region. These are:

- Rocky Intertidal Ecosystems
- Kelp & Shallow (0-30m depth) Rock Ecosystems
- Mid-depth (30-100m depth) Rock Ecosystems
- Estuarine & Wetland Ecosystems
- Soft-bottom Intertidal & Beach Ecosystems
- Soft-bottom Subtidal (0-100m depth) Ecosystems
- Deep (>100m) Ecosystems, including Canyons
- Nearshore Pelagic Ecosystems (the water column habitat within state waters deeper than 30m)
- Consumptive Uses
- Non-consumptive Uses

There are 2 options for monitoring Ecosystem Features: Ecosystem Feature Checkups and Ecosystem Feature Assessments. Ecosystem Feature Checkups are designed to be carried out by community and citizen-scientist groups and thus use simplified sampling protocols and methods. The metrics for Checkups are referred to as Vital Signs, and they collectively provide a coarse-grained evaluation of ecosystem condition. Ecosystem Feature Assessments are more detailed and technically demanding than Checkups and thus are likely to be implemented by government agencies and research institutions. This monitoring option relies on the identification of key attributes, which are important aspects of the structure or functioning of the Ecosystem Feature, and indicators that provide insight into the condition of each key attribute.

These draft metrics were developed in consultation with technical experts, agency scientists and stakeholders in the region. In selecting indicators many considerations were taken into account, including species identified as priorities by stakeholders during public workshops, those with important ecological roles, likely fast and slow MPA responders, species with different life history characteristics, fished species which may be likely to show an MPA response, and unfished species for comparison with fished species.

As described in the RFP, the Baseline Program offers the opportunity to gather initial data on these metrics and others as needed to provide a comprehensive foundation for long-term monitoring and to help test and refine these metrics for use in long-term monitoring.

The following tables present the draft vital signs, key attributes and indicators for each Ecosystem Feature.

ROCKY INTERTIDAL ECOSYSTEMS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Mussel bed cover ➢ Rockweed cover ➢ Ochre sea star abundance & size frequency ➢ Marine bird richness and abundance ➢ Black abalone abundance & size frequency ➢ Purple sea urchin abundance & size frequency ➢ Owl limpet density & size frequency ➢ Pinniped abundance (harbor seal, California sea lion, northern elephant seal)

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat	Percent cover of focal species: Mussels (*Mytilus* spp.) Feather boa kelp *(Egregia menziesii*) Rockweed (Fucaceae*,* multiple species) Surfgrass (*Phyllospadix* spp.)
Trophic Structure: Predators	Ochre sea star (*Pisaster ochraceus*) density & size structure
	Piscivorous bird richness & abundance
	Shorebird richness & abundance
Trophic Structure: Herbivores	Density & size structure of focal species/species groups: Black abalone (*Haliotis cracherodii*) Purple sea urchin (*Strongylocentrotus purpuratus*) Owl limpet (*Lottia gigantea*) Turban snails (*Tegula* spp.)

DRAFT OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat: Macroalgae	Cover of focal groups Turf algae Foliose red algae Fucoid algae
Diversity	Species richness (algae & invertebrates)
	Species diversity (functional groups of algae & invertebrates)

KELP & SHALLOW (0-30M) ROCK ECOSYSTEMS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Sheephead abundance & size frequency ➢ Red sea urchin abundance & size frequency ➢ Purple sea urchin abundance & size frequency ➢ Spiny lobster abundance & size frequency ➢ Kelp bass abundance & size frequency ➢ Rockfish abundance & size frequency ➢ Pink abalone abundance & size frequency ➢ Green abalone abundance & size frequency ➢ Red abalone abundance & size frequency

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat: Macroalgae	Giant kelp (*Macrocystis pyrifera*) areal extent
Strong Ecological Interactors	Density & size structure of focal species: Red sea urchin (*Strongylocentrotus franciscanus*) Purple sea urchin (*Strongylocentrotus purpuratus*) Spiny lobster (*Panulirus interruptus*)abundance & size structure Sheephead (*Semicossyphus pulcher*) density, size structure & sex ratio
Trophic Structure: Predatory fishes	Density & size structure of focal species: Kelp bass (*Paralabrax clathratus*) Olive rockfish(*Sebastes serranoides*) Kelp rockfish (*Sebastes atrovirens*) Cabezon (*Scorpaenichthys marmoratus*) Giant sea bass (*Stereolepis gigas*)
Trophic Structure: Predatory invertebrates	Density & size structure of focal species: Kellet's whelk (*Kelletia kelletii*) Sea stars (*Pisaster* spp*., Pycnopodia helianthoides*)
Trophic Structure: Planktivorous fishes	Density & size structure of focal species: Blacksmith (*Chromis punctipinnis*) Señorita (*Oxyjulis californica*) Blue rockfish (*Sebastes mystinus*)
Trophic Structure: Herbivores	Density & size structure of focal species: Pink abalone (*Haliotis corrugata*) Green abalone (*Haliotis fulgens*) Red abalone (*Haliotis rufescens*) Giant keyhole limpet (*Megathura crenulata*)

DRAFT OPTIONAL ADD-ONS FOR ECOSYSTEM ASSESSEMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat	Giant kelp (*Macrocystis pyrifera*) stipe density
	Sub-canopy & turf algae cover
	Surfgrass (*Phyllospadix torreyi*) cover
	Sessile invertebrate percent cover
Strong Ecological Interactors	Sea otter (*Enhydra lutris*) abundance
Trophic Structure: Predatory birds	Abundance (colony size) and fledgling rate of focal species: Brandt's cormorant (*Phalacrocorax penicillatus*) Pelagic cormorant (*Phalacrocorax pelagicus*) Pigeon guillemot (*Cepphus columba*) California least tern (*Sternula antillarum*)
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

MID-DEPTH (30-100M) ROCK ECOSYSTEMS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Rock crab abundance & size frequency ➢ Rockfish abundance & size frequency ➢ Lingcod abundance & size frequency ➢ California scorpionfish abundance & size frequency

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat: Sessile invertebrates	Structure forming invertebrate cover & height
Trophic Structure: Mobile invertebrates	Density of focal species: Rock crab (*Cancer* spp.) Sheep (spider) crab (*Loxorhynchus grandis*)
Trophic Structure: Predatory fishes	Density & size structure of focal species: Bocaccio (*Sebastes paucispinis*) Vermilion rockfish (*Sebastes miniatus*) Lingcod (*Ophiodon elongatus*) Ocean whitefish (*Caulolatilus princeps*) California scorpionfish (*Scorpaena guttata*) Rockfish (*Sebastes* spp.) size structure
Trophic Structure: Detritivores	Density & size structure of focal species: Urchin (Echinidae, multiple species) White abalone (*Haliotis sorenseni*)
Community Structure: Dwarf rockfishes	Total dwarf rockfish abundance (multiple species)

DRAFT OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat	Cover of focal species: *Metridium* spp. Purple hydrocoral (*Stylaster californicus*) Elk kelp (*Pelagophycus porra*)
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

ESTUARINE & WETLAND ECOSYSTEMS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Eelgrass areal extent ➢ Ghost & mud shrimp abundance ➢ Clam abundance & size frequency (Pacific gaper, Washington & common littleneck) ➢ Marine birds richness & abundance ➢ California halibut abundance & size frequency ➢ Arthropod biomass ➢ Pinniped abundance (harbor seal, California sea lion, northern elephant seal)

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat: Plants	Areal extent of focal species: Eelgrass (*Zostera marina*) Pickleweed (*Salicornia* spp.)
Trophic structure: Infaunal assemblage	Abundance of focal species: Mud shrimp (*Upogebia* spp.) Ghost shrimp (*Neotrypaea* spp.) Pacific gaper clam (*Tresus nuttalli*) Washington clam (*Saxidomus nuttalli*) Common littleneck clam (*Protothaca staminea*)
Trophic Structure: Predatory birds	Piscivorous bird richness & abundance
	Shorebird richness & abundance
Trophic Structure: Predatory fishes	Density & size structure of focal species: Leopard shark (*Triakis semifasciata*) California halibut (*Paralichthys californicus*
Trophic Structure: Resident fishes	Density & size structure of focal species: Spotted sand bass (*Paralabrax maculatofasciatus*) Arrow goby (*Clevelandia ios*) Topsmelt (*Atherinops affinis*))
Productivity	Arthropod biomass

DRAFT OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This set of information includes additional metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Trophic structure: Benthic infauna	Abundance & foraging rates of shorebirds
Trophic structure	Parasite diversity
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

SOFT-BOTTOM INTERTIDAL & BEACH ECOSYSTEMS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Sand crab abundance ➢ Pismo clam abundance & size frequency ➢ Beach wrack composition & abundance ➢ Surfperch abundance (multiple species) ➢ Grunion, number of spawning runs ➢ Marine bird richness & abundance ➢ Pinniped abundance (harbor Seal, California sea lion, northern elephant seal)

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attribute	**Draft Indicator/Focal species**
Trophic Structure: Suspension feeders	Density and size structure of focal species: Sand crab (*Emerita analoga*) Pismo clam (*Tivela stultorum*) Bean clams (*Donax gouldii*)
Productivity: Beach wrack	Wrack composition & abundance
Productivity: Surf zone fish assemblage	Surfperch abundance & size structure (Embiotocidae, multiple species)
	Grunion (*Leuresthes tenuis*) number of spawning runs
Trophic Structure: Predatory birds	Piscivorous bird richness & abundance
	Shorebird species richness & abundance

DRAFT OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This set of information includes additional metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Productivity	Wrack invertebrate diversity and biomass
Diversity	Species richness (invertebrates and fishes)
	Species diversity (functional groups of invertebrates & fishes)

SOFT-BOTTOM SUBTIDAL (0-100M) ECOSYSTEMS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Eelgrass areal extent ➢ Yellow rock crab abundance & size frequency ➢ California halibut abundance & size frequency ➢ Surfperch abundance & size frequency ➢ Flatfish total abundance & size frequency

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attributes	**Draft Indicator/Focal species**
Biogenic Habitat	Eelgrass (*Zostera* spp.) areal extent
	Sand dollar (*Dendraster excentricus*) bed extent
Trophic Structure: Benthic infauna	Functional diversity of benthic infauna (feeding guilds)
Trophic Structure: Mobile invertebrates	Density & size structure of focal species/species groups: Yellow rock crab (*Cancer anthonyi*) Sea star (*Astropecten* spp.) Ridgeback prawn (*Sicyonia ingentis*) Sea cucumber (*Parastichopus* spp.)
Trophic Structure: Predatory fishes	Density & size structure of focal species/species groups: California halibut (*Paralichthys californicus*) Angel shark (*Squatina californica*) Shovelnose guitarfish (*Rhinobatos productus*) Barred sand bass (*Paralabrax nebulifer*) Surfperch (Embiotocidae, multiple species)

DRAFT OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This set of information includes supplemental metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Trophic Structure: Predatory fishes	Density & size structure of focal species: Bat ray (*Myliobatis californica*) Leopard shark (*Triakis semifasciata*) Sanddab (*Citharichthys* spp.))
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

DEEP (>100M) ECOSYSTEMS, INCLUDING CANYONS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Rockfish (*Sebastes* spp.) abundance & size frequency ➢ Flatfish abundance & size frequency ➢ Sea urchin abundance ➢ Spot prawn abundance & size frequency

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attribute	**Draft Indicator/Focal species**
Biogenic Habitat: Sessile invertebrates	Structure forming invertebrate cover & height
Trophic structure: Predatory fishes	Density & size structure of focal species/group: Cowcod (*Sebastes levis*) Bocaccio (*Sebastes paucispinis*) Bank rockfish (*Sebastes rufus*) Sablefish (*Anoplopoma fimbria*)
Trophic structure: Detritivores	Total abundance of focal species/groups: Sea urchin (Echinoidea, multiple species) Hagfish (*Eptatretus stoudii*) Spot prawns (*Pandalus platyceros*) abundance, size structure and sex ratio
Community Structure: Dwarf rockfishes	Total dwarf rockfish abundance (multiple species)

DRAFT OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This set of information includes additional metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Diversity	Species richness (invertebrates & fishes)
	Species diversity (functional groups of invertebrates & fishes)

NEARSHORE PELAGIC ECOSYSTEMS

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Semi-pelagic/pelagic rockfish average & maximum size ➢ Brown pelican abundance ➢ Sooty shearwater abundance ➢ Cassin's auklet breeding success

ECOSYSTEM FEATURE ASSESSMENT

Draft Key Attribute	**Draft Indicator/Focal species**
Predators: Piscivorous/planktivorous fishes	Abundance & size structure of focal species: Widow rockfish (*Sebastes entomelas*) Shortbelly rockfish (*Sebastes jordani*) White sea bass (*Atractoscion nobilis*) Pacific barracuda (*Sphyraena argentea*) Pacific mackerel (*Scomber japonicas*)
Trophic Structure: Predatory birds	Abundance (colony size) and fledgling rate of focal species: Brown pelican (*Pelecanus occidentalis*) Sooty shearwater (*Puffinus griseus*) Cassin's auklet (*Ptychoramphus aleuticus*)
Trophic Structure: Forage base	Forage fish biomass (sardines, anchovies, other school bait fish) Market squid (*Loligo opalescens*) biomass

DRAFT OPTIONAL ADD-ONS TO ECOSYSTEM ASSESSMENT

This information includes supplemental metrics that can be added as methods & resources permit.

Draft Key Attribute	**Draft Indicator/Focal species**
Productivity: Ichthyoplankton	Total ichthyoplankton abundance
	Total abundance of rockfish larvae
	Ratio of fished species to unfished species
Trophic structure	Total jellyfish abundance

CONSUMPTIVE USES

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs
➢ Landings (weight & value) of key species (nearshore rockfishes, spiny lobster, red urchin, California halibut & market squid) per fishing block & port for the commercial fishery ➢ Landings (number & weight) of key species (rockfishes, kelp bass, barred sand bass & Pacific barrcuda) per fishing block & port by CPFVs ➢ CPUE of key species (as above) per fishing block & port by CPFVs ➢ Number of lobster captured per fishing trip and location by recreational fishers

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

DRAFT CONSUMPTIVE USES TO BE MONITORED

For each consumptive use or activity, key fishery species for monitoring include economically and ecologically important species.

Draft Consumptive Uses to be Monitored
Commercial Fishing: Nearshore rockfish (*Sebastes* spp.) Spiny lobster (*Panulirus interruptus*) California halibut (*Paralichthys californicus*) Red sea urchin (*Strongylocentrotus franciscanus*) Market squid (*Loligo opalescens*) Crab (*Cancer* spp., *Loxorhynchus grandis*)
Recreational Fishing – Commercial passenger fishing vessels (CPFVs): Nearshore rockfish (*Sebastes* spp.) Kelp bass (*Paralabrax clathratus*) Barred sand bass (*Paralabrax nebulifer*) Pacific barracuda (*Sphyraena argentea*) California scorpionfish (*Scorpaena guttata*)
Recreational Fishing – Private vessels, including kayaks: Nearshore rockfish (*Sebastes* spp.) Kelp bass (*Paralabrax clathratus*) Barred sand bass (*Paralabrax nebulifer*) Spiny lobster (*Panulirus interruptus*) California halibut (*Paralichthys californicus*)
Recreational Fishing – Shore-based Surfperches (Embiotocidae, multiple species) Croakers (Scianidae, multiple species) Silversides (Antherinopsidae, multiple species)
Recreational Fishing – diving, SCUBA and free-diving White sea bass (*Atractoscion nobilis*) Yellowtail (*Seriola lalandi*) Sheephead (*Semicossyphus pulcher*) Kelp bass (*Paralabrax clathratus*) Spiny lobster (*Panulirus interruptus*)

DRAFT INDICATORS

Each consumptive use is monitored using the same indicators. Note, however, that not all indicators need to be implemented at the same time, or at the same frequency. For example, Knowledge, Attitudes and Perception (KAP) surveys may be most usefully conducted once every five or more years. Indicators for Consumptive Use are:

Draft Indicators
1. Number of people or vessels engaged in the activity 2. Level of activity a. Number of fishing trips per fishing location, vessel, port & region b. Landings of key species per trip, fishing location, vessel, port & region c. CPUE (catch per unit effort) of key species per trip, fishing location, vessel, port & region 3. Economic value or quality of activity a. Landings value of key species per trip, fishing location, vessel, port & region b. Ex vessel value of key species (commercial fisheries) c. Net revenue (commercial fisheries) or expenditures (recreational fisheries) 4. Knowledge, Attitudes and Perceptions (KAP) of participants a. Motivation b. Satisfaction

DRAFT OPTIONAL CONSUMPTIVE USES TO BE MONITORED

This information includes supplemental Consumptive Use metrics, some or all of which can be monitored using the same indicators above, as methods & resources permit.

Draft Consumptive Uses to be Monitored
Recreational Fishing – Clamming Pacific gaper clams (*Tresus nuttalli*) Pismo clams (*Tivela stultorum*) Washington clams (*Saxidomus nuttalli*) Common littleneck clams (*Protothaca staminea*)
Scientific collecting (metrics being developed)

NON-CONSUMPTIVE USES

DRAFT METRICS FOR ECOSYSTEM FEATURE CHECKUP

Draft Vital Signs

- Number of diving trips & divers per access point & dive site
- Number of visitors engaging in recreational beach use
- Number of visitors to rocky intertidal ecosystems for tidepooling
- Number of boat-based wildlife viewing trips & visitors per port & viewing locations
- Number of shoreline wildlife viewers to estuarine, wetland & beach ecosystems

DRAFT METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

DRAFT NON-CONSUMPTIVE USES TO BE MONITORED

Draft Non-consumptive Uses to be Monitored

Scuba diving
Recreational beach use
Tidepooling
Wildlife viewing – boating, including kayaking
Wildlife viewing - shorebased

DRAFT INDICATORS

Each non-consumptive use is monitored by applying the same indicators listed below. Note, however, that not all indicators need to be implemented at the same time, or at the same frequency. For example, Knowledge, Attitudes and Perception (KAP) surveys may be most usefully conducted once every five or more years. Indicators for Non-consumptive uses are:

Draft Indicators

1. Level of activity
    a. Number & location of trips (spatial use & intensity)
2. Knowledge, Attitudes and Perceptions (KAP) of participants
    a. Motivation – including MPAs
    b. Satisfaction – e.g., travel distance, travel & activity costs, likelihood of return

DRAFT OPTIONAL NON-CONSUMPTIVE USES TO BE MONITORED

This information includes supplemental non-consumptive uses, some or all of which can be monitored using the same indicators above, as methods & resources permit.

Draft Non-consumptive Uses to be Monitored

Educational use

APPENDIX C-3. SUMMARY REPORT FROM THE SOUTH COAST MPA MONITORING PLANNING WORKSHOP 1, JULY 19, 20, 26, 2010

South Coast Marine Protected Areas Monitoring Planning Round 1 Public Workshops

Workshops Overview

July 19, 2010 – Santa Barbara, California
July 20, 2010 – Santa Monica, California
July 26, 2010 – Carlsbad, California

Prepared by Kearns & West

Purpose of this Document

This document highlights the discussions held at the South Coast Marine Protected Areas (MPA) Monitoring Planning Round 1 Public Workshops. The purpose of the workshops was to gather input on public priorities and perspectives on monitoring of marine protected areas (MPAs) in the South Coast region (Point Conception to the Mexico border), as a step in developing the South Coast MPA Monitoring Plan.

The workshops were convened by the MPA Monitoring Enterprise, in cooperation with the Department of Fish and Game, and facilitated by Kearns & West. The workshops were held in July 2010 in Santa Barbara, Santa Monica and Carlsbad, California. All workshops were open to the public, and the same agenda and format were followed at each workshop.

All input received during the workshops will be considered in the development of the South Coast MPA Monitoring Plan. The purpose of this document is to provide highlights of the discussions, including key questions and answers, from all three workshops. These discussion highlights are intended as a companion document to the workshop presentations, available on the Monitoring Enterprise website at http://calost.org/reports/SouthCoast_Workshop_Presentations.pdf.

Outline of this Document

I. Introduction—Workshop objectives, structure and participants
II. Introduction to the MPA Monitoring Enterprise and South Coast MPA Monitoring Planning
III. Overview of approach to MPA monitoring
IV. Breakout Session #1: Input on monitoring and assessing ecosystems
V. Breakout Session #2: Input on possible MPA design and management questions for monitoring
VI. Post-workshop follow-up and next steps
VII. Appendices

INTRODUCTION – WORKSHOP OBJECTIVES, STRUCTURE AND PARTICIPANTS

Workshop Objectives

The workshops were held to inform the development of the monitoring plan for the South Coast MPAs, currently under consideration by the California Fish & Game Commission. Specifically, the workshops were designed to:

1. Describe the role and function of the MPA Monitoring Enterprise;
2. Provide an overview of the anticipated process and timeline to develop the South Coast MPA Monitoring Plan;
3. Present information about the MPA monitoring framework and approach developed to meet MLPA requirements; and
4. Offer an opportunity for participants to provide input on MPA monitoring perspectives and priorities.

Workshop Organization

Three workshops were held in three different locations in order to facilitate participation by stakeholders living in different parts of the South Coast region. All three workshops followed the same agenda (see Appendix 1) and format. Each workshop included both presentations and small group discussions.

Participants' feedback during the small group discussions was captured on flipcharts, and then reported back to all participants in plenary sessions. The feedback was subsequently compiled for review and consideration by the Monitoring Enterprise in development of the South Coast MPA Monitoring Plan.

Workshop Participants and Conveners

All three workshops were open to the public. More than 120 participants attended this first round of workshops. The list of workshop participants at each workshop location is attached as Appendix 2. Together, the participants represented a broad variety of stakeholder interests including conservation, recreational and commercial fishing, California tribes and tribal communities, surfing, local, state, and federal agencies, ocean users, research institutions, and the general public.

Cheri Recchia, Director of the Monitoring Enterprise, Jason Vasques, California Department of Fish & Game, and Eric Poncelet, Kearns & West facilitator, convened the workshop.

I. INTRODUCTION TO THE MONITORING ENTERPRISE AND SOUTH COAST MPA MONITORING PLANNING

Introducing the Monitoring Enterprise

Cheri Recchia, Director of the MPA Monitoring Enterprise, provided an overview of the Monitoring Enterprise and set the context for monitoring planning for the South Coast region (Point Conception south to the Mexico border).

The Monitoring Enterprise was established in 2007 to lead the development of impartial, science-based, and cost-effective MPA monitoring; the Monitoring Enterprise does not make management recommendations for the MPAs themselves. The Monitoring Enterprise has three core focuses: 1. Science, ensuring that monitoring is scientifically rigorous and that the data collected are the most useful and cost-effective for meeting MLPA requirements and supporting future MPA management decisions; 2. Information Management, making data, analyses and reports available to decision-makers and the

public; and 3. Communications, understanding decision-maker and public monitoring priorities and effectively sharing monitoring informing and results.

Meeting MLPA Monitoring Requirements
Monitoring is required by the MLPA to ensure the MPAs meet MLPA goals, to facilitate adaptive management of the MPAs, and to improve understanding of marine systems. The MLPA Master Plan recommends review of the MPAs every five years. Reflecting that guidance, MPA monitoring has been designed to provide monitoring results to the California Fish & Game Commission (FGC) and the public to inform each 5-year review. At the end of each 5-year monitoring cycle, the Monitoring Enterprise will lead re-assessment of monitoring needs and updating of monitoring plans as needed to guide the next cycle of monitoring.

To meet the requirements of the MLPA, the Monitoring Enterprise addresses three questions. First, what is the most important information for monitoring to collect? This identifies monitoring that is most relevant to MLPA goals, most applicable to future MPA management decisions, and feasible and cost-effective to conduct. Second, how can information be collected most efficiently, to make the best use of existing programs, partnerships and limited resources? Third, how can the resulting information be shared and presented to the public and decision-makers most usefully? This workshop will inform how the Monitoring Enterprise begins to answer the first of these questions as it pertains to the South Coast region.

Timing of South Coast MPA Monitoring Planning
The timing for planning South Coast MPA monitoring is driven by several key factors:

- The FGC is scheduled to consider adoption of the South Coast MPAs in late 2010.
- Given that the South Coast MPAs may, if adopted, take effect in 2011, baseline monitoring should begin as soon as is feasibly possible, likely in the summer or fall of 2011. To facilitate the initiation of baseline monitoring in 2011, a request for proposals (RFP) for baseline monitoring will be released in late 2010.
- The South Coast MPA Monitoring Plan must reflect the MPAs adopted by the FGC and so will be finalized following adoption of the MPAs.

Considering these factors, the following is a summary of key events in the development of the South Coast MPA Monitoring Plan and MPA Baseline Monitoring Program, and anticipated timing:

- May – June 2010: Initial outreach to key stakeholders and technical contacts
- July 2010: Round 1 public workshops, to solicit input on monitoring priorities
- August – October 2010: Development of the baseline program, baseline RFP and metrics for the monitoring plan, including ongoing discussions with technical experts.
- November 2010: Round 2 public workshops, to solicit feedback on draft monitoring metrics
- Late 2010: Release of South Coast MPA Baseline Program RFP
- Early 2011: Proposals for baseline monitoring due, with the timing contingent on adoption of South Coast MPAs by the FGC. The Ocean Protection Council has approved $4M to help fund the baseline program in the South Coast region.
- Early 2011: A draft South Coast MPA Monitoring Plan will be released for public comment.
- Spring 2011: The Plan will be revised in consideration of public comment and submitted to the FGC for consideration. If adopted, the Plan will be incorporated into the MLPA Master Plan.

For additional details on process and timing, please see Appendix 3.

Key Questions
Some of the key questions raised during this portion of the workshops included:

Q: How will monitoring allow us to discern whether changes are caused by the MPAs or by oceanographic or other conditions?
A: The approach to MPA monitoring is to first document changes (or lack of changes) and then to explore the causes of the observed changes. Disentangling the effects of MPAs from large-scale dynamics and broader human influences will be achieved through the collection of data over long time scales to incorporate into time series analyses. Through development of partnerships for information exchange, oceanographic, economic and other contextual data will be incorporated into these analyses to facilitate interpretation of MPA monitoring results.

Q: How will the monitoring sites be selected?
A: The first stage of monitoring will be implemented through the South Coast MPA Baseline Program. Projects carried out as part of the Baseline Program will be selected through an RFP process. Sites to be monitored will be proposed by project leaders, then subject to review and possible modification to ensure the Baseline Program will provide the broadest possible coverage of the South Coast MPAs, reference sites, and the broader region.

Q: Is baseline monitoring separate from long-term monitoring?
A: The South Coast MPA Monitoring Plan will describe the approach and monitoring framework that underpins both the Baseline Program and long-term monitoring. The Baseline Program addresses the most time-sensitive aspects of MPA monitoring, specifically: 1) characterizing key ecological and socioeconomic aspects of the region near the time of MPA implementation, to provide one point of reference for future comparisons, and 2) documenting key initial socioeconomic and ecological changes in the first 2-3 years after the MPAs take effect. Long-term monitoring will follow and build on the foundation established by the Baseline Program.

Q: What is the Baseline Request for Proposals (RFP)?
A: The South Coast MPA Baseline Program will be implemented through a Request for Proposals (RFP). The Ocean Protection Council has authorized $4M to help fund the South Coast MPA Baseline Program. The RFP will solicit proposals to conduct monitoring consistent with the baseline program purposes and priorities. Proposals will be subject to independent technical review and projects will be selected that collectively best meet the needs identified in the RFP.

Q: Will the study of socioeconomic impacts be included in the monitoring plan?
A: Yes. The South Coast MPA Monitoring Plan will include monitoring of consumptive and non-consumptive human uses. This will include, for example, monitoring of the changes in distribution and intensity of human use activities and the economic value or quality of human uses.

Q: It is useful to get input from people who spend a lot of time on the water. Will information and input be considered from ocean users as well as scientists?
A: Yes. In developing the South Coast plan, the Monitoring Enterprise is seeking input on monitoring priorities from all stakeholders as well as scientists. In addition, monitoring partnerships, such as partnerships between fishermen and scientists, will be encouraged in the Baseline Program RFP. Baseline and long-term monitoring will also seek to incorporate useful information from existing programs, such as citizen science programs.

Q: Will the monitoring plan be designed to support other, related management goals beyond those identified in the MLPA, such as fisheries?
A: Yes. The plan will be designed first and foremost to best meet MLPA requirements. This will include MPA monitoring metrics and management questions pertaining to aspects of fisheries resources and

resource uses, such as monitoring of fished species inside and outside MPAs. This information can be used to support other management needs, such as fisheries management.

II. OVERVIEW OF APPROACH TO MPA MONITORING

Liz Whiteman, Lead Scientist for the Monitoring Enterprise, described the MPA monitoring framework, which will be applied in developing the South Coast MPA Monitoring Plan and designing the South Coast MPA Baseline Program.

Developing an Ecosystems Approach to MPA Monitoring

Efficiently meeting the broad requirements of the MLPA leads to taking an ecosystems approach to MPA monitoring. Ecosystems provide the umbrella that encompasses species, populations, habitats, and human uses.

The central focus of the monitoring approach is to identify a set of key metrics that can provide information about the condition of, and trends within, ecosystems over long time scales. This can be compared to similar approaches from other contexts. For example, during a visit to a doctor, there are countless tests that can provide a detailed picture of aspects of someone's health, but conducting all those tests at each visit would neither be efficient nor necessary in most cases. Instead, the doctor usually performs a set of routine, standard measurements (such as taking blood pressure, pulse, and temperature) to coarsely assess an individual's health. These standard measurements are designed to provide an alert when additional, more specific tests may be warranted.

Unlike the medical field, there is no standard list of metrics for "taking the pulse" of South Coast marine ecosystems and MPAs. The process to develop the South Coast MPA Monitoring Plan therefore includes identification of ecosystems and ecosystem components (including human uses) that can provide efficient and feasible insight into ecosystem condition and trends inside and outside MPAs across the region. The selected ecosystems and ecosystem components should reflect public priorities and interests as well as the best available scientific information.

Introduction to the MPA Monitoring Framework

Ecosystem Features provide the top level of the monitoring framework (see Appendix 4). Ecosystem Features provide a limited number of targets for focusing monitoring that collectively represent and encompass the South Coast marine ecosystems and related human uses.

The Monitoring Enterprise has developed 10 draft Ecosystem Features to represent and encompass the South Coast region:

- Consumptive Uses
- Non-consumptive Uses
- Rocky Intertidal
- Soft-bottom Intertidal, including Beaches
- Wetlands and Estuaries
- Kelp and Shallow Rock (0 – 30m)
- Mid-depth Rock (30 – 100m)
- Soft-bottom Subtidal (0 – 100m)
- Deep Ecosystems including Canyons (> 100m)
- Nearshore Pelagic (in state waters > 30m)

The MPA monitoring framework includes two core monitoring elements: long-term tracking of ecosystem condition; and evaluating specific MPA design and management decisions. These two elements work together to assess the effectiveness of the MPAs in meeting MLPA goals and to inform future adaptive management decisions. These two elements can be thought of as addressing two key questions:

1. How is the system doing?
2. How are MPAs affecting the system?

Assessing Ecosystem Condition and Trends (*How is the system doing?)*
As described above, monitoring metrics will be identified which can track the condition or 'health' of each Ecosystem Feature through time. The monitoring framework includes two options for monitoring ecosystem condition: Ecosystem Feature Checkups provide a coarse evaluation of ecosystem condition through a set of vital signs, while Ecosystem Feature Assessments are implemented through evaluation of a limited set of key attributes using a limited set of focal species or indicators.

Workshop participants were asked to identify their priorities for tracking ecosystem condition during the first breakout discussion (see page 8 for more information).

Evaluating MPA Design and Management Decisions (*How are MPAs affecting the system?*)
The establishment and ongoing management of MPAs involve a number of decisions, ranging from design decisions such as MPA size and spacing to management decisions such as those related to managing visitors to MPAs. Evaluation of the effects of specific design or management decisions on Ecosystem Features or ecosystem components can be used to inform future management decisions.

Workshop participants were asked identify their priority design and management questions during the second breakout discussion (see page 10 for more information).

Implementing the South Coast MPA Baseline Program
The Monitoring Enterprise is developing the South Coast MPA Baseline Program, which will be implemented using an RFP process. The Baseline Program will include characterization of the South Coast ecosystems and human uses at the time of MPA implementation and assessment of initial key ecological and socioeconomic changes in the first 2-3 years following implementation. The Baseline Program will incorporate existing data to understand both the historical context and broader influences (e.g., oceanography, water quality, economic trends).

Key Questions
Some of the key questions raised during this portion of the workshops included:

Q: The goals of the MLPA include specific biological goals, such as protecting the natural diversity and abundance of marine life. Are those things clear indicators for monitoring?
A: These goals provide guidance for monitoring, but are not specific enough to be indicators. The MPA monitoring framework begins with these goals, and uses a hierarchical approach to select monitoring metrics to allow assessment of the MPAs' effectiveness in meeting these and the other MLPA goals.

Q: How will the short-term and long-term monitoring be addressed, when there is debate as to whether a five-year review timeframe is sufficient to see changes to the system?
A: The monitoring plan will include metrics selected to provide insight into both short-term and long-term changes in ecosystems and human uses. The 5-year reviews of the MPAs recommended in the MLPA Master Plan for MPAs provide an opportunity to structure monitoring to provide results to inform the review process. In addition, monitoring data collection can be evaluated at this time and updated as

appropriate to ensure relevance to subsequent 5-year reviews. Continued data collection across multiple 5-year cycles will be required for monitoring metrics expected to respond slowly to MPA implementation.

Q: What is the control area? Are non-MPA areas going to be monitored?
A: Monitoring will occur both inside and outside the MPAs across the region. The primary goal is to find how the system is changing, inside and outside MPAs, and how that relates to achieving the goals of the MLPA.

Q: The monitoring plan seems to primarily focus on structural aspects of ecosystems; has any thought been given to process studies to monitor ecosystem condition?
A: Yes. As we develop the South Coast plan we will be seeking input from scientists and other technical experts and we will explore opportunities to incorporate indicators of ecosystem function and processes (for example, predator-prey relationships or nutrient cycling) in addition to ecosystem structure.

Q: Will you look for the drivers of change?
A: Yes. Marine ecosystems and MPAs are influenced by many factors, including, for example, oceanographic variability. Interpretation of monitoring results will include not only comparisons inside and outside MPAs, but also consideration of other factors or drivers that may influence ecosystem changes (including human uses) inside and outside MPAs.

Q: Why are "uses" separate from the other ecosystem features rather than integrated into the ecological features?
A: Uses are considered separately to underline their importance, and to reflect the fact that there is a specific MLPA goal to improve recreational, educational and study opportunities. However, the monitoring framework is designed to facilitate examination of relationships among Ecosystem Features.

Q: Which Ecosystem Feature(s) account for birds and marine mammals?
A: They will be considered within the Ecosystem Feature that encompasses their primary foraging or nesting areas. If they are migratory species, they will be considered in the ecosystem where they most frequently rest and feed during migrations.

Q: Have you considered how to manage data, considering limited resources and existing programs?
A: Yes, the Monitoring Enterprise is currently developing an online information management system. An initial step to identify user needs of an IMS is completed and development of the system will build on the findings of that assessment. The user needs assessment will soon be available on the Monitoring Enterprise website.

Q: A lot of monitoring and data collection is already going on in the South Coast. Will the MPA monitoring take advantage of that or duplicate it?
A: The Monitoring Enterprise is committed to taking the best possible advantage of existing monitoring programs and datasets and to avoiding duplication or "reinventing the wheel". The South Coast MPA Monitoring Plan and Baseline Program will take into consideration the significant other marine/coastal monitoring occurring on the South Coast. In the coming months, we will be working with experts involved in many monitoring programs (including fisheries and water quality monitoring) to determine how best to take advantage of existing programs and data.

Q: Is the South Coast Monitoring Plan essentially an extension of the North Central Coast Monitoring Plan so that monitoring can be compared on a statewide basis, or is it an entirely separate plan?

A: Both plans are guided by the monitoring framework, which is consistent across all the regions, so that results can be compared statewide. However, each region has unique features, so the monitoring framework will be adapted as needed to be relevant to each region.

III. BREAKOUT SESSION #1: INPUT ON MONITORING AND ASSESSING ECOSYSTEMS

In the first of two afternoon breakout sessions, workshop participants were organized into small groups and invited to provide input on the important species, habitats and other aspects of each Ecosystem Feature that should be considered for inclusion in MPA monitoring.

The general question posed was:

> *What information do participants feel is most important for monitoring to provide in assessing the condition of ecosystems and changes in condition over time?*

This discussion focused on monitoring Ecosystem Features, as described during the morning presentation on the monitoring framework. All 10 of the Ecosystem Features were discussed. Participant input was captured on flip charts. At the end of the breakout group discussions, staff presented summaries of each breakout group's discussions back to the full group.

The sections below highlight some of the common themes heard in breakout discussions at all three workshop locations.

Human Uses Ecosystem Features

Consumptive Uses

- Participants indicated interest in monitoring changes in fishing effort and associated changes in the commercial and recreational fishing industries.
- Specific fisheries, including the lobster and urchin fisheries, are of particular interest.
- Participants are interested in monitoring encompassing the effects of MPAs on the availability of fresh, local seafood and hope that MPAs may ultimately increase seafood availability.

Non-Consumptive Uses

- Participants are interested in how recreational uses (including snorkeling, surfing and kayaking) may change following the implementation of the MPAs.
- Participants would like to see an increase in educational visits, including tidepooling and general wildlife viewing, leading to associated benefits such as increased awareness of the MPAs.

Intertidal Ecosystem Features

Rocky Intertidal

- Participants expressed particular interest in having monitoring include mussels, abalone, and sea stars.
- Participants expressed a concern that that trampling and poaching may affect changes in rocky intertidal ecosystems inside MPAs and believe these additional factors should be monitored.

Soft-bottom intertidal, including beaches

- Participants expressed particular interest in including monitoring of Grunion spawning runs.
- Participants suggested that increased kelp wrack and biomass of associated species may indicate increased physical stability of this ecosystem.

- Participants also suggested that activities occurring above the mean high tide, such as sand nourishment, beach grooming, and tourism will affect whether changes are observed inside and outside MPAs and should therefore be monitored.

Wetlands and estuaries

- If MPAs are "working", participants expect to see an increase in the abundance and diversity of species in this ecosystem, along with an increase in its function as a refuge for nursery species.
- Eelgrass was suggested as a potentially important indicator of habitat sustainability.
- There was interest in having monitoring include migratory birds as well as other species, including least terns and snowy plovers, as indicators of estuarine ecosystem condition.

Subtidal Ecosystem Features

Kelp and shallow rock (0-30m)

- If the MPAs are "working", participants expect to see an increase in kelp cover, density, and persistence.
- Species and groups of particular interest for monitoring include sheephead, lobster, urchin and rockfish.
- Participants are also interested in how predator-prey relationships would change in the short-term and long-term in the absence of fishing.

Mid-depth rock (30-100m)

- Species and groups of particular interest for monitoring include sheephead, rockfish and sharks.

Soft-bottom subtidal (0-100m)

- Participants expressed interest in having monitoring in this ecosystem include halibut, flatfish and rockfish.

Deep ecosystems including canyons (> 100m)

- Participants felt that relatively little information exists about these ecosystems, potentially increasing the importance of baseline data collection.
- Several participants also commented on the need for different monitoring methods for these deeper ecosystems.
- Monitoring of squid populations was of interest to several participants.

Nearshore pelagic (in state waters > 30m)

- Participants felt that important pelagic fish species and groups to monitor include yellowtail, swordfish and baitfish.
- Several participants expressed the view that populations of marine mammals should increase if the MPAs are "working", and thus consider marine mammals as indicators for the health of the habitat.
- Participants are particularly interested in having monitoring include sea otters, turtles and dolphins.

Workshop participants also expressed additional ideas and considerations for MPA monitoring that were not specific to a particular Ecosystem Feature. The Monitoring Enterprise will consider how best to accommodate these ideas, given the scope of the MLPA. Some of the common discussion themes included:

- In general, participants expressed that monitoring should encompass key focal species, to observe changes in populations, biomass and productivity, and consideration of biodiversity. They also expressed particular interest in having monitoring include native species.
- Water quality was also considered to be very important. It was noted that consistent data collection will be important to accurately monitor water quality.
- Several participants expressed an interest in ensuring the protection of cultural heritage sites and uses.

- Participants also generally agreed that there should be efforts to conduct education about the MPAs so people understand which uses are allowed.
- It was also suggested that interpretation of monitoring data will need to consider additional fisheries information as well as information on poaching.
- Participants also suggested that selection of appropriate monitoring methods should consider impacts of research methods and tools on the ecosystems being monitored.
- Some participants expressed the view that monitoring should consider submerged cultural resources.

IV. BREAKOUT SESSION #2: INPUT ON POSSIBLE MPA DESIGN AND MANAGEMENT QUESTIONS FOR MONITORING

In the second afternoon breakout session, workshop participants were organized into different small groups and asked to identify potential MPA design and management decisions that should be addressed by MPA monitoring in both the short-term (5 years) and long-term (10+ years) after MPA implementation.

The general question posed was:

> *What specific MPA or MPA network design and/or management decisions are most important for monitoring to evaluate, according to participants?*

This discussion included suggestions of both short-term and long-term design and management decisions, as presented in the monitoring framework.

Participants were initially asked to write down some brainstorming ideas on index cards. Participants then discussed their ideas, and this discussion was captured on flip charts. At the end of the breakout group discussions, workshop support staff again presented summaries of each breakout group's discussions to the full group. Index cards were also collected.

Questions below highlight some of the common themes heard across the three workshops:

- Does the size of an MPA affect the way it performs? Does it influence spillover effects? Is a group of many small MPAs as effective as a few large MPAs?
- Are the MPAs performing as a network and having an impact on the region as a whole?
- How does the placement of MPAs impact access and use of the areas?
- Do MPAs containing multiple habitats perform better than those with fewer habitats?
- Is the spacing between MPAs appropriate to allow larval connectivity?
- Are MPA complexes (e.g., SMR-SMCA combinations) more or less effective than a single MPA in terms of biomass or habitat protection?
- What is the cumulative impact of allowing take of certain species in MPAs? In particular, what is the effect of removing pelagic species, including squid, from an ecosystem?
- What are the economic impacts of MPAs on local industries?
- How does enforcement impact MPA effectiveness?
- Do MPAs change understanding or sentiments of local populations toward the ocean?

V. POST-WORKSHOP FOLLOW UP AND NEXT STEPS

Workshop participants were invited to submit written comments on the topics discussed during the workshops, by completing a comments form at the workshop and/or by providing subsequent written comments. All comments, together with all of the input received during the workshop, will be considered by the Monitoring Enterprise staff as they continue to develop the draft South Coast MPA Monitoring Plan.

Following the round 1 public workshops, Monitoring Enterprise staff will consult with a wide range of technical experts and conduct other research in order to develop draft South Coast MPA monitoring metrics that reflect the input received in the round 1 workshops, that meet the goals of the MLPA, and that are grounded in the best available science.

The draft monitoring metrics will be presented at second round of public workshops, currently planned for November 2010. In addition, the draft South Coast MPA Monitoring Plan will be released for public review, likely early 2011.

Throughout the South Coast MPA monitoring planning process, the Monitoring Enterprise will share updates and progress through its website (monitoringenterprise.org) and listserv (sign-up available on the Monitoring Enterprise website). For any additional comments or questions, please contact the Monitoring Enterprise by email at: mpamonitoring@calost.org.

VI. APPENDICES

1. Workshop Agenda
2. Workshop Attendees
3. South Coast Monitoring Plan Development Timeframe
4. The MPA Monitoring Framework

Appendix 1: Workshop Agenda

South Coast Marine Protected Areas (MPA) Monitoring Planning – Public Workshops, Round 1

Monday, July 19	*Tuesday, July 20*	*Monday, July 26*
Santa Barbara, CA	*Santa Monica, CA*	*Carlsbad, CA*
Fess Parker's Doubletree	*Marriott-Le Merigot Beach Hotel*	*Hilton Garden Inn*
633 East Cabrillo Boulevard	*1740 Ocean Avenue*	*6450 Carlsbad Boulevard*

Workshop Objectives

1. Describe the role and function of the MPA Monitoring Enterprise;
2. Provide an overview of the anticipated process and timeline to develop the South Coast MPA Monitoring Plan;
3. Present information about the MPA monitoring framework and approach developed to meet MLPA requirements; and
4. Offer an opportunity for participants to provide input on MPA monitoring perspectives and priorities.

Agenda

9:00	*Arrival and Sign-in*
9:30	Welcome, Introductions, and Agenda Review
9:45	Introduction to the MPA Monitoring Enterprise and the South Coast MPA Monitoring Plan Development
10:15	Overview of Approach to MPA Monitoring
11:30	*Lunch*
12:45	Introduction to Breakout Session #1 Activity
1:00	Breakout Session #1 – Input on Monitoring and Assessing Ecosystems
2:20	Plenary Discussion
3:00	*Break*
3:15	Introduction to Breakout Session #2 Activity
3:30	Breakout Session #2 – Input on Possible MPA Design and Management Questions for Monitoring
4:10	Plenary Discussion
4:30	Next Steps and Workshop Close
4:45	*Adjourn*

Appendix 2: Lists of Workshop 1 Participants

July 19, 2010, Santa Barbara

Fess Parker's Doubletree Resort, Santa Barbara, CA

Name	Affiliation
Sean Anderson	California State University Channel Islands
Frank Arredondo	Chumash MLD
Steve Bigler	Self
Jenn Caselle	University of California Santa Barbara
Chris Cohen	Scripps Institute of Oceanography
Michael Cordero	Coastal Band of Chumash Nation
Jenny Dugan	University of California Santa Barbara
Jenn Feinberg Eckerle	Natural Resources Defense Council
Craig Fusaro	Joint Oil/Fisheries Liaison Office
Janet Garcia	Coastal Band of Chumash Nation
Jim Garcia	Coastal Band of Chumash Nation
Jimmy Garcia	Coastal Band of Chumash Nation
Chris Goldblatt	Self
Michael Gould	Pacific Freediver
Sean Hastings	Channel Islands National Marine Sanctuary
Greg Helms	Ocean Conservancy
David Kushner	Channel Islands National Park
Hunter Lenihan	University of California Santa Barbara
Merit McCrea	Condor Cruises
Vennise A. Miller-Forte	Coastal Band of Chumash Nation
Christina Mokhtarzadeh	Bureau of Indian Affairs
Stephanie Mutz	Commercial Fishermen of Santa Barbara, Inc.
Mary Nishimoto	University of California Santa Barbara
Leslye "Maeghan" Owen	Coastal Band of Chumash Nation
Sarah Rathbone	University of California Santa Barbara
Geoffrey Ravenhill	Self
Dan Robinette	Point Reyes Bird Observatory
Fred Rohrs	Self
Michael Sheehy	Santa Barbara Channelkeeper
Maura Sullivan	Coastal Band of Chumash Nation
John Ugoretz	U.S. Navy/Department of Defense
Jennifer Voccola	City of Malibu
Dave Weeshoff	International Bird Rescue Center
Joanne Williamson	Gaviota coast resident
Clare Wormald	California State University Northridge

Appendix 2: Lists of Workshop 1 Participants (cont.)

July 20, 2010, Santa Monica

Le Merigot Beach Hotel, Santa Monica, CA

Name	Affiliation
Harry Bateman	Self
Maddalena Bearzi	Ocean Conservation Society
Bob Bertelli	California Sea Urchin Commission
Dirk Burcham	Self
Nancy Caruso	Get Inspired Inc.
Laurel Fink	Reef Check California
Josh Fisher	Commercial lobster fisherman
Tom Ford	Santa Monica Bay Restoration Foundation
Jan Friewald	Reef Check California
Steve Fukuto	United Anglers of Southern California
Phyllis Grifman	University of Southern California
Joe Gully	L.A. County Sanitation District
Luhui Isha	Wishtoyo Foundation
Andrew Jirick	Port of Los Angeles
Renee Klein	Santa Monica High School
Ken Kurtis	Statewide Interest Group (SIG)
Darlen Lee	Freedom Sportfishing
Karen Martin	Pepperdine University
Sean McGary	Self
Brian Meux	Santa Monica Baykeeper
Victoria Minnich	University of California Santa Barbara
Chuck Mitchell	MBC Applied Environmental Services
Dana Murray	Heal the Bay
Bob Osborn	United Anglers of Southern California
Joseph Palazzolo	Real Property Group
Daniel Pondella	Occidental College
Lia Protopapadakis	Santa Monica Bay Restoration Commission
Michael Quill	Santa Monica Baykeeper
Shana Rapoport	Self
Freddie Romero	Santa Ynez Band of Chumash
Sarah Sikich	Heal the Bay
Chuck Tennin	Marina Del Rey Sportsfishing
David Vilas	MBC Applied Environmental Services
Mati Waiya	Wishtoyo Foundation
Guanyu Wang	Santa Monica Bay Restoration Commission

Appendix 2: Lists of Workshop 1 Participants (cont.)

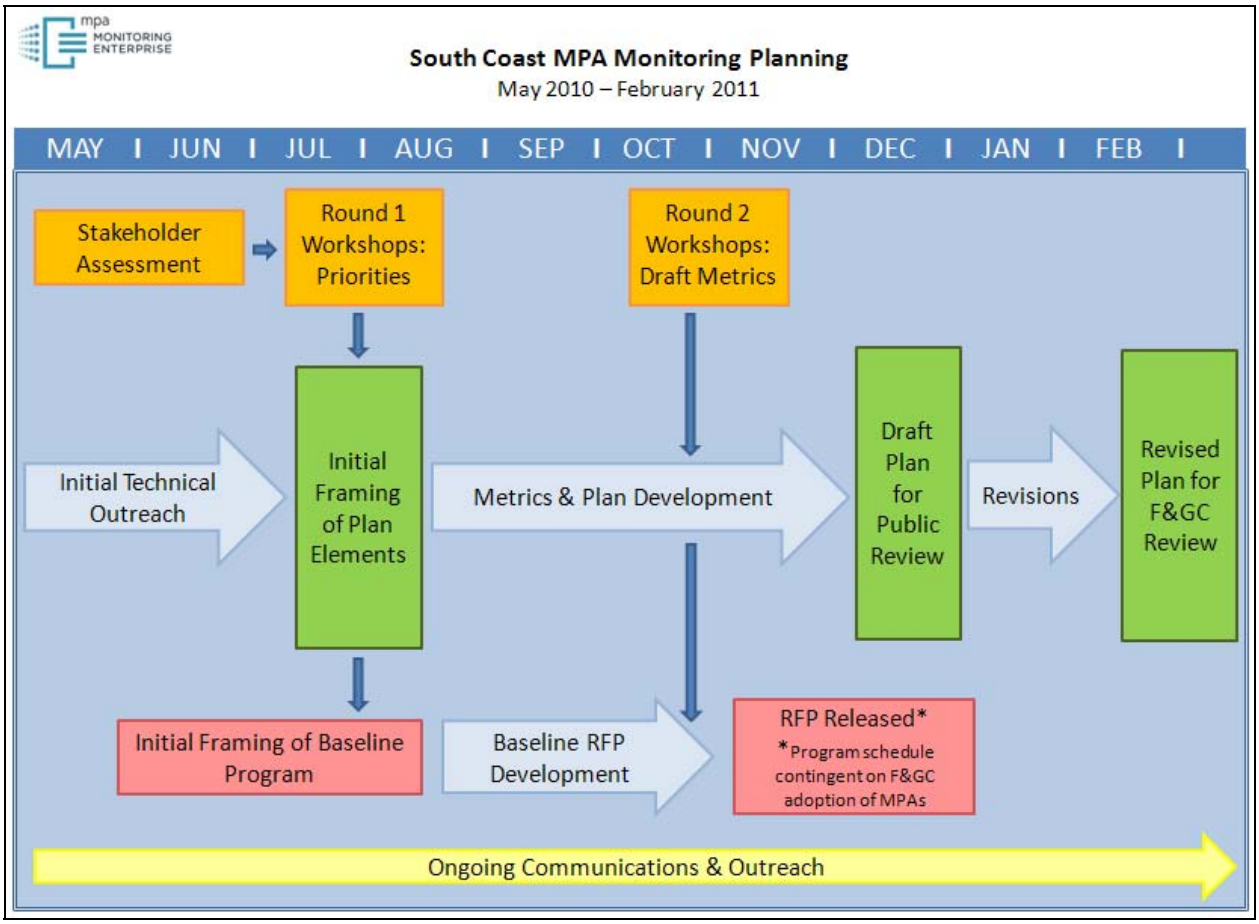
July 26, 2010, Carlsbad

Hilton Garden Inn, Carlsbad, CA

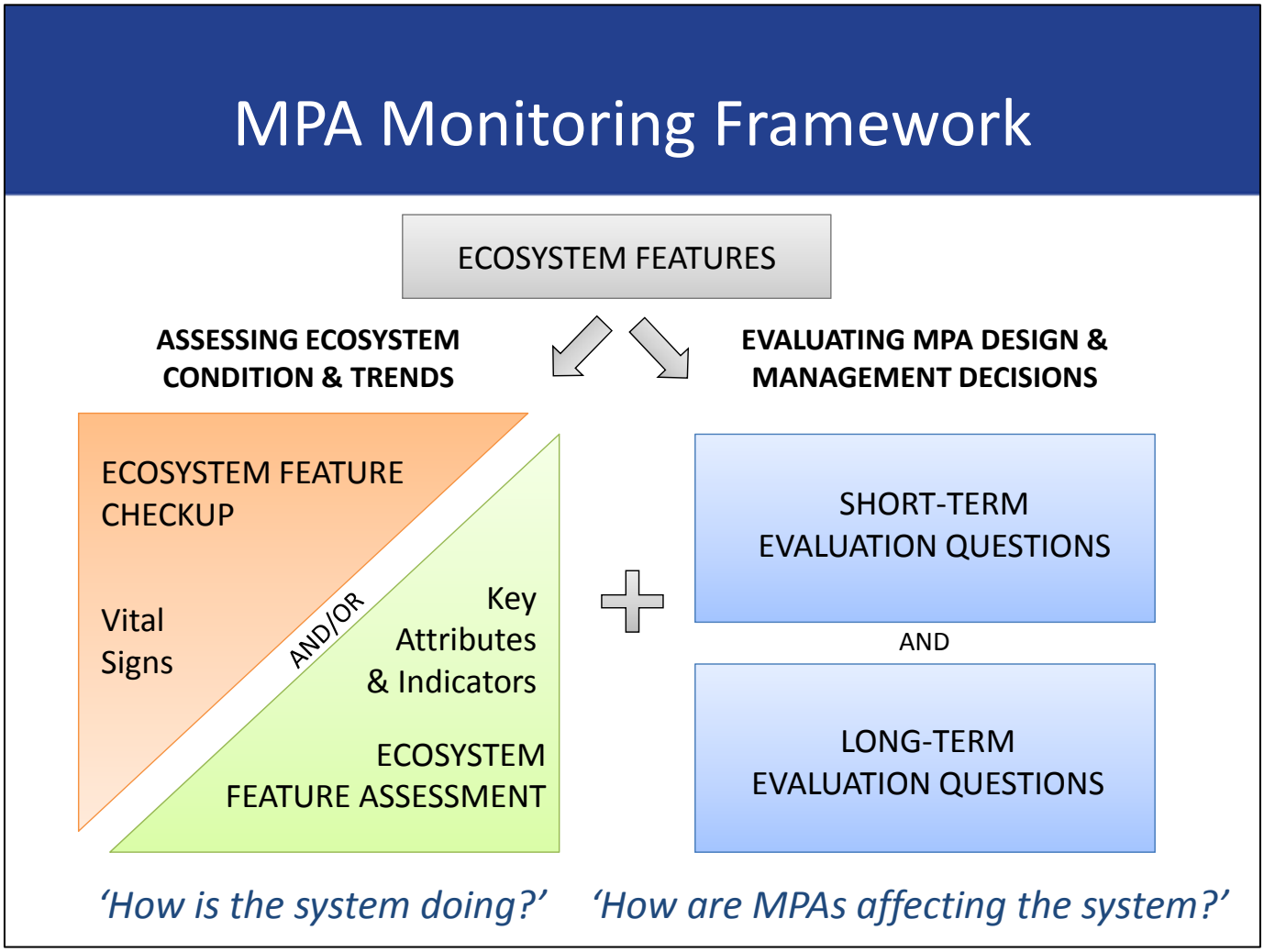
Name	Affiliation
Loni Adams	Department of Fish and Game
Calla Allison	City of Laguna Beach
Todd Anderson	San Diego State University
Rick Baker	Ocean Institute
Heidi Batchelor	Scripps Institute of Oceanography
Peter Bavasi	Scripps Coastal Reserve volunteer
John Butler	National Oceanographic and Atmospheric Administration (NOAA)
Dave Connell	Self
Michael Dong	Scripps Institute of Oceanography
Ken Franke	Sportfishing Association of California
Dale Ghere	Self
John Gill	JS Gill Photography
Christopher Granado	Juaneño Tribe/Acjachemen Nation of Orange County, CA
Kate Hanley	San Diego Coastkeeper
Irwin Haydock	Newport Bay Naturalists and Friends
Ray Hiemstra	Orange County Coastkeeper
Volker Hoehne	San Diego Freedivers
Lawrence Honma	Merkel & Associates
Maggie Houlihan	City of Encinitas
Mike Huber	Department of Defense
Nora Jans	RBF Consulting
Donna Kalez	Dana Wharf Sportfishing and Whale Watching
Isabelle Kay	University of California San Diego
Joel Kramer	San Elijo Lagoon Conservancy
Alan Kwok	Self
Barry Lindgren	San Elijo Lagoon Conservancy
Chad Loflen	State Water Resources Control Board
Brent Mardian	AMEC Earth & Environmental, Inc.
Jenny Marshall	U.S. Navy
Wesley Marx	Self
Carl Mayhugh	Pacific Ocean Works
Dan McCoy	Weston Solutions
Michael McCoy	Tijuana River National Estuarine Research Reserve
Garth Murphy	The Surfers Party
Jim Nakagawa	City of Imperial Beach
Shauna Oh	Scripps Institute of Oceanography
Dean Pasko	Orange County Sanitation District
Joe Prola	Self
Roxy Carter Raymundo	Surfrider Foundation
Annie Reisewitz	Strategic Ocean Solutions
John Riordan	Tuna Club of Avalon

Jim Rivera	Juaneño Tribe/Acjachemen Nation of Orange County, CA
Anthony Rivera Jr.	Juaneño Tribe/Acjachemen Nation of Orange County, CA
Dave Rudie	Catalina Offshore Products
Matthew Salinas	Juaneño Tribe/Acjachemen Nation of Orange County, CA
Ken Schiff	Southern California Coastal Water Research Project
Steve Schroeter	University of California Santa Barbara
Anne Spacie	Batiquitos Lagoon Foundation
Cary Marie Strand-Jack	Self
Chris Stransky	AMEC Earth & Environmental, Inc.
Tim Sullivan	Ocean Institute
Andrew Thompson	National Oceanographic and Atmospheric Administration (NOAA)
Louise Thornton	Laguna Ocean Foundation
Dave Valentine	Self
Bill Watson	National Oceanographic and Atmospheric Administration (NOAA) Southwest Fisheries Science Center
Meagan Wylie	San Diego Coastkeeper
Louie Zimm	San Diego Flyfishers, San Diego Yacht Club
Nikos Zoggas	WildCoast

Appendix 3: South Coast Monitoring Plan Development Timeline



Appendix 4: The MPA Monitoring Framework



Schematic diagram of the MPA Monitoring Framework showing the two principal monitoring elements: assessing ecosystem condition and trends; and evaluating MPA design and management decisions. Ecosystem condition and trends may be monitored using Ecosystem Feature Checkups, which employ monitoring metrics called Vital Signs, or by Ecosystem Feature Assessments, which employ Key Attributes and Indicators or Focal Species as monitoring metrics. MPA design and management decisions may be evaluated through answering targeted questions, including both short-term questions, expected to be answered within four years, and long-term questions, expected to take longer than four years to answer. Monitoring is focused using nine Ecosystem Features, which collectively represent and encompass a region's ecosystems, including humans, and is designed to deliver useful results in advance of the five-year MPA reviews recommended by the MLPA Master Plan.

APPENDIX C-4. SUMMARY REPORT FROM THE SOUTH COAST MPA MONITORING PLANNING WORKSHOP 2, NOVEMBER 8, 10, 15, 2010

South Coast Marine Protected Areas Monitoring Planning Round 2 Public Workshops

Workshop Overview

November 8, 2010 – Santa Barbara, California
November 10, 2010 – Culver City, California
November 15, 2010 – Carlsbad, California

Prepared by Kearns & West

Purpose of this Document
This document provides an overview of the discussions held at the South Coast Marine Protected Areas (MPA) Monitoring Planning Round 2 Public Workshops. The purpose of the workshops was to present and discuss draft metrics for monitoring MPAs in the South Coast region (Point Conception to the Mexico border, including the Channel Islands), as a step in developing the South Coast MPA Monitoring Plan. Written comments on the draft monitoring metrics were invited from workshop participants and anyone who wished to provide them before November 27, 2010.

The workshops were convened by the MPA Monitoring Enterprise, in cooperation with the Department of Fish and Game, and facilitated by Kearns & West. The workshops were held in Santa Barbara, Culver City and Carlsbad, California on November 8, 10 and 15 respectively. All workshops were open to the public, and the same agenda and format were followed at each workshop.

All input received during and after the workshops is being considered in the development of the South Coast MPA Monitoring Plan. This document does not contain the input received, but instead serves to provide highlights of the discussion from all three workshops. These discussion highlights are intended as a companion document to the workshop PowerPoint presentations and advance materials, available on the Monitoring Enterprise website at http://calost.org/South_Coast.html.

Outline of this Document

I. INTRODUCTION – WORKSHOP OBJECTIVES AND ORGANIZATION

Workshop Objectives

The purpose of this round of public workshops was to present and discuss draft monitoring metrics developed to monitor MPAs in the South Coast region. These workshops followed an initial round of public workshops held in July 2010. Specifically the workshop objectives were to:

1. Present and discuss with workshop participants:
    a. Draft monitoring metrics for assessing ecosystem condition and trends, and
    b. Draft questions to evaluate MPA design and management decisions; and
2. Invite written comment on the draft metrics and questions to be completed at and/or following the workshops.

Workshop Organization

Three workshops were held in different locations in order to facilitate participation by stakeholders living throughout the South Coast region. All three workshops followed the same agenda (see *Appendix 1*). Monitoring Enterprise staff presented a set of draft metrics for consideration by the workshop participants. Participants were invited to ask clarifying questions to learn about and understand the draft metrics. Participants, and others who wished to do so, were also invited to provide written comments on the draft monitoring metrics at and/or following the workshops; comments were due by November 27, 2010.

Eighty-one members of the public participated in the workshops. The list of workshop participants at each may be found in *Appendix 2*. The participants represented a broad variety of interests, including recreational and commercial fishing; conservation groups; California tribes and tribal communities; local, state, and federal agencies; ocean users; research institutions; and the general public.

Cheri Recchia, Director of the MPA Monitoring Enterprise, Jason Vasques, California Department of Fish & Game (DFG), and Eric Poncelet, Kearns & West facilitator, convened the workshop.

II. OVERVIEW OF SOUTH COAST MPA MONITORING PLAN DEVELOPMENT

Cheri Recchia, Director of the MPA Monitoring Enterprise, provided an overview of the Monitoring Enterprise and the MPA monitoring plan development process in the South Coast region.

The MPA Monitoring Enterprise was established to lead development of efficient, cost-effective monitoring of MPAs established under the Marine Life Protection Act (MLPA). The Monitoring Enterprise is not involved in MPA planning or adoption, nor does it make management recommendations.

The Monitoring Enterprise, working in close collaboration with the DFG, is currently developing the South Coast MPA Monitoring Plan. The monitoring plan will provide a framework and approach to guide the implementation of monitoring. Monitoring will be implemented first through the South Coast MPA Baseline Program, and subsequently through implementation of long-term monitoring.

The key steps in developing the plan are shown in the diagram in Appendix 3. In brief, the purpose of the first round of public workshops held in July 2010 was to obtain public perspectives on MPA monitoring priorities for the South Coast region. Input obtained during the

workshops together with input from scientists and other technical experts was used to inform development of draft monitoring metrics and approaches, which were presented in the second round of workshops. Input received at and following the second round of workshops is being considered in revising the draft metrics, which will then be incorporated into a draft South Coast MPA Monitoring Plan. The full plan will be released for public comment in early 2011, then revised and submitted to the Fish and Game Commission.

III. APPROACH TO MPA MONITORING TO MEET MLPA REQUIREMENTS

Liz Whiteman, Lead Scientist for the Monitoring Enterprise, introduced the monitoring framework developed to ensure that monitoring will meet Marine Life Protection Act (MLPA) requirements (see *Appendix 4*).

Overview of the monitoring framework

The top level of the monitoring framework is the set of Ecosystem Features chosen to collectively represent and encompass an MLPA region, and human uses, for the purposes of focusing MPA monitoring. Ten Ecosystem Features, selected in consultation with stakeholders and scientists, have been identified for the South Coast region:

- Consumptive Uses
- Non-consumptive Uses
- Kelp & Shallow (0 – 30m) Rock Ecosystems
- Mid-depth (30 – 100m) Rock Ecosystems
- Deep (> 100m) Ecosystems, including Canyons
- Rocky Intertidal Ecosystems
- Soft-bottom Subtidal (0 – 100m) Ecosystems
- Estuarine & Wetland Ecosystems
- Soft-bottom Intertidal & Beach Ecosystems
- Nearshore Pelagic Ecosystems (in state waters > 30m)

The Ecosystem Features provide the focus for two core MPA monitoring elements: (1) Assessment of Ecosystem Condition & Trends; and (2) Evaluation of MPA Design & Management Decisions. Assessment of ecosystem condition and trends will track the state of marine ecosystems, including human activities, in the South Coast region, and how they change over time inside and outside the MPAs. Evaluations of specific MPA design and management decisions, such as MPA size and spacing, will examine the effects of these decisions on Ecosystem Features or Ecosystem Feature components. Collectively, the two core monitoring elements will provide information to assess progress in achieving MLPA goals, and facilitate future adaptive management decisions.

The process to develop the South Coast MPA Monitoring Plan focuses on determining how best to apply these two core monitoring elements to the South Coast region, including identifying appropriate South Coast MPA monitoring metrics. Monitoring metrics include many different kinds of measurements, such as the numbers of a particular species, area of particular habitats, or numbers of people participating in a particular commercial or recreational use.

Assessing Ecosystem Condition & Trends

Assessments of ecosystem condition are implemented by monitoring the South Coast Ecosystem Features. There are two approaches or options for tracking the condition of Ecosystem Features: Ecosystem Feature Checkups and Ecosystem Feature Assessments. Ecosystem Feature Checkups are designed to be carried out by community and citizen-scientist

groups and thus use simplified sampling protocols and methods. The metrics for Checkups are referred to as Vital Signs, and they collectively provide a coarse-grained evaluation of Ecosystem Feature condition. Ecosystem Feature Assessments are more detailed and technically demanding than Checkups and thus are likely to be implemented by government agencies and research institutions. Metrics for Assessments are divided into two levels: key attributes, which are important aspects of the structure or functioning of the Ecosystem Feature, and indicators or focal species that provide insight into the condition of each key attribute. The indicators or focal species are used together to assess the key attribute, and the key attributes are used together to assess the Ecosystem Feature.

In addition to the draft metrics for monitoring via Checkups or Assessments, we also identify contextual information for each Ecosystem Feature. This information will facilitate the interpretation of monitoring results and includes, for example, information such as sea surface temperature, ocean currents, and indicators of water quality.

Evaluating MPA Design & Management Decisions
Evaluations of specific MPA design and management decisions, such as MPA size and spacing, will examine the effects of these decisions on Ecosystem Features or Ecosystem Feature components.

The establishment and on-going management of MPAs involve a number of decisions, ranging from fundamental design decisions made during the MPA planning process, such as MPA size and spacing, to day-to-day management decisions made to address ongoing and emerging issues, such as those related to managing visitors to MPAs. Monitoring to meet MLPA requirements includes evaluation of select MPA design and management decisions to inform future management decisions and thereby facilitate adaptive management.

To guide the implementation of this monitoring element, evaluations of MPA design and management decisions are categorized into two groups: (1) short-term evaluations, which are expected to generate conclusive information in four years or less (i.e., within one of the five-year MPA review periods recommended in the MLPA Master Plan); and (2) long-term evaluations, which are expected to take more than four years to answer. The potential MPA design and management questions function as an inventory from which priority questions to be addressed can be selected when this monitoring element is implemented.

Questions about the Approach to MPA Monitoring
Key clarifying questions raised during this portion of the workshops, along with responses received from Monitoring Enterprise staff, included:

Q: What is the relationship between indicators and vital signs?
A: Both vital signs (which are the metrics of an Ecosystem Feature Checkup) and indicators (which are the metrics of an Ecosystem Feature Assessment) encompass key aspects of each Ecosystem Feature needed to track the condition of that feature. Thus, they both include measurements of, for example, habitats and trophic structure as appropriate to assess ecosystem condition. Vital signs differ from indicators in that they are selected to be amenable to monitoring by community and citizen-science groups using simplified sampling protocols and methods. Collectively, vital signs provide a more coarse assessment of ecosystem condition than indicators.

Q: At what scales will monitoring data be collected and reported?

A: The monitoring framework is designed to be hierarchical, allowing data collection and reporting at a range of scales, including the South Coast region as a whole, individual ecosystem types (such as kelp forests), individual MPAs, and individual ecosystem components, such as selected species.

Q: Will monitoring occur inside and outside MPAs?
A: Yes. Assessing the effectiveness of MPAs requires monitoring to be conducted both inside and outside MPAs.

Q: Will MPA monitoring incorporate or build on existing monitoring programs in the South Coast region?
A: Yes. In the South Coast region, there are many programs and activities that may contribute to MPA monitoring. These include monitoring conducted for the purposes of fisheries and water quality management, as well as monitoring of existing MPAs (such as in the Channel Islands). In addition, there are many existing datasets that may be useful for MPA monitoring purposes. The South Coast MPA Baseline Program, the first step in implementing MPA monitoring in the region, will prioritize projects that will take advantage of existing data and partner with existing programs to meet Baseline Program purposes most efficiently.

Q: Will the South Coast MPA monitoring plan include fisheries monitoring?
A: Yes. Fisheries monitoring is necessary to assess the effectiveness of the MPAs and to meet the requirements of the MLPA. The draft monitoring metrics include socioeconomic and ecological aspects of consumptive human activities, including commercial and recreational fishing. For example, the metrics include monitoring of the spatial distribution, landings, catch per unit effort (CPUE) and economic value of commercial and recreational fisheries, focusing on economically and ecologically important species in each region. MPA monitoring thus overlaps with but does not encompass all monitoring required for fisheries management purposes.

Q: How will collected data be stored and managed?
A: The Monitoring Enterprise is currently developing an online Information Management System. The system will house and make publicly accessible MPA monitoring data, as well as analyses, reports and related information products, once they are available.

IV. ASSESSING ECOSYSTEM CONDITION AND TRENDS

Tess Freidenburg, Assistant Scientist for the Monitoring Enterprise, presented the draft monitoring metrics for tracking the condition of Ecosystem Features. These include key attributes and indicators, and vital signs. After the metrics for each Ecosystem Feature were presented, participants were invited to ask clarifying questions. An overview of key clarifying questions posed along with responses received is presented below.

[*Note: Workshop participants provided their actual feedback on the draft metrics via written comment submitted at and/or after the workshops; those comments are not summarized in this workshop overview document but are being considered by Monitoring Enterprise staff as they revise the draft metrics and develop a full draft South Coast MPA Monitoring Plan for agency review and public comment.*]

Q: Why are certain species included in one Ecosystem Feature but not another in which they also reside?
A: The metrics for each Ecosystem Feature are designed to encompass the most important information to assess the condition of that feature. Although species may occur within several

different ecosystems or habitats, the role that they play in the structuring or functioning of the ecosystem may be more important in one ecosystem than another. Thus, they are more likely to be identified for monitoring in the ecosystem where they play an important role. However, during analysis of monitoring results, information from one Ecosystem Feature can also be used to interpret the results from another Ecosystem Feature to understand changes more broadly in the region, inside and outside MPAs.

Q: Will MPA monitoring just consider the abundance of adults, or are young also included? How will data collection span different life history stages?
A: Many of the draft metrics include the size structure of the focal fish or invertebrate species as well as abundance or density, and thus both juveniles and adults will be counted and measured. In addition, some species have been identified as focal species or indicators in two different Ecosystem Features to ensure data collection encompasses different life history stages. For example, the draft metrics include monitoring of halibut in their nursery habitat, estuaries and wetlands, as well as in soft-bottom subtidal ecosystems where they are most common as adults.

Q: Will monitoring include diversity indices?
A: Diversity metrics are currently identified as optional add-ons to Ecosystem Feature Assessments that can be implemented where resources, capacity and expertise permit. While these indices provide additional information, there is a complex relationship between species diversity and ecosystem condition and the results are hard to interpret. For example, increases in diversity often occur as a result of ecosystem disturbance or as a result of increases in invasive species numbers. The attributes and indicators instead encompass the key aspects of ecosystem structure and function needed to assess ecosystem condition.

Q: Will illegal uses, like poaching, be monitored?
A: Information about MPA compliance will be essential for correctly interpreting MPA monitoring results. MPA enforcement and compliance monitoring are the responsibility of the Department of Fish and Game (DFG) and will be conducted by DFG and its partners. All available compliance information will be used during analysis and interpretation of monitoring results.

Q: Is monitoring of knowledge and attitudes included within MPA monitoring?
A: Knowledge, attitudes and perception (KAP) surveys are designed to monitor changes in attitudes and are included within the metrics for monitoring consumptive and non-consumptive uses. Typically, KAP surveys are most usefully conducted once every five years, or even less frequently.

Q: What were the considerations in selecting non-consumptive uses for monitoring?
A: The draft non-consumptive uses for monitoring reflect consideration of uses likely to respond to MPAs, activities with many participants in the region and activities with relationships to ecological changes. We also considered the input from the first round of monitoring planning public workshops to ensure that the non-consumptive uses to be monitored reflect stakeholder interests and priorities.

Q: How will human-caused changes to the landscape (e.g., construction of a road over a lagoon) be considered?
A: In order to correctly interpret monitoring results, it will be important to consider other types of information, referred to as contextual information. Human changes to the landscape, including coastal development, are examples of contextual information. Other examples include oceanographic, water quality, and economic information. This information will be incorporated into analyses and interpretation of MPA monitoring results. Linkages and information exchanges

with programs collecting contextual data will be provided for in the South Coast MPA Monitoring Plan.

V. EVALUATING MPA DESIGN & MANAGEMENT DECISIONS

Liz Whiteman described the second core element of monitoring: Evaluating MPA Design & Management Decisions (see *Appendix 4*).

Monitoring to meet MLPA requirements includes evaluation of select MPA design and management decisions such as MPA size, spacing and visitation to inform future management decisions. To guide the implementation of this monitoring element, potential evaluations are categorized into two groups: short-term evaluations, which are expected to generate conclusive information in four years or less (i.e., within one of the five-year MPA review periods recommended in the MLPA Master Plan); and long-term evaluations, which are expected to take more than four years to answer.

In addition to the long- and short-term questions presented in the advance materials, the final version of the monitoring plan will include questions that are specific to the network of MPAs adopted by the Fish and Game Commission.

An overview of key clarifying questions posed and the responses provided is presented below.

[*Note: Workshop participants provided their actual feedback on the draft questions via written comment submitted at and/or after the workshops; those comments are not summarized in this workshop overview document but are being considered by Monitoring Enterprise staff as they revise the draft metrics and develop a full draft South Coast MPA Monitoring.*]

Q: Is monitoring itself open to adaptive management?
A: Yes, both the monitoring plan and monitoring itself will be periodically evaluated to ensure that they remain aligned with management needs, take advantage of new, improved monitoring methods, and incorporate advances in scientific understanding of MPAs and marine ecosystems.

Q: Is the Monitoring Enterprise involved in making management decisions?
A: The Monitoring Enterprise does not make management recommendations or decisions. Rather, we lead development and implementation of monitoring that will assess progress towards MLPA goals and provide results to inform management decisions.

VI. POST-WORKSHOP NEXT STEPS

Workshop participants and anyone who wished to do so were invited to submit written comments on the draft monitoring metrics by completing a comment form at the workshop and/or by submitting a comment form following the workshop, through November 27, 2010. All comments submitted via the comment form are being considered by the Monitoring Enterprise staff as they continue to develop the draft South Coast MPA Monitoring Plan.

Following this second round of public workshops, Monitoring Enterprise staff continue to further develop and refine the draft monitoring metrics to reflect the input received from the two rounds of public workshops and from technical experts and to ensure that monitoring meets the requirements of the MLPA.

A draft South Coast MPA Monitoring Plan will be released for public comment, likely in early 2011. The Monitoring Enterprise will then revise the plan in consideration of comments received, and submit it to the Fish and Game Commission. If adopted by the Commission, the plan will be incorporated into the MLPA Master Plan for MPAs.

Throughout the South Coast MPA monitoring planning process, the Monitoring Enterprise will share updates and progress through its website (monitoringenterprise.org) and listserv (sign-up on the Monitoring Enterprise website). For any additional comments or questions, please contact the Monitoring Enterprise by email at: mpamonitoring@calost.org.

Appendix 1: Workshop Agenda

South Coast Marine Protected Areas (MPA) Monitoring Planning – Public Workshops, Round 2

Monday, November 8	*Wednesday, November 10*	*Monday, November 15*
Santa Barbara, CA	*Culver City, CA*	*Carlsbad, CA*
Hotel Mar Monte	*Radisson Hotel Los Angeles*	*Hilton Garden Inn*
1111 East Cabrillo Boulevard	*Westside*	*6450 Carlsbad Boulevard*
**Free Parking*	*6161 Centinela Avenue*	**Free Parking*
	**Parking $8*	

All three workshops will have the same format and agenda.

Workshop Purpose

The MPA Monitoring Enterprise, in collaboration with the Department of Fish and Game, is holding a second round of public workshops to inform development of a South Coast MPA Monitoring Plan. The purpose of these Round 2 workshops is to provide an opportunity for members of the public to learn about and discuss draft metrics for monitoring South Coast MPAs. Development of the draft metrics was informed by public input received during the Round 1 Public Workshops (held in July 2010), as well as by discussions with scientists and other monitoring experts. The Monitoring Enterprise is seeking written comment on the draft metrics at and/or following the workshops. The deadline for submission of written comments is November 27, 2010. Comments received will not be responded to individually, but will inform development of a draft South Coast MPA Monitoring Plan which will be released for public comment likely in spring 2011.

Workshop Objectives

Staff of the Monitoring Enterprise will:

1. Present and discuss with workshop participants:
    a. Draft monitoring metrics for assessing ecosystem condition and trends, and
    b. Draft questions to evaluate MPA design and management decisions; and
2. Invite written comment on the draft metrics and questions, at and/or following the workshops.

Agenda

8:30 Arrival and Sign-in
9:00 Welcome, Introductions, and Agenda Review
9:15 Overview of the South Coast MPA Monitoring Plan Development
9:45 Review of Approach to MPA Monitoring to Meet MPLA Requirements
10:15 Break

Note: Each of the following sessions will consist of a short presentation followed by Q & A. Guidance for submitting written comments will also be provided.

10:30 Session #1 – Assessing Condition and Trends of Human Use Ecosystem Features
- Consumptive Uses
- Non-consumptive Uses

11:15 Session #2 – Assessing Condition and Trends of Intertidal Ecosystem Features
- Rocky Intertidal Ecosystems
- Soft-bottom Intertidal & Beach Ecosystems
- Estuarine & Wetland Ecosystems

12:15 Lunch (provided for people who have RSVP'd by Oct. 29)

1:15 Session #3 - Assessing Condition and Trends of Subtidal Ecosystem Features
- Kelp & Shallow Rock Ecosystems
- Mid-depth Rock Ecosystems
- Deep Ecosystems, including Canyons
- Soft-bottom Subtidal Ecosystems
- Nearshore Pelagic Ecosystems

2:45 Break
3:00 Session #4 – Evaluating MPA Design and Management Decisions
3:45 General Clarifying Questions and Feedback
4:00 Next Steps, Guidance for Submitting Comments, and Workshop Close
4:30 Adjourn

Appendix 2: Workshop Attendees

November 8, 2010, Santa Barbara

Hotel Mar Monte, Santa Barbara, CA

Name	Affiliation
Steven Appleton	Self
Jeremy Bordofsky	Spearfisherman
Chris Cohen	Southern California Coastal Ocean Observing System
Jenny Dugan	University of California Santa Barbara
Jenn Feinberg Eckerle	Natural Resources Defense Council
Jan Freiwald	Reef Check California
Chris Goldblatt	Gold Leaf Sustainable
Greg Helms	Ocean Conservancy
Sal Inda	Self
David Kushner	Channel Islands National Park
Vennise Miller-Forte	Coastal Band of Chumash Nation
Dominique Monie	California MLPA Initiative
Stephanie Mutz	Commercial Fishermen of Santa Barbara, Inc.
Dan Robinette	PRBO Conservation Science
Diana Russell	California Recreational Fisheries Surveys
Michael Sheehy	Santa Barbara Channelkeeper
Craig Shuman	California Fish and Game Commission
John Ugoretz	U.S. Navy/Department of Defense
Chris Voss	California Abalone Association
Paul Weakland	Self

November 10, 2010, Culver City

Radisson Los Angeles Westside Hotel, Culver City, CA

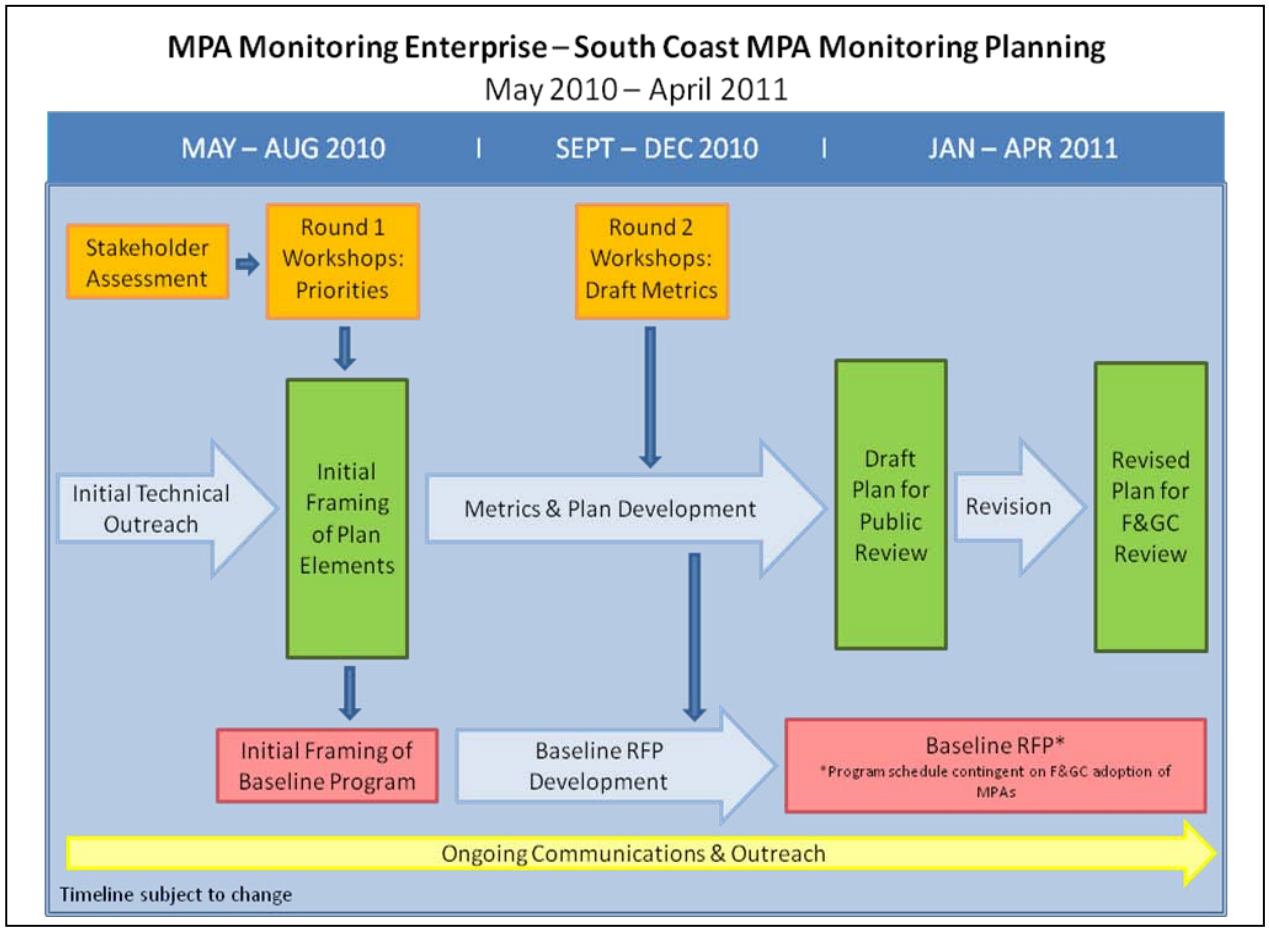
Name	Affiliation
Bob Bertelli	CA Sea Urchin Commission
Laurel Fink	Reef Check California
Josh Fisher	California Lobster & Trap Fishermen's Association
Tom Ford	Santa Monica Bay Restoration Commission
Phyllis Grifman	Sea Grant, University of Southern California
Renee Klein	Santa Monica High School
Ken Kurtis	Statewide Interest Group (SIG)
Karen Martin	Pepperdine University
Brian Meux	Santa Monica Baykeeper
Dana Murray	Heal the Bay
Shauna Oh	Scripps Institution of Oceanography
Bob Osborn	United Anglers of Southern California
Ana Pitchon	California State University Dominguez Hills
Lia Protopapadakis	Santa Monica Bay Restoration Commission
Freddie Romero	Santa Ynez Band of Chumash
Steve Santen	Community Police Advisory Board
Sarah Sikich	Heal the Bay
Kenny Swanson	Self
Guangyu Wang	State Water Resources Control Board
Dave Weeshoff	International Bird Rescue Research Center
Jon Wirsing	Redondo Beach Marina

November 15, 2010, Carlsbad

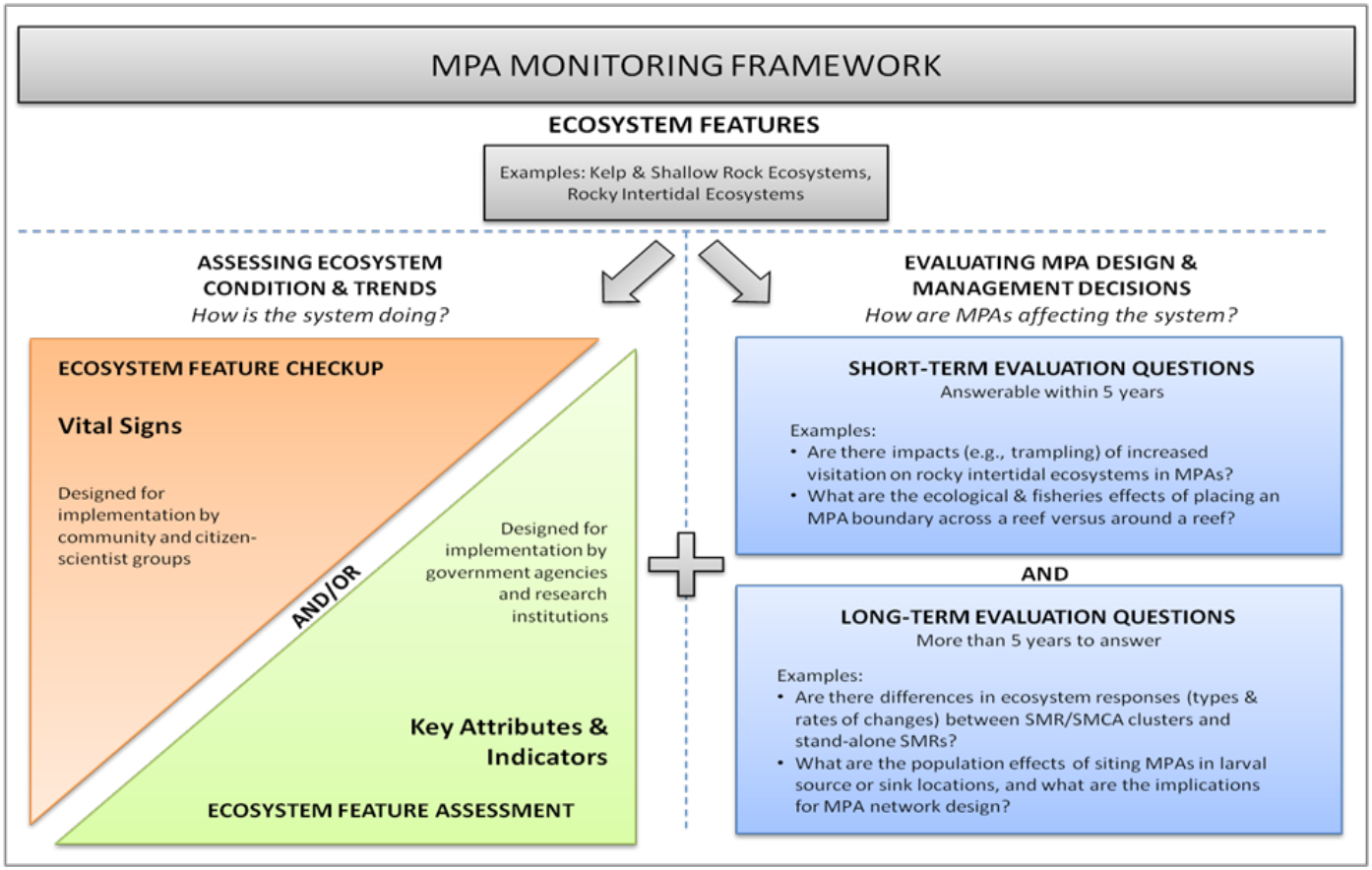
Hilton Garden Inn, Carlsbad, CA

Name	Affiliation
Heidi Batchelor	Scripps Institution of Oceanography
Peter Bavasi	Scripps Coastal Reserve
Dave Connell	Self
Jim Covell	University of California San Diego
Bob Crane	Seacoast Preservation Association
Jeff Crooks	Tijuana River National Estuarine Research Reserve and the Southwest Wetlands Interpretive Association
Amanda Dillon	Scripps Institution of Oceanography
Wayne Dolik	Self
Gerald D'Spain	University of California San Diego
Joe Exline	Oceanside Anglers Club
Steve Gruber	Weston Solutions, Inc.
Joe Gully	Los Angeles County Sanitation Districts
Irwin Haydock	Newport Bay Naturalists and Friends
Ray Hiemstra	Orange County Coastkeeper
Lawrence Honma	Merkel & Associates, Inc.
Michael Huber	Department of Defense
Donna Kalez	Dana Wharf Sportfishing and Whale Watching
Tony Koslow	Scripps Institution of Oceanography
Barry Lindgren	San Elijo Lagoon Conservancy
Wesley Marx	Self
Dave Mayer	Tenera Environmental, Inc.
Daniel McCoy	Weston Solutions, Inc.
Mike McCoy	Tijuana River National Estuarine Research Reserve
Leslea Meyerhoff	City of Solana Beach
Jim Nakagawa	City of Imperial Beach
Ken Nielsen	Seaventures Inc.
Dean Pasko	Orange County Sanitation District
David Pryor	California State Parks
Jeff Rosaler	City of Dana Point
Steve Schroeter	UCSB, Marine Science Institute
Anne Spacie	Batiquitos Lagoon Foundation
Chris Stransky	AMEC Earth & Environmental
Andrew Thompson	NOAA Fisheries Service
Louise Thornton	Laguna Ocean Foundation
Dave Valentine	Self
Bill Watson	NOAA Southwest Fisheries Science Center
Katherine Weldon	City of Encinitas
Colleen Wisniewski	Reef Check Foundation
Meagan Wylie	San Diego Coastkeeper
Jeremy Zagarella	Pauma Band of Indians

Appendix 3: Monitoring Plan Development Process



Appendix 4: Monitoring Framework



Schematic diagram of the South Coast MPA Monitoring Framework showing the two principal monitoring elements: (1) Assessing Ecosystem Condition & Trends; and (2) Evaluating MPA Design & Management Decisions. Ecosystem condition and trends may be monitored using Ecosystem Feature Checkups, which employ monitoring metrics called Vital Signs, or through Ecosystem Feature Assessments, which employ Key Attributes and Indicators or Focal Species as monitoring metrics. MPA design and management decisions are evaluated through answering targeted questions, including both short-term questions, expected to be answered within four years (one monitoring and reporting cycle), and long-term questions, expected to take longer than four years to answer. Monitoring is focused using ten Ecosystem Features, which collectively represent and encompass the South Coast ecosystems, including humans, and is designed to deliver useful results in advance of the five-year MPA reviews recommended by the MLPA Master Plan.

APPENDIX C-5. SOUTH COAST REGIONAL GOALS AND OBJECTIVES

During the MPA planning process, goals and objectives for the South Coast regional MPA network were developed, based on the statewide goals expressed in the MLPA. The California Marine Life Protection Act Initiative, South Coast Regional Goals and Objectives (Approved by the MLPA Blue Ribbon Task Force on February 26, 200) details these goals and objectives.

California MLPA South Coast Project
Adopted Regional Goals and Objectives and Design and Implementation Considerations for the MLPA South Coast Study Region
February 26, 2009

Adopted by the MLPA South Coast Regional Stakeholder Group on January 14, 2009
Approved by the MLPA Blue Ribbon Task Force on February 26, 2009

Introduction

The members of the MLPA South Coast Regional Stakeholder Group (SCRSG) agree that regional goals, objectives, and design and implementation considerations are all very important in the development of an effective system of marine protected areas (MPAs) that has stakeholder support and meets the Marine Life Protection Act (MLPA) goals. MLPA goals are broad statements of what the regional MPAs are ultimately trying to achieve (Pomeroy et al. 2004)[1] and are provided in the MLPA. Regional objectives are more specific measurable statements of what MPAs may accomplish to attain a related goal (Pomeroy et al. 2004). The SCRSG recognizes that MPAs are one among a suite of tools to manage marine resources.

Design considerations are additional factors that may help fulfill provisions of the MLPA related to facilitating enforcement, encouraging public involvement, and incorporating socio-economic considerations, while meeting the MLPA's goals and guidelines. Design considerations will be applied as the location, classification (reserve, park or conservation area), size and other characteristics of potential MPAs are being developed. Design considerations are cross-cutting (they apply to all MPAs) and are not necessarily measurable. MPA alternatives developed by the SCRSG should include analysis of how the proposal addresses the MLPA goals and regional objectives and design and implementation considerations.

[1] Pomeroy R.S., J.E. Parks, and L.M. Watson. 2004. How is your MPA doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness. IUCN, Gland, Switzerland and Cambridge, UK. xvi + 216 p. (Accessed 17 January 2004). http://effectivempa.noaa.gov/guidebook/guidebook.html.

Regional Goals and Objectives

The marine protected area (MPA) design process begins with setting regional goals and objectives that are consistent with the MLPA, then identifying site-specific rationales for individual MPAs. Once set, regional goals and objectives influence crucial decisions regarding MPA size, location and boundaries, as well as management measures and the focus of monitoring and evaluation programs.

Goal 1. To protect the natural diversity and abundance[2] of marine life, and the structure, function, and integrity of marine ecosystems.

1. Protect and maintain species diversity and abundance consistent with natural fluctuations, including areas of high native species diversity and representative habitats.
2. Protect areas with diverse habitat types in close proximity to each other.
3. Protect natural size and age structure and genetic diversity of populations in representative habitats.
4. Protect biodiversity, natural trophic structure and food webs in representative habitats.
5. Promote recovery of natural communities from disturbances, both natural and human induced, including water quality.

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

1. Help protect or rebuild populations of rare, threatened, endangered, depressed, depleted, or overfished species, and the habitats and ecosystem functions upon which they rely.[3]
2. Sustain or increase reproduction by species likely to benefit from MPAs, with emphasis on those species identified as more likely to benefit from MPAs, and promote retention of large, mature individuals[4].

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[2] *Natural diversity* is the species richness of a community or area when protected from, or not subjected to, human-induced change (drawn from Allaby 1998 and Kelleher 1992). *Natural abundance* is the total number of individuals in a population protected from, or not subjected to, human-induced change (adapted from Department 2004 and Kelleher 1992).

[3] The terms "rare," threatened," "endangered," "depressed," "depleted," and "overfished" referenced here are designations in state and federal legislation, regulations, and fishery management plans (FMPs) - e.g., California Fish and Game Code, Marine Mammal Protection Act, Magnuson Stevens Fishery Conservation and Management Act, California Nearshore FMP, Federal Groundfish FMP. Rare, e*ndangered,* and *threatened* are designations under the California Endangered Species Act. *Depleted* is a designation under the federal Marine Mammal Protection Act. *Depressed* means the condition of a marine fishery that exhibits declining fish population abundance levels below those consistent with maximum sustainable yield (California Fish and Game Code, Section 90.7). *Overfished* means a population that does not produce maximum sustainable yield on a continuing basis (MSA) and in the California Nearshore FMP and federal Groundfish FMP also means a population that falls below the threshold of 30% or 25%, successively, of the estimated unfished biomass

3. Sustain or increase reproduction by species likely to benefit from MPAs with emphasis on those species identified as more likely to benefit from MPAs through protection of breeding, spawning, foraging, rearing or nursery areas or other areas where species congregate.
4. Protect selected species and the habitats on which they depend while allowing some commercial and/or recreational harvest of migratory, highly mobile, or other species; and other activities.

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

1. Sustain or enhance cultural, recreational, and educational experiences and uses (for example, by improving catch rates, maintaining high scenic value, lowering congestion, increasing size or abundance of species, and protection of submerged sites).
2. Provide opportunities for scientifically valid studies, including studies on MPA effectiveness and other research that benefits from areas with minimal or restricted human disturbance.
3. Provide opportunities for collaborative scientific monitoring and research projects that evaluate MPAs that promote adaptive management and link with fisheries management, seabird and mammals information needs, classroom science curricula, cooperative fisheries research and volunteer efforts, and identifies participants.

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

1. Include within MPAs key and unique habitats identified by the MLPA Master Plan Science Advisory Team for this study region.
2. Include and replicate to the extent possible [practicable], representatives of all marine habitats identified in the MLPA or the *California Marine Life Protection Act Master Plan for Marine Protected Areas* across a range of depths.

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

1. Minimize negative socio-economic impacts and optimize positive socio-economic impacts for all users including coastal dependent entities, communities and interests, to

[4] An increase in lifetime egg production will be an important quantitative measure of an improvement of reproduction.

the extent possible, and if consistent with the Marine Life Protection Act and its goals and guidelines.

2. Provide opportunities for interested parties to help develop objectives, a long-term monitoring plan that includes standardized biological and socioeconomic monitoring protocols, a long-term education and outreach plan, and a strategy for MPA evaluation.
3. Effectively use scientific guidelines in the *California Marine Life Protection Act Master Plan for Marine Protected Areas*.
4. Ensure public understanding of, compliance with, and stakeholder support for MPA boundaries and regulations.
5. Include simple, clear, and focused site-specific objectives/rationales for each MPA and ensure that site-level rationales for each MPA are linked to one or more regional objectives.

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

1. Provide opportunities to promote a process that informs adaptive management and includes stakeholder involvement for regional review and evaluation of management effectiveness to determine if regional MPAs are an effective component of a statewide network.
2. Provide opportunities to coordinate with future MLPA regional stakeholder groups in other regions to ensure that the statewide MPA network meets the goals of the MLPA.
3. Ensure ecological connectivity within and between regional components of the statewide network.
4. Provide for protection and connectivity of habitat for those species that utilize different habitats over their lifetime.

Regional Design and Implementation Considerations

Design Considerations

The SCRSG recognizes several issues that should be considered in the design and evaluation of MPAs. Like the "Considerations in the Design of MPAs" that appears in the *California Marine Life Protection Act Master Plan for Marine Protected Areas*, these considerations may apply to all MPAs and MPA proposals regardless of the specific regional goals and objectives for that MPA and may contribute to the site-level rationales for individual MPA design and placement.

The design considerations will be incorporated with the goals and objectives and transmitted to the MLPA Blue Ribbon Task Force for adoption and then to the California Fish and Game Commission as part of the suite of recommendations for the study region. Design considerations with long-term monitoring components will be used in developing monitoring plans and to inform the adaptive management process.

Design considerations include:

1. In evaluating the siting of MPAs, considerations shall include the needs and interests of all users.
2. When designing or modifying MPAs, consider leveraging relevant portions of existing management activities and area-based restrictions, including state and federal fishery management areas and regulations (such as rockfish conservation areas and trawl fishery closures, or other restricted access zones).
3. Site MPAs to prevent fishing effort shifts that would result in serial depletion.
4. When crafting MPA proposals, include considerations for design found in state fishery management plans such as the Nearshore Fishery Management Plan[5] and the Abalone Recovery and Management Plan.[6]

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[5] Design considerations from the Nearshore Fishery Management Plan:

1. 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.
2. 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.
3. Include some areas known to enhance distribution or retain larvae of NFMP species
4. 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.
5. Consist of areas that replicate various habitat types within each region including areas that exhibit representative productivity.

[6] Design considerations from the Abalone Recovery and Management Plan:
Proposed MPA sites should satisfy at least four of the following criteria.

1. Include within MPAs suitable rocky habitat containing abundant kelp and/or foliose algae
2. Insure presence of sufficient populations to facilitate reproduction.
3. Include within MPAs suitable nursery areas, in particular crustose coralline rock habitats in shallow waters that include microhabitats of moveable rock, rock crevices, urchin spine canopy, and kelp holdfasts.
4. Include within MPAs the protected lee of major headlands that may act as collection points for water and larvae.

5. In developing MPA proposals, consider how existing state, local and federal programs address the goals and objectives of the MLPA and the south coast study region as well as how these proposals may coordinate with other programs.
6. Site MPAs adjacent to terrestrial federal, state, county, or city parks, marine laboratories, or other "eyes on the water" to facilitate management, enforcement, monitoring, education and outreach.
7. Site MPAs to facilitate use of volunteers to assist in monitoring and management.
8. Site MPAs to take advantage of existing long-term monitoring studies.
9. Design MPA boundaries that facilitate ease of public recognition and ease of enforcement.
10. Consider existing public coastal access points when designing MPAs.
11. MPA design should consider the benefits and drawbacks of siting MPAs near to or remote from public access.
12. Consider the potential impacts of climate change, ocean acidification, community alteration, and distributional shifts in marine species when designing MPAs.
13. Preserve the diversity of recreational, educational, commercial, and cultural uses.
14. Optimize the design of the MPA network to facilitate monitoring and research that answers resource management questions; an example is including MPAs of different protection levels in similar habitats and depths, adjacent or in otherwise comparable locations, to state marine reserves, to evaluate the effectiveness of different protection levels in meeting regional and statewide goals.
15. Ensure some MPAs are close to population centers, coastal access points, and/or research and education institutions and include areas of educational, recreational, and cultural use.

Implementation Considerations

Implementation considerations arise after the design of MPAs, when the California Department of Fish and Game and any other responsible agencies implement decisions of the California Fish and Game Commission and, if appropriate, the California Park and Recreation Commission, with funding from the California State Legislature or other sources.

Implementation considerations will be incorporated with the regional goals and objectives and design considerations and transmitted to the MLPA Blue Ribbon Task Force for adoption and, then to the California Fish and Game Commission as part of the suite of recommendations for the study region.

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5. Include MPAs large enough to include large numbers of abalone and for research regarding population dynamics.
6. Include MPAs that are accessible to researchers, enforcement personnel, and others with a legitimate interest in resource protection.

The MLPA South Coast Regional Stakeholder Group recommends the following implementation and management activities, as appropriate, also be included in the regional MPA management plans required under the *California Marine Life Protection Act Master Plan for Marine Protected Areas* (section 4.0) for designated MPAs.

1. Improve public outreach related to MPAs through the use of docents, improved signage, and production of an educational brochure for south coast MPAs.
2. When appropriate, phase the implementation of south coast MPAs to ensure their effective management, monitoring, and enforcement.
3. Ensure adequate funding for monitoring, management, outreach and enforcement is available for implementing new MPAs.
4. Develop coordinated regional management and enforcement plans in coordination with state, local, and federal entities, including cooperative enforcement agreements, adaptive management, and jurisdictional maps, which can be effectively used, adopted statewide, and periodically reviewed.
5. Incorporate volunteer monitoring and/or cooperative research, where appropriate.

APPENDIX C-6. LIST OF SPECIES LIKELY TO BENEFIT FROM MPAS IN THE SOUTH COAST REGION

This document was included as Appendix C in the South Coast Regional Profile and lists species identified by the South Coast Science Advisory Team (SCSAT) as those likely to benefit from MPAs, as well as special status species in the South Coast region

Appendix C: Species Likely to Benefit from MPAs and Special Status Species in the MLPA South Coast Study Region

(a) Species likely to benefit from marine protected areas in the MLPA South Coast Study Region

(b) Special status species likely to occur in the MLPA South Coast Study Region

For information on the criteria used in identifying species likely to benefit from MPAs please see the MLPA Initiative South Coast Study Region website http://www.dfg.ca.gov/mlpa/southcoast.asp

Appendix C: Species Likely to Benefit from MPAs andSpecial-Status Species

This appendix contains two sections:

C.1 Species likely to benefit from marine protected areas in the MLPA South Coast Study Region

C.2 Special status species likely to occur in the MLPA South Coast Study Region

C.1 Species Likely to Benefit From MPAs

The Marine Life Protection Act requires that species likely to benefit from MPAs be identified; identification of these species will contribute to the identification of habitat areas that will support achieving the goals of the MLPA. The *California Marine Life Protection Act Master Plan for Marine Protected Areas* (DFG 2008) includes a broad list of species likely to benefit from protection within MPAs. The master plan also indicates that regional lists will be developed by the MLPA Master Plan Science Advisory Team (SAT) for each study region described in the master plan.

A list of species likely to benefit for the MLPA South Coast Study Region (Point Conception in Santa Barbara County to the California/Mexico border in San Diego County) has been compiled and approved by the SAT.

The SAT used a scoring system to develop the list of species likely to benefit. This scoring system was developed to provide a metric that is more useful when comparing species than a simple on/off the list metric. Each species was scored using "1" to indicate a criterion was met or "0" to indicate a criterion was not met. Species on the list meet the following filtering criteria:

- they occur in the study region,
- they must score a "1" for either the "Removal and Discards" or "Disturbance" criterion (possible high score of 2), which means they are either taken directly or indirectly in commercial or recreational fisheries, or are otherwise targeted for take or collection for other uses, or suffer reduced survival or reproductive output as a result of human disturbance, and
- they must score a "1" for either the "Feature Association" or "Limited Adult Home Range" criteria (possible high score of 2), which means a species biomass or abundance would increase due to the protection of features that species is known to favor, or the species has a limited or small adult home range.

Special-status species and species with abundance below the range of natural fluctuations also received a score of "1", resulting in a highest possible score of 5. A higher score suggests a species is more apt to benefit from or respond to MPAs.

Table C-1. Species likely to benefit from MPAs

Common Name	Scientific Name	Total Score
	Fish	
Surfperch, barred	*Amphistichus argenteus*	4
Bass, kelp	*Paralabrax clathratus*	4
Bass, barred sand	*Paralabrax nebulifer*	4
Scorpionfish, California	*Scorpaena guttata*	4
Bass, Giant sea	*Stereolepis gigas*	4

Common Name	Scientific Name	Total Score
Surfperch, shiner	*Cymatogaster aggregata*	3
Surfperch, rainbow	*Hypsurus caryi*	3
Grouper, Broomtail	*Mycteroperca xenarcha*	3
Steelhead	*Oncorhynchus mykiss*	3
Lingcod	*Ophiodon elongatus*	3
Bass, spotted sand	*Paralabrax maculatofasciatus*	3
Turbot, C-O	*Pleuronichthys coenosus*	3
Croaker, spotfin	*Roncador stearnsii*	3
Cabezon	*Scorpaenichthys marmoratus*	3
Rockfish, kelp	*Sebastes atrovirens*	3
Rockfish, brown	*Sebastes auriculatus*	3
Rockfish, aurora	*Sebastes aurora*	3
Rockfish, redbanded	*Sebastes babcocki*	3
Rockfish, gopher	*Sebastes carnatus*	3
Rockfish, copper	*Sebastes caurinus*	3
Rockfish, greenspotted	*Sebastes chlorostictus*	3
Rockfish, starry	*Sebastes constellatus*	3
Rockfish, darkblotched	*Sebastes crameri*	3
Rockfish, calico	*Sebastes dallii*	3
Rockfish, swordspine	*Sebastes ensifer*	3
Rockfish, pink	*Sebastes eos*	3
Rockfish, squarespot	*Sebastes hopkinsi*	3
Rockfish, freckled	*Sebastes lentiginosus*	3
Cowcod	*Sebastes levis*	3
Rockfish, blackgill	*Sebastes melanostomus*	3
Rockfish, vermilion	*Sebastes miniatus*	3
Rockfish, speckled	*Sebastes ovalis*	3
Bocaccio	*Sebastes paucispinis*	3
Rockfish, grass	*Sebastes rastrelliger*	3
Rockfish, rosy	*Sebastes rosaceus*	3
Rockfish, greenblotched	*Sebastes rosenblatti*	3
Rockfish, flag	*Sebastes rubrivinctus*	3
Rockfish, bank	*Sebastes rufus*	3
Rockfish, olive	*Sebastes serranoides*	3
Rockfish, treefish	*Sebastes serriceps*	3
Rockfish, pinkrose	*Sebastes simulator*	3
Rockfish, honeycomb	*Sebastes umbrosus*	3
Sheephead, California	*Semicossyphus pulcher*	3
Shark, Pacific angel	*Squatina californica*	3
Shark, leopard shark	*Triakis semifasciatus*	3
Seabass, white	*Atractoscion nobilis*	2
Croaker, black	*Cheilotrema saturnum*	2
Blacksmith	*Chromis punctipinnis*	2
Surfperch, black	*Embiotoca jacksoni*	2
Opaleye	*Girella nigricans*	2
Shark, horn	*Heterodontus francisci*	2
Sculpin, staghorn	*Leptocottus armatus*	2
Grunion, Calfiornia	*Leuresthes tenuis*	2
Goby, bluebanded	*Lythrypnus dalli*	2
Goby, zebra	*Lythrypnus zebra*	2
Halfmoon	*Medialuna californiensis*	2

Common Name	Scientific Name	Total Score
Surfperch, rubberlip	*Rhacochilus toxotes*	2
Surfperch, pile	*Rhacochilus vacca*	2
Guitarfish, shovelnose	*Rhinobatos productus*	2
Rockfish, blue	*Sebastes mystinus*	2
	Invertebrates	
California mussel	*Mytilus californianus*	4
Sea Hare (two species)	*Aplysia spp.*	3
Shrimp, Ghost	*Callianassa spp.*	3
Crab, Brown Rock	*Cancer antennarius*	3
Crab, Yellow Rock	*Cancer anthonyi*	3
Scallop, Rock	*Crassadoma gigantea*	3
Abalone, pink	*Haliotis corrugata*	3
Abalone, black	*Haliotis cracherodii*	3
Abalone, green	*Haliotis fulgens*	3
Abalone, red	*Haliotis rufescens*	3
Abalone, white	*Haliotis sorenseni*	3
Whelk, Kellets	*Kelletia kelletii*	3
Wavy Turban Snail	*Megastrea undosa*	3
Mussels (several spp.)	*Mytilus spp., Septifer spp., Brachydontus spp.*	3
Prawn, Spot	*Pandalus platyceros*	3
Lobster, Ca. Spiny	*Panulirus interruptus*	3
Cucumber, California Sea	*Parastichopus californicus*	3
Cucumber, Warty Sea	*Parastichopus parvimensis*	3
Sandcastle worm	*Phragmatopoma californica*	3
Ochre Star	*Pisaster ochraceus*	3
Clam, littleneck	*Protothaca staminea*	3
Prawn, Ridgeback	*Sicyonia ingentis*	3
Urchin, Red	*Strongloceńtrotus fransiscanus*	3
Clam, manila	*Tapes philippinarum*	3
Clam, Pismo	*Tivela stultorium*	3
Clam, gaper	*Tresus nuttalli*	3
Shrimp, Mud	*Upogebia spp.*	3
Snail, Top (several spp.)	*Calliostoma, spp.*	2
Crab, Red Rock	*Cancer productus*	2
Clam, smooth chione	*Chione fluctifraga*	2
Clam, Cockle	*Clinocrdium nuttallii*	2
Shrimp, Red Rock	*Crangon spp.*	2
Crab, sand	*Emerita analoga*	2
Squid, Market	*Loligo opalescens*	2
Owl Limpet	*Lottia gigantea*	2
Limpets	*Lottia spp.*	2
Crab, Spider (Sheep)	*Loxorhynchus grandis*	2
Giant Keyhole Limpet	*Megathura crenulata*	2
Snail, Southern Moon	*Naticidae polinises*	2
Octopus, two spot	*Octopus bimaculatus*	2
Octopus, two spot	*Octopus bimaculoides*	2
Clam, geoduck	*Panopea abrupta*	2
Urchin, Purple	*Strongloceńtrotus purpuratus*	2
Clam, California jackknife	*Tagelus californianus*	2
Snail, Turban (several spp.)	*Tegula spp., Lithopoma spp.*	2
Orange Puffball Sponge	*Tethya aurantia*	2

Common Name	Scientific Name	Total Score
	Algae and Marine Plants	
	Gelidium spp. (many species)	3
Feather Boa Kelp	*Egregia menziesii*	2
Southern Sea Palm	*Eisenia arborea*	2
Intertidal Rockweeds	*Fucus spp.*	2
	Gracilaria spp. (many species)	2
Kelp, Giant	*Macrocystis pyrifera*	2
	Porphyra spp. (many species)	2
	Silvetia compressa	2
Eel Grass	*Zostera marina*	2
Eel Grass	*Zostera pacifica*	2
	Marine Birds	
Pigeon Guillemot	*Cepphus columba*	4
Black Oystercatcher	*Haematopus bachmani*	4
Bald Eagle	*Haliaeetus leucocephalus*	4
Brown Pelican	*Pelecanus occidentalis*	4
Pelagic Cormorant	*Phalacrocorax pelagicus*	4
Brandt's Cormorant	*Phalacrocorax penicillatus*	4
Least Tern	*Sternula antillarum*	4
Xantus's Murrelet	*Synthliboramphus hypoleucus*	4
Clark's Grebe	*Aechmophorus clarkii*	3
Western Grebe	*Aechmophorus occidentalis*	3
Northern Pintail	*Anas acuta*	3
American Wigeon	*Anas americana*	3
Northern Shoveler	Anas clypteata	3
Mallard	*Anas platyrhynchos*	3
Gadwall	*Anas strepera*	3
Lesser Scaup	*Aythya affinis*	3
Greater Scaup	*Aythya marila*	3
Canvasback	*Aythya valisineria*	3
Brant	*Branta bernicla*	3
Canada Goose	*Branta canadensis*	3
Bufflehead	*Bucephala albeola*	3
Common Goldeneye	*Bucephala clangula*	3
Red Knot	*Calidris canutus*	3
Snowy Plover	*Charadrius alexandrinus*	3
American Peregrine Falcon	*Falco peregrinus anatum*	3
Northern Fulmar	*Fulmarus glacialis*	3
Common Loon	*Gavia immer*	3
Pacific Loon	*Gavia pacifica*	3
Red-throated Loon	*Gavia stellata*	3
Gull-billed Tern	*Gelochelidon nilotica*	3
Herring Gull	*Larus argentatus*	3
California Gull	*Larus californicus*	3
Mew Gull	*Larus canus*	3
Ring-billed Gull	*Larus delawarensis*	3
Glaucous-winged Gull	*Larus glaucescens*	3
Heermann's Gull	*Larus heermanni*	3
Western Gull	*Larus occidentalis*	3
Bonaparte's Gull	*Larus philadelphia*	3

Common Name	Scientific Name	Total Score
Thayer's Gull	*Larus thayeri*	3
Red-breasted Merganser	*Mergus serrator*	3
Ashy Storm-Petrel	*Oceanodroma homochroa*	3
Ruddy Duck	*Oxyura jamaicensis*	3
Double-crested Cormorant	*Phalacrocorax auritus*	3
Horned Grebe	*Podiceps auritus*	3
Red-necked Grebe	*Podiceps grisegena*	3
Eared Grebe	*Podiceps nigricollis*	3
Pied-billed Grebe	*Podilymbus podiceps*	3
Pink-footed Shearwater	*Puffinus creatopus*	3
Sooty Shearwater	*Puffinus griseus*	3
Black-vented Shearwater	*Puffinus opisthomelas*	3
Clapper Rail	*Rallus longirostris*	3
Black Skimmer	*Rynchops niger*	3
Caspian Tern	*Sterna caspia*	3
Forster's Tern	*Sterna forsteri*	3
Surfbird	*Aphriza virgata*	2
Great Egret	*Ardea alba*	2
Great Blue Heron	*Ardea herodias*	2
Ruddy Turnstone	*Arenaria interpres*	2
Black Turnstone	*Arenaria melanocephala*	2
American Bittern	*Botarus lentiginosus*	2
Sanderling	*Calidris alba*	2
Dunlin	*Calidris alpina*	2
Western Sandpiper	*Calidris mauri*	2
Least Sanpiper	*Calidris minutilla*	2
Semipalmated Plover	*Charadrius semiplamatus*	2
Killdeer	*Charadrius vociferus*	2
Snowy Egret	*Egretta thula*	2
American Coot	*Fulica americana*	2
Common Moorhen	*Gallinula chloropus*	2
Wandering Tattler	*Heteroscelus incanus*	2
Black-necked Stilt	*Himantopus mexicana*	2
Short-billed Dowitcher	*Limnodromus griseus*	2
Long-billed Dowitcher	*Limnodromus scolopaceus*	2
Marbled Godwit	*Limosa fedoa*	2
Surf Scoter	*Melanitta perspicillata*	2
Long-billed Curlew	*Numenius americanus*	2
Whimbrel	*Numenius phaeopus*	2
Black-crowned Night Heron	*Nycticorax nycticorax*	2
Red Phalarope	*Phalaropus fulicarius*	2
Red-necked Phalarope	*Phalaropus lobatus*	2
Wilson's Phalarope	*Phalaropus tricolor*	2
Black-bellied Plover	*Pluvialis squatarola*	2
Cassin's Auklet	*Ptychoramphus aleuticus*	2
American Avocet	*Recurvirostra americana*	2
Common Tern	*Sterna hirundo*	2
Royal Tern	*Thalassesus maxima*	2
Elegant Tern	*Thalasseus elegans*	2
Lesser Yellowlegs	*Tringa flavipes*	2
Greater Yellowlegs	*Tringa melanoleuca*	2

Common Name	Scientific Name	Total Score
Willet	*Tringa semipalmata*	2
Marine Mammals		
Guadalupe fur seal	*Arctocephalus townsendi*	3
Northern fur seal	*Callorhinus ursinus*	3
Northern elephant seal	*Mirounga angustirostris*	3
Harbor seal	*Phoca vitulina richardsi*	3
California sea lion	*Zalophus californianus californianus*	3
Marine Reptiles		
Green turtle	*Chelonia mydas*	3

Note: This list may be revised and appended with Science Advisory Team input. Information was compiled by Santa Monica Bay Restoration Commission. Blank cells have not yet been evaluated.

C.2 Special-Status Species Likely to Occur in the Study Region

Listed below are species that are protected under state or federal law and occur within the MLPA South Coast Study Region for consideration in marine protected area planning. Some of these species are described in further detail in section 3.2.4 of this regional profile.

Table C-2. Special-status species likely to occur in southern California

Common Name	Scientific Name	Federal Status	State Status	Other Status
Mammals				
Blue whale	*Balaenoptera musculus musculus*	E		MMPA
Fin whale	*Balaenoptera physalus*	E		MMPA
Humpback whale	*Megaptera novaeangliae*	E		MMPA
North Pacific right whale	*Eubalaena japonica*	E		MMPA
Gray whale	*Eschrichtius robustus*	D		MMPA
Sei whale	*Balaenoptera borealis*	E		MMPA
Sperm whale	*Physeter macrocephalus*	E		MMPA
Killer whale	*Orcinus orca*	PT, SC (NMFS)		MMPA
Dall's porpoise	*Phocoenoides dalli*			MMPA
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*			MMPA
Risso's dolphin	*Grampus griseus*			MMPA
Northern right whale dolphin	*Lissodelphis borealis*		FP	MMPA
California sea lion	*Zalophus californianus*			MMPA
Guadelupe fur seal	*Arctocephalus townsendi*	T	T, FP	MMPA
Northern fur seal	*Callorhinus ursinus*			MMPA
Harbor seal	*Phoca vitulina*			MMPA
Northern elephant seal	*Mirounga angustirostris*		FP	MMPA
Southern sea otter	*Enhydra lutris nereis*	T	FP	MMPA
Southern California Salt Marsh Shrew	*Sorex ornatus salicornicus*		SSC(SP)	IUCN
Birds				
Common Loon	*Gavia immer*		SSC(FP)	IUCN
Short-tailed Albatross	*Phoebastria albatrus*	E	SSC(FP)	IUCN
Black-footed Albatross	*Phoebastria nigripes*	SC (FWS)		
Dark-rumped Petrel	*Pterodroma phaeopygia*	E		
Ashy Storm-Petrel	*Oceanodroma homochroa*	BCC (FWS)	SSC(SP)	IUCN
Fork-tailed Storm-Petrel	*Oceanodroma furcata*		SSC(FP)	IUCN
Black Storm-Petrel	*Oceanodroma melania*		SSC(TP)	IUCN

Common Name	Scientific Name	Federal Status	State Status	Other Status
California Brown Pelican	*Pelecanus occidentalis californicus*	E, PD	E, FP	IUCN
American White Pelican	*Pelecanus erythrorhynchos*		SSC(FP)	IUCN
American Bittern	*Botaurus lentiginosus*	BCC (FWS)		IUCN
Least Bittern	*Ixobrychius exilis*		SSC(SP)	
White-faced Ibis	*Plegadis chihi*	SC (FWS)		
Harlequin Duck	*Histrionicus histrionicus*	SC (FWS)	SSC(SP)	
California Clapper Rail	*Rallus longirostris obsoletus*	E	E, FP	
Light-footed Clapper Rail	*Rallus longirostris levipes*	E	E, FP	
California Black Rail	*Laterallus jamaicensis coturniculus*	BCC (FWS)	T, FP, SSC(FP)	IUCN
Western Snowy Plover	*Charadrius alexandrinus nivosus*	T, BCC (FWS)	SSC(FP)	
Black Oystercatcher	*Haematopus bachmani*	BCC (FWS)		
Whimbrel	*Numenius phaeopus*	BCC (FWS)		
Long-billed Curlew	*Numenius americanus*	BCC (FWS)		
Marbled Godwit	*Limosa fedoa*	BCC (FWS)		
Black Turnstone	*Arenaria melanocephala*	BCC (FWS)		
Red Knot	*Calidris canutus*	BCC (FWS)		
Elegant Tern	*Sterna elegans*	BCC (FWS)	SSC(TP)	IUCN
California Least Tern	*Sterna antillarum browni*	E	E, FP, SCC(FP)	IUCN
Caspian Tern	*Sterna caspia*	BCC (FWS)		
Gull-billed Tern	*(Sterna nilotica)*	BCC (FWS)	SSC(TP)	
Royal Tern	*(Sterna maxima)*	BCC (FWS)		
Marbled Murrelet	*Brachyramphus marmoratus marmoratus*	T	E	
Xantus's Murrelet	*Synthliboramphus hypoleucus*	BCC (FWS) - Candidate	T	IUCN
Cassin's Auklet	*Ptychoramphus aleuticus*	BCC (FWS)	SSC(TP)	IUCN
Rhinoceros Auklet	*Cerorhinca monocerata*		SSC(TP)	IUCN
Double-crested Cormorant	*Phalacrocorax auritus*		SSC(WL)	IUCN
Black-crowned Night Heron	*Nycticorax nycticorax*	SC		IUCN
"Tule" Greater White-fronted Goose	*Anser albifrons elgasi*		SSC(SP)	
Canadian Goose	*Branta canadensis leucopareia*	T		
"Aleutian"and"cackling" Canada Goose	*Branta canadensis minima*	D	SSC(SP)	
Saltmarsh Common Yellowthroat	*Geothlypis trichas sinuosa*	SC BCC (FWS)		
Black Brant	*Branta bernicla nigricans*		SSC(TP)	
Redhead	*Aythya americana*		SSC(SP)	
Bufflehead	*Bucephala albeola*		SSC(TP)	
Osprey	*Pandion haliaetus*		SSC(WL)	
Northern Harrier	*Circus cyaneus*		SSC(TP)	
Sharp-shinned Hawk	*Acipiter striatus*		SSC(WL)	
Cooper's Hawk	*Accipiter cooperi*		SSC(WL)	
Ferruginous Hawk	*Buteo regalis*	SC	SSC(WL)	
Golden Eagle	*Aquila chrysaetos*		SSC(FP), FP	
Bald Eagle	*Haliaeetus leucocephalus*	T	E	
Merlin	*Falco columbarius*		SSC(WL)	
American Peregrine Falcon	*Falco peregrinus anatum*	D, SC	E, FP, CD	
Yellow Rail	*Coturnicops noveboracensis*	BCC (FWS)	SSC(SP)	
Greater Sandhill Crane	*Grus canadensi tabida*		T, FP	
Long-billed Curlew	*Numenius americanus*	SC		
California Gull	*Larus californicus*		SSC(WL)	
Coastal California Gnatcatcher	*Polioptila californica californica*	T	SSC	
Willow Flycatcher	*Empidonax traillii*		E	
Black Skimmer	*Rynchops niger*	SC BCC (FWS)	SSC(TP)	
Tufted Puffin	*Fratercula cirrhata*		SSC(FP)	IUCN
Belding's Savannah Sparrow	*Passerculus sandwichensis beldingi*	BCC (FWS)	E	IUCN

Common Name	Scientific Name	Federal Status	State Status	Other Status
Reptiles				
Leatherback sea turtle	*Dermochelys coriacea*	E		
Loggerhead sea turtle	*Caretta caretta*	T		
Pacific ridley sea turtle	*Lepidochelys olivacea*	T		
Green sea turtle	*Chelonia mydas*	T		IUCN
Fish				
Fish Common Name	*Scientific Name*	Federal Status	State Status	Other Status
Steelhead (CA southern Santa Maria river to U.S.-Mexico boarder)	*Oncorhynchus mykiss*	E	SSC(QE)	
Tidewater goby	*Eucyclogobius newberryi*	E	SSC(QE)	IUCN
Green sturgeon	*Acipenser medirostris*	SC (NMFS) - Candidate	SSC(QT)	
Cowcod	*Sebastes levis*	Overfished, SC (NMFS)		
Bocaccio	*Sebastes paucispinis*	Overfished, SC (NMFS)		
Canary rockfish	*Sebastes pinniger*	Overfished(NMFS)		
Darkblotched Rockfish	*Sebastes crameri*	Overfished(NMFS)		
Pacific Ocean Perch	*Sebastes alutus*	Overfished(NMFS)		
Widow rockfish	*Sebastes entomelas*	Overfished (NMFS)		
Yelloweye rockfish	*Sebastes ruberrimus*	Overfished (NMFS)		
Eulachon	*Thaleichthys pacificus*		SSC(WL)	
Bluefin tuna	*Thunnus thynnus*	SC		
Swordfish	*Xiphias gladius*	SC		
Gulf grouper	*Mycteroperca jordani*		P	
Broomtail grouper	*Mycteroperca xenarcha*		P	
Garibaldi	*Hypsypops rubicundus*		P	
Giant sea bass	*Stereolepis gigas*		P	IUCN
White shark	*Carcharodon carcharias*		P	IUCN, CITES, CMS
Invertebrates				
Black abalone	*Haliotis cracherodii*	PE, SC (NMFS)	P	IUCN
Green abalone	*Haliotis Fulgens*	SC (NMFS)	P	
Pink abalone	*Haliotis corrugata*	SC (NMFS)	P	
White abalone	*Haliotis sorenseni*	E	P	
Purple hydrocoral	*Stylaster californicus*		P	
Sandy beach tiger beetle	*Cicindela hirticollis gravida*	SC		
Plant Common Name	*Scientific Name*	Federal Status	State Status	Other Status
Northcoast sand verbena	*Abronia umbellata ssp. breviflora*	SC		

Index of the listing codes used in Appendix C(ii)

Federal Listing Codes	
ESA: Endangered Species Act of 1973 listing codes	
E	Federally listed as endangered
T	Federally listed as threatened
D	Federally delisted

PE	Proposed for federal listing as endangered
PT	Proposed for federal listing as threatened
PD	Proposed for federal de-listing
Candidate	Candidate for federal listing as endangered or threatened
SC	Species of concern
SC (NMFS)	Species of concern by the National Marine Fisheries Service
SC (FWS)	Species of concern by the US Fish and Wildlife Service
BCC (FWS)	Birds of Conservation Concern by US Fish and Wildlife Service

State Listing Codes

CESA: California Endangered Species Act listing codes

E	State-listed as endangered
T	State-listed as threatened
CE	Candidate for state listing as endangered
CT	Candidate for state listing as threatened
CD	Considered for state delisting as endangered

SSC: Species of special concern listing codes

(QE)	Qualify as endangered (fish list)
(QT)	Qualify as threatened (fish list)
(WL)	Watch list
(FP)	First priority (bird list)
(SP)	Second priority (bird list)
(TP)	Third priority (bird list)

Other State listings

FP	State fully protected animal list
P	Protected species

Other Status Codes

MMPA	Protected under the Marine Mammal Protection Act
IUCN	Included in the World Conservation Union's Red List of Vulnerable Species
CITES	Protected under the Convention of Intertational Trade in Endangered Species of Fauna and Flora
CMS	Protected by the Convention on Migratory Species

Sources for special status species list

Original list from MBNMS

California ESA status: http://www.dfg.ca.gov/whdab/pdfs/TEAnimals.pdf

California Species of Special Concern http://www.dfg.ca.gov/wildlife/species/ssc/index.html

Federal ESA status: http://www.nmfs.noaa.gov/pr/species/esa.htm

Birds of Conservation Concern: http://migratorybirds.fws.gov/reports/bcc2002.pdf>

California Natural Diversity Database
http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/SPAnimals.pdf

APPENDIX C-7. ORGANIZATIONS LISTED IN THE MLPA INITIATIVE SOUTH COAST REGIONAL PROFILE WITH A FOCUS ON COASTAL AND MARINE ECOSYSTEMS IN THE MLPA SOUTH COAST STUDY REGION

This document was included as Appendix H in the South Coast Regional Profile (MLPA Initiative, 2009) and identifies organizations with a focus on coastal and marine ecosystems in the MLPA South Coast Study Region. Please note that it is not an exhaustive list of all organizations that have an interest in coastal and marine ecosystems in the South Coast Study Region.

At the time of implementation of long-term monitoring it will be appropriate to update and revise this document to incorporate other programs and activities with data collection programs which overlap with MPA monitoring needs.

If you are using this information to explore potential partnerships and collaborations for MPA monitoring, we encourage you to contact the marine region's main DFG office at the address below rather than any of the regional offices.

California Department of Fish and Game
Marine Region
20 Lower Ragsdale Drive, Suite 100
Monterey, CA 93940
(831) 649-2870

Appendix H: Academic, Research, and Education Institutions

This appendix lists academic, research, and education institutions with a focus on coastal and marine ecosystems in the MLPA South Coast Study Region.

Table H-1. Academic, research, and education institutions

Name	Address and Telephone	Web Site
Aquarium of the Pacific	100 Aquarium Way Long Beach, CA 90802 (562) 590-3100	http://www.aquariumofpacific.org/
Cabrillo Marine Aquarium	3720 Stephen M. White Drive San Pedro, CA 90731 (310) 548-7562	http://www.cabrilloaq.org/
California Center for Ocean Sciences Education Excellence (COSEE) West	USC; University Park Los Angeles, CA 90089 (213) 740-1961 University of California, Los Angeles Ecology and Evolutionary Biology Los Angeles, CA	http://www.usc.edu/org/cosee-west/
California Coastal Commission	89 South California Street, Suite 200 Ventura, CA 93001-2801 (805) 585-1800 200 Oceangate, 10th Floor Long Beach, CA 90802-4416 (562) 590-5071 7575 Metropolitan Drive, Suite 103 San Diego, CA 92108-4402 (619) 767-2370	http://www.coastal.ca.gov/index.html
California Department of Fish and Game	Marine Region 7329 Silverado Trail Napa, CA 94558 (707) 944-5500	www.dfg.ca.gov/regions/region3.html/
California Maritime Academy	200 Maritime Academy Drive Vallejo, CA 94590 (707) 654-1000	www.csum.edu
California State Polytechnic University, Pomona	3801 W Temple Avenue Pomona, CA 91768 (909) 869-2284	www.csupomona.edu
California State University, Channel Islands	One University Drive Camarillo, CA 93012 (805) 437-8400	http://www.csuci.edu/index.htm

Name	Address and Telephone	Web Site
California State University, Dominguez Hills	1000 E. Victoria Street Carson, CA 90747 (310) 243-3696	http://www.nbs.csudh.edu/biology/index.html
California State University, Fullerton	Department of Biological Science (MH-282) California State University, Fullerton 800 North State College Boulevard Fullerton, CA 92831-3599 (714) 278-3614	http://biology.fullerton.edu/
California State University, Long Beach	1250 N Bellflower Boulevard Long Beach, CA 90840 (562) 985-4111	http://www.csulb.edu
California State University, Los Angeles	College of Natural and Social Sciences; King Hall 5151 State University Drive Los Angeles, CA (323) 343-2000	http://www.calstatela.edu/academic/nssd/
California State University, Northridge	18111 Nordhoff Street Northridge, CA 91330 (818) 677-1200	http://www.csun.edu/
California State University, San Bernardino	5500 University Parkway San Bernardino, CA 92407 (909) 880-5000	http://www.csusb.edu/
Catalina Island Conservancy	P.O. Box 2739 Avalon, CA 90704	http://www.catalinaconservancy.org/
Channel Islands National Marine Sanctuary	113 Harbor Way, Suite 150 Santa Barbara, CA 93109 (805) 966-7107 3600 S. Harbor Blvd., Suite 111 Oxnard, CA. 93035 (805) 382-6149	http://channelislands.noaa.gov/
Channel Islands National Park	1901 Spinnaker Drive Ventura, CA 93001-4354 (805) 658-5700	http://www.channel.islands.national-park.com/
Communication Partnership for Science and the Sea (COMPASS)	c/o National Center for Ecological Analysis and Synthesis (NCEAS) 735 State Street, Suite 300 Santa Barbara, CA 93101 (805) 892-2515	http://www.compassonline.org/
Conservation Corps S.E.A. Lab	1021 North Harbor Drive Redondo Beach, CA 90277 (310) 318-7438	http://mysite.verizon.net/john.healy5/sealab/

Name	Address and Telephone	Web Site
Grunion.org Pepperdine University	24255 Pacific Coast Highway Malibu, CA 90263 (310) 506-4000	http://arachnid.pepperdine.edu/grunion/default.htm http://www.grunion.org
Heal the Bay	1444 Ninth Street Santa Monica, CA 90401 (310) 451-1500	http://www.healthebay.org/
Hubbs Sea World Research Institute	2595 Ingraham Street San Diego, CA 92109 (619) 226-3870	http://www.hswri.org/index.cfm
Jet Propulsion Laboratory	4800 Oak Grove Drive Pasadena, CA 91109 (818) 354-4321	http://www.jpl.nasa.gov/
Long Beach Marine Institute	5875 E Appian Way Long Beach, CA 90803 (562) 431-7156	http://www.longbeachmarine.org/
Los Angeles County Natural History Museum	900 Exposition Boulevard Los Angeles, CA 90007 (213) 763-DINO	http://www.nhm.org/
Marine Mammal Center at Fort MacArthur	3601 S Gaffey Street San Pedro, CA 90731 (310) 548-5677	http://www.marinemammalcare.org/
MARINe (Multi-Agency Rocky Intertidal Network)	Attn: Mary Elaine Helix 1111 Jackson St., Suite 520 Oakland, CA 94607 (510) 817-1479	http://www.marine.gov
Ocean Institute	24200 Dana Point Harbor Drive Dana Point, CA 92629 (949) 496-2274	http://www.ocean-institute.org/index2.html
Orange County Coastkeeper	3151 Airway Ave., Suite F-110 Costa Mesa, Ca 92626 (714) 850-1965	http://www.coastkeeper.org/
Oxnard College	4000 South Rose Avenue Oxnard, CA 93033 (805) 986-5800	http://www.oxnardcollege.edu/
Pepperdine University	Department of Biology 24255 Pacific Coast Highway Malibu, CA 90263 (310) 506-4321	http://www.pepperdine.edu
Port of Long Beach	925 Harbor Plaza Long Beach, CA 90802 (562) 437-0041	http://www.polb.com
Port of Los Angeles	425 South Palos Verdes Street San Pedro, CA 90731 (310) SEA-PORT	http://www.portoflosangeles.org/

Name	Address and Telephone	Web Site
PISCO	Marine Science Institute University of California Santa Barbara, CA 93106-6150 (805) 893-3387	http://www.piscoweb.org
Reef Check California	17575 Pacific Coast Highway Pacific Palisades, CA 90272 (310) 230-2371	http://www.ReefCheck.org
San Diego Coastkeeper	2825 Dewey Road, Suite 200 San Diego, CA 92106	http://www.sdcoastkeeper.org
San Diego State University	5500 Campanile Drive San Diego, CA 92182 (619) 594-6561	http://www.sdsu.edu
Santa Barbara City College	721 Cliff Drive Santa Barbara, CA 93109-2394 (805) 965-0581	http://www.sbcc.edu/
Santa Monica Baykeeper	P.O. Box 10096 Marina del Rey, CA 90295 (310) 305-9645	http://www.smbaykeeper.org/
Santa Monica Bay Restoration Commission	320 West 4th Street, Suite 200 Los Angeles, CA 90013 (213) 576-6615	http://www.santamonicabay.org/smbay/
Santa Monica Pier Aquarium	1600 Ocean Front Walk Santa Monica, CA 90401 (310) 393-6149	http://www.healthebay.org/smpa/
Scripps Institution of Oceanography	8602 La Jolla Shores Drive La Jolla, CA 92037	http://sio.ucsd.edu/
Sea World	500 Sea World Dr. San Diego, CA 92109 (800) 257-4268	http://www.seaworld.com/sandiego/default.aspx
Southern California Academy of Sciences	900 Exposition Blvd. Los Angeles, CA 90007 (909) 607 2836	http://scas.jsd.claremont.edu/
Southern California Coastal Ocean Observing System	info@sccoos.org	http://www.sccoos.org/index.html
Southern California Marine Institute	820 South Seaside Avenue Terminal Island, CA 90731 (310) 519-3172	http://scmi.us/
Southwest Fisheries Science Center	8604 La Jolla Shores Drive La Jolla, CA 92037-1508 (858) 546-7000	http://swfsc.noaa.gov/
Stephen Birch Aquarium	2300 Expedition Way La Jolla, CA 92037 (858) 534-FISH	http://aquarium.ucsd.edu/

Name	Address and Telephone	Web Site
Surfrider Foundation	P.O. Box 6010 San Clemente, CA 92674-6010	www.surfrider.org
Tijuana River Reserve	301 Caspian Way Imperial Beach, CA 91932 (619)-575-3613	http://trnerr.org/
Ty Warner Sea Center	211 Stearns Wharf Santa Barbara, CA 93101 (805) 962-2526	http://www.sbnature.org/seacenter/
University of California, Los Angeles; Marine Science Center	621 Charles E. Young South Box 951606 Los Angeles, CA 90095 (310) 206-8247	http://www.msc.ucla.edu/
University of California, Santa Barbara	Visitors Center 552 University Road Santa Barbara, CA 93106 (805) 893-8000	http://www.ucsb.edu/
University of California, Irvine	University of California, Irvine Irvine, CA 92623 – 9557 (949) 824-6836	http://www.uci.edu/
University of California, San Diego	9500 Gilman Drive La Jolla, CA 92093 (858) 534-2230	http://www.ucsd.edu/portal/site/ucsd
University of Southern California Sea Grant	University of Southern California Los Angeles, CA 90089-0373 (213) 740-1961	http://www.usc.edu/org/seagrant/index.html
USC Philip K. Wrigley Marine Science Center on Catalina Island	P.O. Box 5069 1 Big Fisherman Cove Avalon, CA 90704 (310) 510-0811	http://wrigley.usc.edu/
U.S. Geological Survey	345 Middlefield Road Menlo Park, CA 94025 (650) 853-8300	www.usgs.gov
Vantuna Research Group Occidental College	Moore Laboratory of Zoology Occidental College 1600 Campus Road Los Angeles, CA 90041	http://departments.oxy.edu/vrg/
Ventura Coastkeeper	3600 South Harbor Blvd., Suite 218 Oxnard, CA 93035 (805) 382-4540	http://www.wishtoyo.org/venturacoastkeeper/
WiLDCOAST	925 Seacoast Drive Imperial Beach, CA 91932 (619) 423-8665	www.wildcoast.net

APPENDIX C-8. LEVELS OF PROTECTION ASSIGNED TO INDIVIUDAL MPAS AND THE ACTIVITIES ASSOCIATED WITH EACH LEVEL OF PROTECTIONIN THE MLPA SOUTH COAST STUDY REGION.

	Level of Protection	MPA Type	Activities Associated with a Protection Level
	Very high	SMR	No take
	High	SMCA	Coastal pelagic finfish, bonito, and market squid (pelagic seine [round haul nets], dip-net, crowder); pelagic finfish, bonito, and white seabass (spear); jumbo squid (squid jigs); swordfish (harpoon); **In water depth > 50m:** pelagic finfish, bonito and white seabass (H&L)
	Moderate-high	SMCA	Catch and release in <10m water or using surface gear (H&L single barbless hooks and artificial lures only); pier-based fishing (H&L, hoop-net); halibut (spear); **In water depth 30<50m on mainland:** pelagic finfish, bonito and white seabass (H&L)
	Moderate	SMCA SMP	spot prawn (trap/pots); sea cucumber (scuba/hookah); grunion (hand harvest); giant kelp (hand harvest); clams (hand harvest)
	Moderate-low	SMCA SMP	Catch and release in >10m (H&L); shore-based finfish (H&L); kelp bass, barred sand bass, lingcod, cabezon, and rockfish (H&L, spear); sheephead (H&L, spear, trap); spotted sand bass and halibut (H&L); lobster (trap, hoop net, scuba); urchin (scuba/hookah); rock crab and Kellet's whelk (trap); finfish (H&L, spear, trap) **In water depth <50m at islands and <30m on mainland:** pelagic finfish, bonito and white seabass (H&L)
	Low	SMCA SMP	rock scallop (scuba); mussels (hand harvest); giant kelp (mechanical harvest); marine algae other than giant and bull kelp (hand harvest); ghost shrimp (hand harvest)