

## EXECUTIVE SUMMARY

### ROLE OF THIS PLAN

The 1999 California Marine Life Protection Act (MLPA, Chapter 10.5 of the California Fish & Game Code, §2850-2963) 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. On August 5, 2009, the California Fish and Game Commission adopted a regional MPA network for a section of California's waters called the North Central Coast region. This region extends from Alder Creek, near Point Arena, to Pigeon Point, and includes waters surrounding the Farallon Islands. The regional MPA network includes 21 MPAs, of three different types (state marine reserves (SMRs), state marine parks (SMPs), and state marine conservation areas (SMCAs)), and additional special closures and state marine recreational managed areas (SMRMAs).

This plan has been developed to guide monitoring of MPAs in the North Central Coast region that will meet MLPA requirements. It presents a framework for MPA monitoring, and monitoring elements and approaches for implementing the framework. The plan provides a flexible, scalable approach to implementing MPA monitoring, to make best use of available resources and potential partners.

This is not a monitoring workplan, or a monitoring implementation plan. The framework and approaches described in this plan will be implemented in two complementary stages: 1) the North Central Coast MPA Baseline Program, which will begin in 2010 and continue through 2013; and 2) long-term monitoring, which will build on the foundation established through baseline monitoring. Implementation of long-term monitoring will require selecting the monitoring elements to implement and the levels at which to implement them, and designing the sampling or monitoring data collection plan accordingly. This plan provides guidance for making those decisions, and can serve as a foundation for developing a long-term monitoring implementation plan, building on the knowledge gathered through the Baseline Program.

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. This plan was adopted by the California Fish and Game Commission on April 7, 2010, 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. 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

Under the MLPA, the North Central Coast regional MPA network 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 for Marine Protected Areas, 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. The

MLPA Master Plan further notes that to meet this role, the results of monitoring and evaluation must be communicated to decision makers and the public in terms that they can understand and act upon. Accordingly the monitoring plan has been designed to meet these requirements.

The North Central 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. These decisions also inform the scope of MPA monitoring.

Additionally, policies and programs closely related to the MLPA have been considered in designing MPA monitoring, and should be considered again during monitoring implementation. These include other marine managed area programs, such as those carried out by the State Park and Recreation Commission and the State Water Resources Control Board, and the California Marine Life Management Act (MLMA, Stats. 1998 Ch. 1052), which governs state-managed fisheries. MPA monitoring can and should benefit fisheries management. Accordingly, the MPA monitoring metrics in this plan have been selected to benefit fisheries management to the extent possible without compromising the ability to best meet MLPA requirements.

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. The monitoring framework and approaches described in this plan have these features, and consist of two core monitoring elements: 1) assessing the condition of North Central Coast ecosystems and how conditions change over time (i.e., 'status and trends' monitoring); and 2) evaluating specific MPA design and management decisions (i.e., 'management effectiveness' monitoring).

This monitoring plan considers all North Central Coast MPAs, SMRMAs and special closures, and, because MPA assessment relies in part on comparing conditions inside and outside MPAs, the entire North Central Coast region. This monitoring plan includes guidance for the selection of MPAs to be monitored to provide coverage of the region and the regional network.

## DEVELOPING AN ECOSYSTEMS APPROACH

Nine 'Ecosystem Features' have been selected to collectively represent and encompass the North Central Coast region's ecosystems, including their human inhabitants, for the purposes of MPA monitoring. The Ecosystem Features provide the overarching structure for MPA monitoring, and are:

- Kelp and shallow rock ecosystems
- Deep rock ecosystems
- Rocky intertidal ecosystems
- Subtidal soft-bottom ecosystems
- Estuarine ecosystems
- Beaches and soft-bottom intertidal ecosystems
- Pelagic ecosystems (i.e., the water column habitat within state waters)
- Consumptive uses
- Non-consumptive uses

The Ecosystem Features provide the basis for assessing the condition of North Central 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. Any increases in the density and size of fish 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 increases 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. 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.

Rates and magnitudes of population increases are also influenced by the level of compliance with MPA regulations. Non-compliance with MPA regulations is a challenge for MPAs worldwide. Illegal take of marine organisms, for example, can greatly undermine the effectiveness of MPAs. In the monitoring described in this plan, these potential effects are detected by examining differences in the size and local density of select species inside and outside of MPAs with comparable habitats and incorporating available information on legal and illegal fishing distribution and intensity.

Disentangling the effects of MPAs from those of large-scale ocean dynamics (such as the Pacific Decadal Oscillation, or PDO) and broader human influences (such as water quality impairment) will be achieved through the collection of data over long time scales to incorporate into time series analyses and interpretation. Additional insights will be garnered through comparisons of changes in fished and unfished species inside and outside MPAs with comparable habitats and ecosystems and at different locations throughout the region. However, while some changes may be observable fairly quickly, as has occurred with the Channel Islands MPAs, demonstrating that such changes are due to the MPAs is likely to take many years of monitoring.

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. As one 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.

## ASSESSING ECOSYSTEM CONDITION & TRENDS

Tracking ecosystem conditions over time will employ a 'status and trends' monitoring approach focused on the nine Ecosystem Features. Accordingly, nine ecosystem condition monitoring modules have been developed, one for each Ecosystem Feature. For each module, two possible implementation options have been developed. Ecosystem Feature Assessments require technically demanding or otherwise comparatively resource-intensive monitoring methods, and use a hierarchical system of key attributes and indicators or focal species. For each Ecosystem Feature, key attributes have been identified that will be used collectively to assess Feature condition. For each key attribute, selected indicators and, where appropriate, focal species, have been identified that collectively allow assessment of that 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 North Central Coast MPA Baseline Program. The Baseline Program will begin in 2010 and extend through 2013, and has two complementary purposes: baseline characterization; and assessment of initial socioeconomic and ecological changes 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. Examples include brown rockfish (*Sebastes auriculatus*) and copper rockfish (*Sebastes caurinus*), species for which stock assessments have not been conducted.

## 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 assessing the effects of selected design and management decisions on ecosystems and their components. These evaluations, together with assessments of ecosystem condition and trends, should 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 assessments of the effects of specific MPA and MPA network design and management decisions on Ecosystem Features or Feature components. This monitoring element consists of two monitoring modules. Short-term evaluations are those expected to generate conclusive findings within four years that can be used with confidence to inform MPA management decisions. Such evaluations can be completed within the five-year review periods recommended by the MLPA Master Plan. Many of the 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.

Both short- and long-term 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.

Initial possible short-term and long-term evaluations have been developed, including many that are based on input from stakeholders during the development of the monitoring plan. These evaluations form an initial inventory which should be further refined at the time of 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 aspects of the general reporting approach, designed to facilitate adaptive MPA management by presenting interpretable, relevant summary information in an intuitive way. Pages such as these would be accompanied by detailed supporting and technical information and analytical results.

The North Central Coast MPAs were adopted by the Fish and Game Commission in August, 2009, and are expected to take effect in 2010. The first North Central Coast MPA monitoring report should thus be made available in late 2014 or early 2015, assuming that the first of the five-year reviews recommended in the MLPA Master Plan will occur in mid- to late 2015.

Maintaining and making available MPA monitoring information, including data, reports, and other associated information will require the use of an MPA Monitoring Information Management System (IMS). The IMS should accommodate different types of users, including technically advanced users seeking to download data in order to conduct their own analyses, as well as users interested only in highly synthesized information products. The MPA Monitoring Enterprise is currently completing an analysis of user needs.

## DEVELOPING MONITORING PARTNERSHIPS

This monitoring plan has been designed to facilitate development of partnerships to conduct and support monitoring of the North Central 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 North Central Coast MPAs. Many of the MPA monitoring activities conducted in the Channel Islands 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 North Central 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**

The monitoring plan elements have been designed as stand-alone modules, including the nine ecosystem assessment modules (one for each Ecosystem Feature) and the two MPA design and management decision evaluation modules (short- and long-term evaluations). Each module may be scaled to reflect available resources, and implementation may prioritize a limited number of modules.

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 and Central Coast region. 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 North Central 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.