Photo: Reef Check California

# Lessons Learned from California's Marine Protected Area Network Monitoring Program

*Prepared by: Resources Legacy Fund | February 2020*

In 1999, the California legislature passed the Marine Life Protection Act (MLPA), requiring establishment of a statewide, science-based network of marine protected areas (MPA), the first such effort in the United States. In 2004, with significant financial support from philanthropic donors, the non-profit organization Resources Legacy Fund (RLF) signed a formal agreement with the State of California to advance a phased strategy and public-private partnership for implementing the law, called the "Marine Life Protection Act Initiative" (MLPA Initiative).

From 2004 to 2012, the MLPA Initiative implemented an extensive public planning process to secure broad stakeholder input, rigorous scientific and policy guidance, and evaluation. Over a phased, eight-year planning effort, the state hosted community meetings, public workshops, and formal hearings through four coastal regions to collect public input and expert opinion on a range of MPA network designs. In 2012, California completed formal adoption of a statewide network of 124 MPAs covering almost 17 percent of state waters, including 9.5 percent in no-take protection. California's MPA network includes all marine and estuarine habitat types in state waters (from zero to three nautical miles offshore), from sandy beaches and intertidal areas to deep water canyons and islands.

## Goals of the California Marine Life Protection Act

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

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

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

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

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

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

California has committed to partnership-based MPA management, focused on community stewardship and education, enforcement, policy and permitting, and scientific monitoring. State agencies plan to complete the first decadal evaluation of the performance of California's MPA network in 2022. This evaluation will rely heavily on data and analysis from the statewide monitoring program and report on progress toward the six core goals of the MLPA.

This document summarizes some of the key components and lessons learned from California's experience designing, launching, and implementing a program to monitor the ecological and socioeconomic impacts of its MPA network.

# Importance of Monitoring

Monitoring is widely recognized as a core component of effective MPA management. The International Union for Conservation of Nature recommends that MPA monitoring programs "track performance and inform adaptive management" and "be standardized across MPAs in the network to document and demonstrate management effectiveness, and to report that conservation goals, objectives, and defined biodiversity conservation targets are being achieved." There is also a growing recognition that MPAs can serve as sentinel sites where research can be conducted to better understand a broad range of ocean conditions.

The MLPA requires that California's MPA program "shall include…provisions for monitoring, research, and evaluation…to facilitate adaptive management of MPAs and ensure that the system meets the [law's] goals." The California law also requires that state MPAs be designed and managed to function "as a network." This means that scientists must gather data and conduct analysis to evaluate the ecological interaction of MPAs and not only assess individual MPA performance but also network-scale effects. To focus available resources and leverage pre-existing efforts, the MLPA requires monitoring at "selected sites." California has identified priority monitoring areas following an intensive selection process by the state's scientific community, government officials, and non-profit organization partners, with a goal of maximizing the extent to which performance at remaining sites can be inferred from gathered data.

While monitoring programs must be designed to support evaluation of progress toward MPA- and MPA network objectives, they can also be designed to yield valuable auxiliary benefits such as improving collective understanding of climate change impacts and informing fisheries management. Adopted in 1999, the MLPA statute does not explicitly reference climate change. With respect to fisheries management, the goals of the MLPA are focused on conservation and restoration of ecosystems, rather than increased fisheries landings.

The Marine Life Protection Act Master Plan for Marine Protected Areas adopted in 2016 recognized that MPAs can act as "living laboratories" to study and better understand a range of state priorities, such as fisheries, water quality, climate change, marine debris, and invasive species. Scientific efforts are currently underway to better understand the role of California's MPA network in providing ecosystem resilience to climate-related stressors such as ocean acidification, hypoxia, and marine heat waves. Finally, California's MPA monitoring data have also helped inform recent fisheries management efforts, including those related to rockfish, spiny lobster, and warty sea cucumber.

## *LESSONS LEARNED*

» **Include explicit monitoring mandate.** California state law requires systematic, management-oriented scientific monitoring of the state's MPA network. This legal mandate has aligned the state's MPAs with international standards of conservation science, maintained MPA monitoring as a state priority, and helped mobilize significant and ongoing funding for monitoring from the state legislature and other sources.

» **Be realistic about tradeoffs in geographic scope and data quality.** Rather than trying to monitor every parameter at every MPA site, managers should prioritize and focus available resources to ensure the generation of a prioritized body of robust and sustained data that can effectively inform core management needs. California will closely track about one quarter of its MPAs—its so-called Tier 1 sites—over the long-term. While this means that many MPAs may not be monitored at the highest levels of rigor, it also avoids spreading resources too thin and risking discontinuous datasets.

» **Determine monitoring program scale— individual MPA or network?** Assessing performance of an MPA network—i.e. whether sites function better by working in concert—may require development of new and specialized analytical tools, such as complex oceanographic connectivity models, in addition to traditional data collection. Decision makers should

identify the desired focus of a monitoring program (individual MPA or network scale) at the program's outset, as this will influence both MPA site selection and MPA monitoring program design.

» **Clearly establish programmatic scope.** The primary focus of the MLPA is ecosystem protection, including biodiversity and habitat protection, and recovering depleted species. Accordingly, monitoring resources have been focused on these issues. If policymakers and stakeholders intend MPAs to provide climate or fisheries data or benefits, these goals should be articulated early and clearly. Policymakers and stakeholders should also consider the implications of multiple monitoring goals, including broader social benefits, increased complexity, and cost.

# Monitoring Program Planning

Two state agencies, the California Ocean Protection Council (OPC) and California Department of Fish and Wildlife (CDFW), collaboratively oversee the MPA monitoring program, which has occurred in two main phases—baseline monitoring and long-term monitoring.

## Baseline Monitoring (Phase 1, 2007-2018)

California's baseline monitoring program sought to generate for the first time ever "comprehensive snapshots" of ecological and socioeconomic conditions in and around MPA sites following MPA establishment within each of the four coastal regions delineated for MLPA implementation. Monitoring projects targeted eight key habitat types and two human use categories. Baseline data was collected during the first five years after MPA establishment within each region, and culminated in four separate "state of region" reports interpreting monitoring results for resource managers and the public. Officials also shared report findings in public meetings within each region.

## *LESSONS LEARNED*

» **Baseline studies are long-term assets.** While detailed physical and biological baseline characterizations can be expensive, they should be prioritized as a critical component of a monitoring program. Such data sets provide a "benchmark" that can help track changes in MPAs over time, and also provide insight for understanding larger scale oceanic change and a wide range of issues beyond MPA performance (such as climate change, invasive species, fisheries management, and water quality). In California, recognizing the long-term value of MPA baseline data allowed MPA monitoring programs to access state bond funding restricted to investments in capital assets.

» **Include human dimensions monitoring.** Consistent tracking of basic socioeconomic parameters, such as commercial fishing revenues and employment, recreational fishing activity, and non-consumptive use can help inform a range of ocean and coastal management efforts including understanding how MPAs may affect coastal economies. It is also important to recognize from the outset that it may be very difficult to detect or attribute changes linked to MPA establishment given the complexity of factors that affect how humans use the ocean (weather, oceanographic conditions, market conditions, price of fuel, etc.). Empirical human dimensions data can foster stakeholder acceptance by dispelling unrealistic fears of adverse impacts and help build public support for conservation measures over time.

» **Calibrate monitoring effort, expectations, and MPA management to local ecological conditions.** Though California summarized its baseline monitoring results in a five-year review for each

### Regional MPA Baseline Monitoring Program (Phase 1):
***Surveyed habitat types and human uses***

**Habitats:**
- Rocky Intertidal
- Kelp and Shallow Rock (0-30 m)
- Mid-depth Rock (30-100 m)
- Soft-bottom Intertidal and Beach
- Soft-bottom Subtidal (0-100 m)
- Deep Ecosystems and Canyons (>100 m)
- Nearshore Pelagic (i.e., the water column within state waters 0-3 nm)
- Estuaries

**Human uses:**
- Consumptive Human Use
- Non-consumptive Human Use

*This list was expanded slightly for Phase 2 of the monitoring program.*

region, scientists warned that changes in diversity or abundance for many species of interest would likely take longer to observe, due to the temperate environment, the starting conditions of sites within and outside MPAs, and the long lifecycles of many priority species. Based on this information, in 2016, the State committed to a decadal review process.

» **Share results and consider your audience.** Public-facing reports, presentations and press coverage can generate interest in- and answer community questions about MPAs. Communicating scientific information to policymakers early and on a regular basis can encourage political commitment to MPA management. Scientific information should be "translated" into lay terms to be relevant and accessible to the intended audience: synthesized summaries, infographics, electronic newsletters, web content, blogs, and videos may be more effective in sharing information than technical research reports or raw data.

## Long-term Monitoring (Phase 2, 2018 – ongoing)

In 2018, following a public process and peer review, California released its Marine Protected Area Monitoring Action Plan. The Monitoring Action Plan is designed to track changes in an array of selected metrics inside and outside MPAs over time to determine whether the state's MPA network is meeting its statutory goals. The Monitoring Action Plan explicitly links monitoring efforts to the goals of the MLPA by establishing specific scientific objectives for monitoring and articulating a list of key research questions scientists must address to qualify for state research funding. The Monitoring Action Plan also identifies existing, long running research programs already being conducted by a range of scientific and community science group partners with the goal of formally integrating these efforts.

## California MPA Monitoring Action Plan: Prioritized Variables

**The state's monitoring plan identifies long-term observation of the following parameters as key to advance understanding of conditions and performance trends across California's MPA network.**

### Species-level
- » Abundance
- » Density/cover
- » Size/age frequency
- » Biomass

### Community-level
- » Functional diversity—tracking the population dynamics of those species and organismal traits that influence ecosystem functioning
- » Stability

### Physical
- » Temperature
- » Depth
- » Substrate (e.g., rock or sediment size, type, and rugosity)
- » Wave exposure

### Chemical
- » pH
- » Total alkalinity
- » Dissolved oxygen

### Human Use

*Commercial Passenger Fishing Vessel*
- » Annual license renewal and vessel registration
- » Port of departure
- » Number of anglers
- » Target species
- » Trip length
- » Fishing location
- » Average price paid per angler
- » Number and pounds of fish caught by species
- » Number of crew on trip
- » Effort and catch per unit effort (CPUE)
- » Annual operating costs
- » Number of crew employed

*Commercial Fisheries*
- » Annual license and vessel renewal
- » Number of fishermen making landings
- » Landings: catch, price, and revenue by species
- » Gear type
- » Landings port location
- » CPUE
- » Harvest location
- » Annual operating costs
- » Number of crew employed

*Recreational Fisheries*
- » License purchases
- » Catch amount
- » Catch location
- » Catch effort
- » Type of gear/mode

*Coastal Recreation and Tourism*
- » Location of residence
- » Demographic information (e.g., age, gender, education)
- » Income
- » Employment status
- » Frequency and type of visit
- » Location of visit
- » Type of activities
- » Trip expenditures

*Enforcement (location specific)*
- » Patrol hours
- » Citations
- » Warnings
- » Hotline tips submitted for potential MPA violations

## *LESSONS LEARNED*

» **Link monitoring to objectives.** Unlike the baseline monitoring phase, which was focused on gathering as much data as possible to characterize MPAs, the objectives and research questions articulated in the Monitoring Action Plan link long term monitoring activities to public policy goals. This orientation provides benefits such as data continuity, streamlined coordination of scientific effort, and enhanced long-term cost effectiveness of monitoring investments.

» **Plan baseline and long-term monitoring in tandem.** California adopted its long-term monitoring plan after baseline monitoring was largely complete, and evaluated regional MPA monitoring plans before committing to a statewide approach. In an effort to be inclusive, planning involved multiple rounds of stakeholder participation that felt extraneous to some participants. If possible, baseline and long-term monitoring plans should be developed in conjunction early in the MPA planning process, to promote efficiencies and minimize data gaps. It is also important to identify reference sites (outside MPAs) and standardized approaches to monitoring them early on, to provide the best datasets possible to evaluate outcomes.

» **Formally integrate existing monitoring efforts and avoid replication.** By cataloging all relevant social and ecological data-collection already underway in a prospective MPA network area, managers can develop a monitoring plan that integrates and supports high-value, existing efforts and focuses new investments on filling key gaps. California created an online map—its Coastal Monitoring Dashboard—depicting physical locations of statewide monitoring efforts.

# Monitoring Partnerships

In 2014, California formally adopted The California Collaborative Approach, Marine Protected Areas Partnership Plan which identifies research and monitoring as a "key role" for non-governmental partners such as academic and research institutions, Tribes, non-profit organizations, fishermen, non-consumptive recreational users, and private sector entities.

Numerous research and monitoring programs existed before the MLPA Initiative. California's approach has

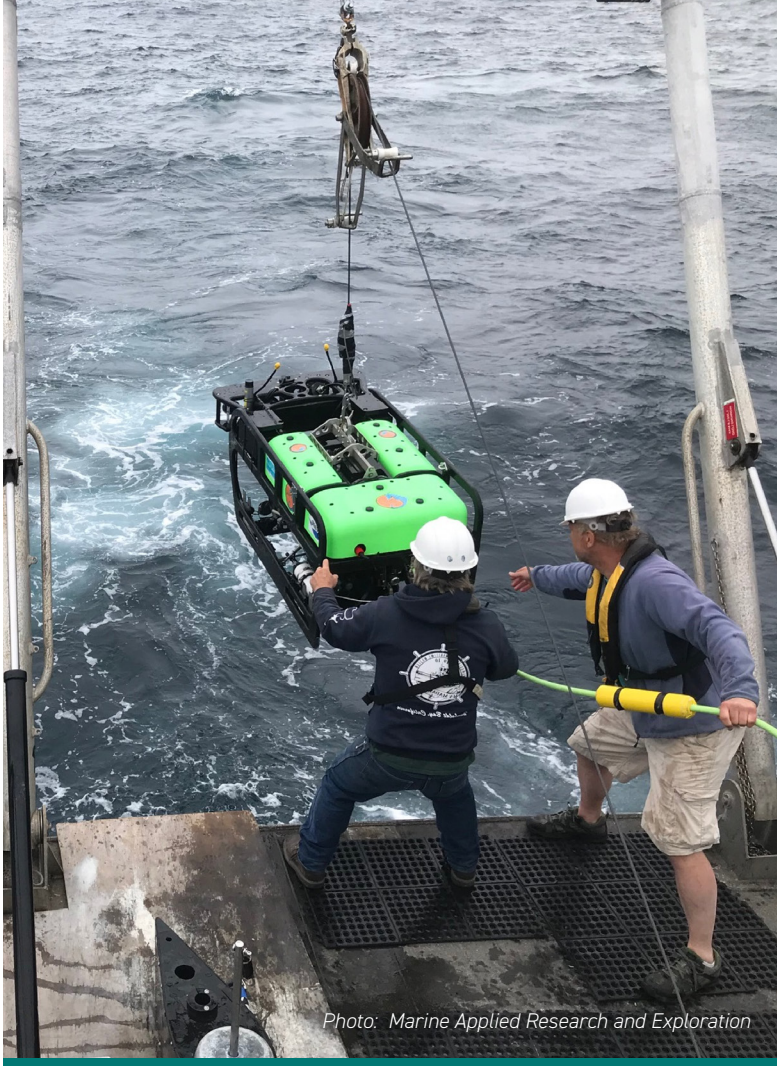

*Photo: Marine Applied Research and Exploration*

### California MPA Partnership Plan: Research and Monitoring Roles for Non-governmental Partners

» Coordinate and identify science and research needs

» Participate in scientifically robust data collection and analysis designed to inform adaptive management

» Convene scientific panels and workshops

» Administer volunteer-based monitoring programs, including citizen-science

» Promote lasting partnerships for ongoing monitoring

» Build new partnerships to create ocean health assessments that incorporate, but are not limited to, traditional knowledge

» Ensure research questions and results align with state priorities and are useful for management decisions

» Conduct research and develop innovative techniques for cost-effective monitoring

» Engage in collaborative research projects

### Example monitoring partners generating long-term data sets for evaluation of California MPAs

**Academic and Science Partners**

» California Cooperative Oceanic Fisheries Investigations (CalCOFI): *calcofi.org*
» Marine Applied Research and Exploration (MARE): *MAREGroup.org*
» Multi-Agency Rocky Intertidal Network (MARINe): *marine.ucsc.edu*
» Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO): *www.piscoweb.org*

**Citizen Science Programs**

» Long-term Monitoring Program and Experiential Training for Students (LIMPETS): *limpets.org*
» MPA Watch: *mpawatch.org*
» Reef Check California: *reefcheck.org/california/ca-overview*

**Fishing Partnerships**

» California Collaborative Fisheries Research Project: *www.mlml.calstate.edu/fisheries/ccfrp*

emphasized collaborations to leverage existing data sets and efforts, and develop new programs to advance MPA science where gaps existed.

The state's 2018 Monitoring Action Plan reinforces the central role of partnerships, highlighting several partners who have generated long-term datasets critical to overall evaluation of the MPA network.

### *LESSONS LEARNED*

» **Explicitly promote partnership.** The diverse partners in California's MPA monitoring program underpin its scientific success, bolster the program politically, and maximize cost-effectiveness. In disbursing public funding for MPA monitoring, the state has required consortiums of scientific principal investigators, often from multiple institutions or organizations, to work together to conduct specific elements of the monitoring, typically organized by habitat type. Generally those partnerships were more effective when established with clear, shared objectives and standardized approaches for the monitoring effort.

» **Be flexible.** An important component of California's Partnership Plan is flexibility to accommodate partnerships in varying degrees of formality, as long as partners align with the fundamental goals of MPA management. While some partnerships may be highly formalized, and include written agreements to specify sharing of data and resources, others may involve simply coordinating volunteers around a mutual focus on shared goals.

» **Foster community science.** California's MPA monitoring program explicitly encourages scientific research teams to partner with relevant community and citizen science organizations. This helps leverage volunteerism for improved data gathering, promotes coordination of efforts, and increases the likelihood of such data being used in management. Monitoring programs that directly engage fishermen can also help broaden MPA acceptance.

## Tribes and Indigenous Communities

California's MPA network lies within traditional territories of coastal Tribes who have stewarded California's marine and coastal resources since time immemorial. The Monitoring Action Plan identifies California Native American Tribes as key partners in ongoing governance of the MPA network, and prioritizes consideration of traditional ecological knowledge in management. Tribes and Tribal organizations have engaged in baseline monitoring and worked to build management capacity. Tribal representatives also serve on key MPA-related state advisory bodies.

Despite these recent advancements, California remains in the very early stages of partnership with Tribes related to natural resource management generally, including MPA monitoring.

### *LESSONS LEARNED*

» **Tribes are critical partners.** California's MPA monitoring program has been improved by the participation of Tribes as partners and Tribal representatives as collaborators.

» **Tribes contribute to our understanding.** Inclusion of traditional ecological knowledge of indigenous

peoples informs and enhances MPA management.

» **Prioritize collaboration and partnership.** There are many opportunities to further seek Tribal engagement and expertise in MPA research and monitoring programs statewide, including continued investment in partnerships and capacity of Tribes to engage in a wide range of monitoring efforts.

» **Ensure inclusive decision-making.** Tribal governments and communities have their own protocols, processes, and timelines that must be observed and respected. Research projects should be collaboratively designed with Tribes from the start to ensure monitoring addresses Tribal priorities, and gathered information and data is managed appropriately to address privacy concerns related to cultural practices.

# Institutional Coordination

California has experimented with different institutional "homes" for its MPA monitoring program over time. The baseline monitoring phase was managed by a stand-alone "MPA Monitoring Enterprise" housed outside of government by a partner organization, the non-profit California Ocean Science Trust. The MPA Monitoring Enterprise was established in an effort to ensure that MPA monitoring received focused attention and directed funding. This arrangement supported successful completion of the baseline monitoring phase and afforded state government time to build its own capacity to manage MPA monitoring, but was ultimately discontinued. Long-term MPA monitoring is now co-managed by the California Ocean Protection Council and the California Department of Fish and Wildlife.

## *LESSONS LEARNED*

» **Weigh options in deciding where to house monitoring program.** Carefully consider the strengths and weaknesses of different institutional options for housing a monitoring program. An independent institution, such as a university or non-profit entity, may be able to provide more focused attention to an MPA monitoring program as compared to a resource management agency charged with multiple competing priorities and may be able to help coordinate amongst multiple agency partners. However, such a "stand alone" approach can also be costly and difficult to maintain over time and may isolate monitoring from MPA management. Housing monitoring within an agency legally responsible for MPA management may provide organizational efficiency, faster internalization of ecological data by decision-makers, and increased awareness of the value of the MPA monitoring program among agency leadership.

» **Build long-term institutional capacity.** An organization or agency charged with housing and operating an MPA monitoring program may need time and resources to build its capacity. During the baseline monitoring period, California agencies increased their scientific and policy staffing to better support MPA monitoring. While external partners may play important roles in monitoring, it is also important to direct public funding to institutionalize MPA monitoring programs and ensure this is a durable element of long-term management and integrated into a broader MPA program.

# Data Storage and Management

Data storage, analysis, and accessibility is a core need for MPA monitoring programs and is typically challenging to implement. California has pursued a range of options for storing and accessing MPA data over time. A custom platform called "Ocean Spaces," developed during the baseline monitoring phase, was later discontinued due to high cost and lack of overall functionality. MPA data will now be stored within the federally-funded, non-profit collaborative DataONE platform (dataone.org), a home for natural sciences

*Photo: LizardJedi on Flickr*

data worldwide. In addition, state officials currently provide access to a portion of the MLPA Initiative's baseline monitoring data at California's own data portal for government-generated data (data.cnra.ca.gov), and are working toward providing access to all MPA data from both baseline and long-term monitoring efforts at that directory in the future.

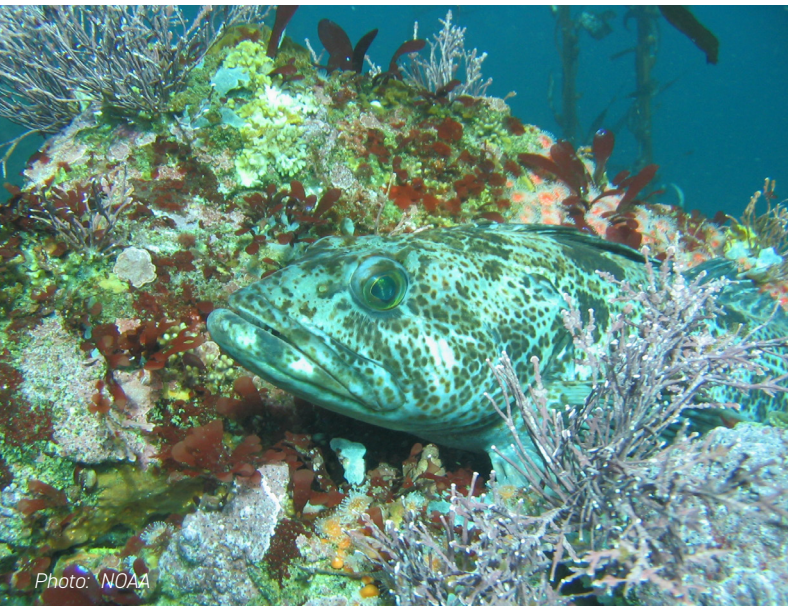
Photo: NOAA

### *LESSONS LEARNED*

» **Design for durability.** Publicly-accessible, centralized data repositories are a standard goal for resource management monitoring programs. However, California's experience demonstrates that developing customized data systems can be costly and difficult to maintain. Those considering new MPA data management systems should proceed with caution, consult with dedicated data scientists, and apply realistic budget parameters. Objectives should favor durability and use of existing technology and infrastructure over expensive customization for purposes of maximizing public access to data.

» **Public accessibility should aim for "good enough."** Consider the costs and benefits of centralizing and making public all raw data, technical reports, and other monitoring output. It may be dramatically less costly, more feasible, and more useful to instead provide synthesized analysis and summaries on a regular basis. This approach may also better address the data privacy needs of Tribes and First Nations. Simple data visualization systems where select indicators are pre-programmed and can be viewed graphically may address the vast majority of policymaker and stakeholder user needs.

## Funding MPA Monitoring

California invested more than $32 million in public funds in formal state MPA monitoring programs between 2004 and 2019 through a combination of bond revenues, general funds, and special funds. Federal funds and philanthropy have supported complementary monitoring efforts. In addition, California has stretched this funding further through extensive leveraging of external research and monitoring partnerships, as discussed above. These combined investments have already generated a wide array of long-term datasets, scientific insights and discoveries, scientific publications and technical reports, and detailed oceanographic characterizations.

### *LESSONS LEARNED*

» **Establish stable, long-term funding.** Funding multi-year monitoring plans allows researchers to plan multiple field seasons, draw more robust conclusions from a larger dataset, and develop stronger collaborations and partnerships. Whenever possible, consider how funding sources might be structured to capture these efficiencies and support a more durable, stable program.

» **Stretch existing funding through partnerships.** Volunteer-driven citizen science can offset some costs if done with approved protocols and rigorous training and designed to integrate with an approved MPA monitoring plan. Philanthropy can provide important supplemental support if external funding for monitoring is targeted in ways that fill gaps.

## Decadal Review and Adaptive Management

In 2022, the State of California will conduct its first decadal review of MPA network performance relative to the statutory goals of the MLPA. The review will include ecological, socioeconomic, and governance aspects of the MPA network and is expected to include a scientific evaluation, public scoping meetings, and panel discussions. Based on the review, the California Fish and Game Commission may take adaptive management actions if data and information support changes to the MPA network or its management program.

# Additional Resources


California Department of Fish and Wildlife and California Ocean Protection Council. Marine Protected Area Monitoring Action Plan. 2018.

Ocean Protection Council. The California Collaborative Approach: Marine Protected Area Partnership Plan. 2014.

California Department of Fish and Wildlife and California Ocean Protection Council. Marine Life Protection Act Master Plan for MPAs. 2016.

Murray, S. and Hee, T. *A rising tide: California's ongoing commitment to monitoring, managing and enforcing its marine protected areas*. Ocean & Coastal Management 182: 104920. 2019.

California Ocean Protection Council, "California's MPA Monitoring Program."
www.opc.ca.gov/programs-summary/marine-protected-areas/research-and-monitoring

California Department of Fish and Wildlife, "MPA Monitoring."
wildlife.ca.gov/Conservation/Marine/MPAs/Management/Monitoring

California Department of Fish and Wildlife, California Ocean Science Trust, and California Ocean Protection Council. "State of Region," regional 5-year baseline monitoring reports:

- State of the California North Coast, 2017
- State of the California North Central Coast, 2015
- State of the California Central Coast, 2013
- State of the California South Coast, 2017


---


*Nature United, the Canadian affiliate of The Nature Conservancy, commissioned Resources Legacy Fund, a non-profit organization based in California, to prepare a document summarizing lessons learned from the development and operation of the State of California's monitoring program for its statewide marine protected area (MPA) network. This document was prepared by synthesizing available literature and conducting a series of interviews with scientists, government officials, NGOs, and Tribal leaders.*

RESOURCES LEGACY FUND®
CREATIVE SOLUTIONS. LASTING RESULTS.

www.resourceslegacyfund.org