SECTION 1: INTRODUCTION

- Background
- Monterey Bay National Marine Sanctuary Setting
- Regulations and Prohibitions
- Implementing the Management Plan

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Background

The sanctuary encompasses a range of habitats from sandy beaches to rocky intertidal areas to open ocean, one of the nation's largest kelp forests, a submarine canyon, and Davidson Seamount. The highly productive biological communities in MBNMS are host to one of the highest levels of marine biodiversity in the world, including 30 threatened and endangered species. MBNMS is adjacent to one of the largest urban concentrations in North America with approximately 8 million people living within 50 miles (80 kilometers) of its shoreline. The designation of this area as a national marine sanctuary indicates its value to the American people, and the need for long-term protection.

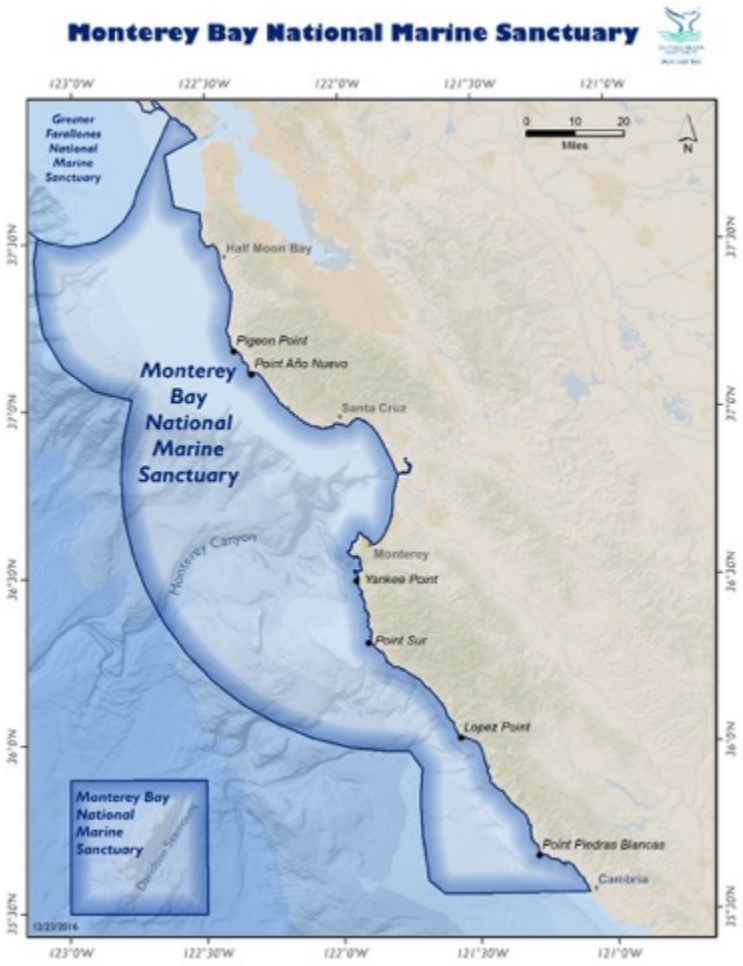


Figure I-2. MBNMS boundary. Image: NOAA

This management plan revises the 2008 plan and continues to focus on understanding and protecting the resources of MBNMS. This update was developed with public input from public scoping meetings, written comments, and Sanctuary Advisory Council and working group meetings, all providing input and recommendations regarding which issues MBNMS should address and how to address them.

Many marine resource management issues confront MBNMS. The action plans making up this management plan provide strategies to understand the issues and protect the coastal and marine environments comprising the sanctuary. The action plans address these issues through education and outreach, research and monitoring, collaborative planning and management efforts, regulation, and enforcement. The majority of actions described within this management plan are addressed in partnership with local, state, and other federal agencies, as well as many stakeholders with an interest in MBNMS.

This management plan is composed of 14 action plans guiding MBNMS staff for the next 10 years, beginning in 2020. The action plans are grouped into two main management themes: issue- and program-based. Each section contains several action plans

addressing issues identified through the public scoping process and prioritized by the Sanctuary Advisory Council. MBNMS staff often collaborate with partners to provide the services and activities necessary to implement the mandates outlined in the NMSA as well as addressing priority marine management issues of the sanctuary.

The programmatic action plans address the procedural requirements needed to implement the management plan and meet the NMSA mandates of resource protection, research, and education. Each action plan details the management action and describes mechanisms to evaluate the progress of the plan.

This introductory section provides background on ONMS, MBNMS, and the management plan review process. The section describes the administrative hierarchy and the organic act establishing ONMS. Next, it references the terms of designation, and details the history, mission, goals, and program foci of MBNMS. Finally, this section introduces the fundamental steps of the management plan review process, concluding with development of the new management plan.

Overview of ONMS

ONMS resides within the Department of Commerce, managed by the National Ocean Service (NOS) in the National Oceanic and Atmospheric Administration (NOAA). ONMS manages a national system of marine protected areas (MPAs). Since 1972, ONMS has worked cooperatively with the public and federal, state, tribal, and local officials to promote conservation while allowing compatible commercial and recreational activities. Increasing public awareness and protection of our marine environment and the natural and cultural resources within it are accomplished through site management, scientific research, monitoring, exploration, and educational programs.

The National Marine Sanctuary System consists of 14 national marine sanctuaries and Papahānaumokuākea and Rose Atoll marine national monuments. The system encompasses more than 600,000 square miles (1,554,000 square kilometers) of marine and Great Lakes waters from Washington state to the Florida Keys and from Lake Huron to American Samoa (Figure I-3). ONMS has recently designated one new sanctuary, Mallows Bay-Potomac River National Marine Sanctuary and two other designations, Wisconsin-Lake Michigan and Lake Ontario, are in progress. ONMS provides oversight and coordination among the National Marine Sanctuary System by setting priorities for addressing resource management issues and directing program and policy development. ONMS is responsible for ensuring each sanctuary has an updated management plan consistent with the NMSA. The plans include management strategies to address current and emerging threats.

On an annual basis, ONMS reviews and adjusts funding priorities and requirements to reflect resource management needs at each of the sites. ONMS also monitors the effectiveness of sanctuary management plans, makes recommendations to promulgate regulatory changes where necessary, and monitors intra- and inter-agency agreements.

The National Marine Sanctuaries Act

The NMSA, as amended (16 U.S.C. §1431 et seq.), is the law creating and guiding management of the National Marine Sanctuary System. The NMSA authorizes the Secretary of Commerce to designate areas of the marine environment or Great Lakes with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities as national marine sanctuaries. The primary objective of the NMSA is to protect sanctuary resources. The NMSA also directs facilitation of all public and private uses of those resources compatible with the primary objective of resource protection.
The purposes and policies of the NMSA are:

A. To identify and designate national marine sanctuaries as areas of the marine environment which are of special national significance and to manage these areas as the National Marine Sanctuary System;
B. To provide authority for comprehensive and coordinated conservation and management of these marine areas and activities affecting them, in a manner that complements existing regulatory authorities;
C. To maintain the natural biological communities in the national marine sanctuaries, protect where appropriate, restore and enhance natural habitats, populations, and ecological processes;
D. To enhance public awareness, understanding, appreciation, and sustainable use of the marine environment and the natural, historical, cultural, and archeological resources of the National Marine Sanctuary System;
E. To support, promote, and coordinate scientific research on and long-term monitoring of the resources of these marine areas;
F. To facilitate, to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities;
G. To develop and implement coordinated plans for the protection and management of these areas with appropriate federal agencies, state and local governments, Native American tribes and organizations, international organizations, and other public and private interests concerned with the continuing health and resilience of these marine areas;
H. To create models of and incentives for ways to conserve and manage these areas, including the application of innovative management techniques; and
I. To cooperate with global programs encouraging conservation of marine resources.

A complete version of the NMSA is available from the ONMS website at sanctuaries.noaa.gov/.

Figure I-3. National Marine Sanctuary System. Image: NOAA

Ecosystem-Based Management in ONMS

The purpose and policy of the NMSA is to "maintain for future generations the habitat, and ecological services, of the natural assemblage of living resources that inhabit [sanctuaries]" (16 U.S.C. § 1431(a)(4)(C)) noting "while the need to control the effects of particular activities has led to enactment of resource-specific legislation, these laws cannot in all cases provide a coordinated and comprehensive approach to the conservation and management of the marine environment" (16 U.S.C. § 1431 (a)(3)). As such, the units of the National Marine Sanctuary System subscribe to a broad and comprehensive management approach in keeping with the NMSA's primary objective of resource protection. This approach differs from the various laws directed at managing single or limited numbers of species or specific human activities within the ocean. Ecosystem-based management serves as a framework for addressing long-term protection of a wide range of living and non-living marine resources, while allowing multiple uses within the sanctuary that are deemed compatible with resource protection. These ecosystems managed by ONMS span diverse geographic, administrative, political, and economic boundaries. Strong partnerships among resource agencies, non-governmental interests, members of the public and scientific community, user groups, and conservationists are essential.

MBNMS Designation

MBNMS was established for the purpose of resource protection, research, education, and public use. Designated in 1992, MBNMS stretches from Rocky Point in Marin County to Cambria, encompassing a shoreline length of 276 miles (444 kilometers) and 6,094 square miles (15,783 square kilometers) of ocean, extending an average distance of 25 miles (40 kilometers) from shore. At its deepest point, MBNMS reaches down 12,743 feet (3,884 meters).

The natural resources of MBNMS include one of our nation's largest contiguous kelp forests, an underwater extinct volcano, one of North America's largest underwater canyons, and the closest-to-shore deep ocean environment off the continental United States. MBNMS is home to some of the most diverse and productive marine ecosystems in the world, including a vast diversity of marine life, with 36 species of marine mammals (MBNMS is one of the best places in the world to view elephant seals, sea otters, and a huge variety of whales and dolphins), 180 species of seabirds, 525 species of fish, four species of sea turtles, 31 phyla of invertebrates, and more than 450 species of marine algae. This highly productive and biodiverse area is often referred to as the "Serengeti of the Sea." MBNMS is also home to 30 species receiving special protection under the Endangered Species Act (ESA). Federally-listed threatened or endangered species include seven species of large whales, the southern sea otter, Steller sea lion, Guadalupe fur seal, California condor, California clapper rail, western snowy plover, marbled murrelet, four species of sea turtles, six species of salmon or steelhead, two species of sturgeon, eulachon (a smelt), and the tidewater goby. MBNMS is also a meeting place for the geographic ranges of many species. MBNMS lies at the southern end of the range for some species, like the Steller sea lion, which occur from central California north to Alaska and Japan. The sanctuary lies at the northern end of the range for others, like giant kelp, occurring from San Francisco to Baja California, Mexico.

MBNMS resides within one of four eastern boundary current upwelling centers worldwide. Coastal upwelling occurs along the western edges of continents, where winds from the northwest drive oceanic surface waters away from shore due to the Coriolis effect. Shallow, relatively warm waters are replaced by deep, cold, and nutrient-rich water. The cold water increases primary productivity, allowing phytoplankton to bloom, which in turn supports zooplankton. This process provides a key prey resource for higher-order predators such as fishes, birds, and whales. Globally, these upwelling regions rival the productivity of tropical rain forests and account for nearly 95% of the annual global production of marine biomass, despite only representing 0.1% of the ocean's total surface area.

A variety of potential resource threats and opportunities exist within MBNMS due to the sensitivity of habitats and species in the region, the long stretch of adjacent populated coastline with several urban centers, and the multiple uses of the marine environment. MBNMS research and monitoring programs evaluate the status and health of marine species, habitats, and ecosystems, provide critical information to resource managers, and coordinate activities with the array of world-class research institutions in the region. Resource protection activities use a variety of means to reduce or prevent detrimental human impacts, including collaborative planning and management efforts, regulations and permits, emergency response activities, and enforcement. Education and outreach are critical elements in enhancing understanding and stewardship of this national treasure, using tools ranging from visitor centers and public events, to interactive teacher workshops and extensive written materials.

Cultural resources abound and are protected by MBNMS regulations. Archaeologists estimate 450 reported historical vessel (shipwreck or aircraft) losses within the waters

of MBNMS and approximately 718 historic sites (former village sites, customs houses, and submerged cultural sites) within the sanctuary and adjacent coastal zone.

History

MBNMS was established in 1992 by authority of the Secretary of Commerce under the NMSA as directed congressionally by the Oceans Act of 1992. This designation was achieved 15 years after the sanctuary was first nominated by the state of California for consideration as a national marine sanctuary. During this period, many site analyses and meetings were conducted to determine whether this region met the designation criteria required by the NMSA:

A. The area is of special national significance due to its resource or human-use values.
B. Existing state and federal authorities are inadequate to ensure coordinated and comprehensive conservation and management of the area, including resource protection, scientific research, and public education.
C. Designation of the area will ensure comprehensive conservation and management, including resource protection, scientific research, and public education.
D. The area is of a size and nature that will permit comprehensive and coordinated conservation and management.

NOAA was directed to designate Monterey Bay as a national marine sanctuary under the 1988 reauthorization of the NMSA. On August 3, 1990, NOAA released the draft environmental impact statement/management plan for the proposed MBNMS and published proposed regulations. NOAA held public hearings and published the final management plan and environmental impact statement in June 1992. MBNMS final regulations were published in the Federal Register on September 18, 1992.

In 2008, MBNMS expanded to include Davidson Seamount. The final rule, which includes the boundary expansion, is available at http://montereybay.noaa.gov/intro/mp/welcome.html. Davidson Seamount is a pristine undersea mountain habitat off the coast of Central California, 80 miles (128.75 kilometers) southwest of Monterey and 75 miles (120.7 km) west of San Simeon. At 26 miles (41.8 kilometers) long and 8 miles (12.8 kilometers) wide, it is one of the largest known seamounts in U.S. waters. From base to crest, the seamount is 7,480 ft tall (2,188.5 m.), yet its summit is still 4,101 ft (1,250 meter) below the sea surface. ONMS determined Davidson Seamount required protection from the take of or other injury to benthic organisms or those organisms living near the seafloor because of the seamount's special ecological and fragile qualities. The boundary change added a 775 square mile (2,007 square kilometer) area to MBNMS, increasing its area to 6,094 square miles (15,783 square kilometers).

Mission and Goals

The mission of MBNMS staff is to understand and protect the coastal ecosystem and cultural resources of Monterey Bay National Marine Sanctuary.

MBNMS program goals per the NMSA are to:

A. Enhance resource protection through comprehensive and coordinated conservation and management tailored to the specific resources that complements existing regulatory authorities.
B. Support, promote, and coordinate scientific research on and monitoring of the site-specific marine resources to improve management decision-making.
C. Enhance public awareness, understanding, and wise use of the marine environment through public interpretive and recreational programs.
D. Facilitate, to the extent compatible with the primary objective of resource protection, multiple uses of these marine areas not prohibited pursuant to other authorities.
E. Maintain four program areas making up the administration of MBNMS: research and monitoring, resource protection, education and outreach, and program operations.

Focus and Accomplishments of the Research and Monitoring Program

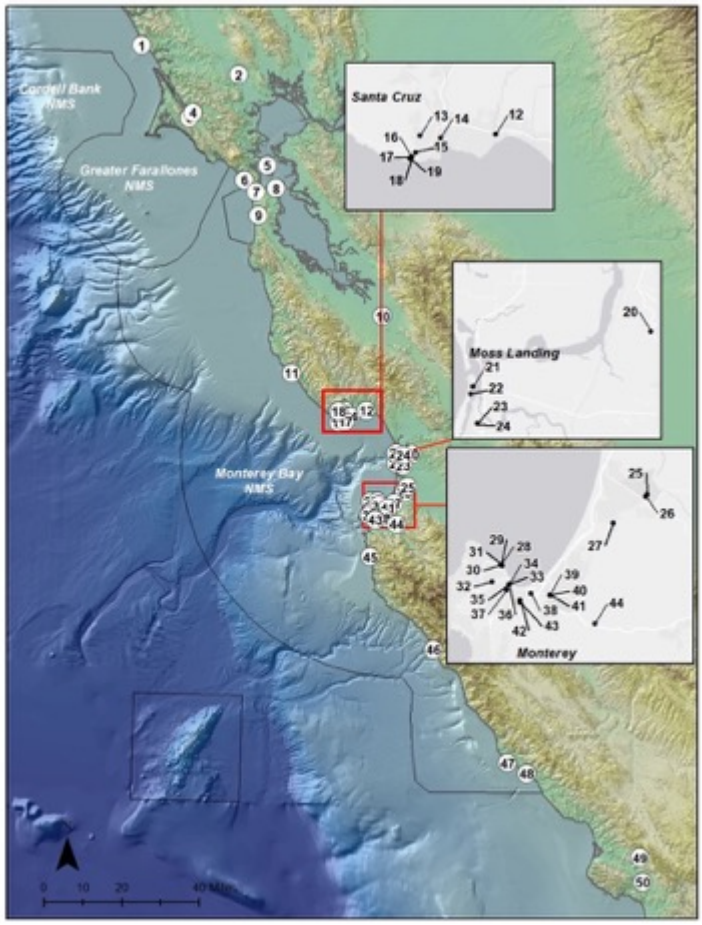


Figure I-4: Regional Institutions. Image: NOAA

The research and monitoring program's focus is on science-based activities to support resource management by: determining information gaps; developing studies to improve understanding of distinct management issues and long-term sanctuary health; and interpreting research for decision makers. MBNMS is part of the world-renowned and collaborative research community in coastal central California. Twenty research institutions are represented on the MBNMS Research Activity Panel (RAP). Members of the RAP and other scientists from regional institutions (Figure I-4) share their expert knowledge, facilities, equipment, and academic programs to help address issues identified in the MBNMS management plan. The research and monitoring program, in collaboration with regional partners, has achieved notable regional and international success through advisory committees, organizing symposia, developing websites with monitoring information, developing sanctuary condition reports with associated data sharing portals, obtaining research grants, gaining access to national research assets, conducting research expeditions, publishing scientific papers, and integrating science into education, research, and resource management endeavors. Examples of research program accomplishments over the past decade include:

- Facilitating more than 50 research institution collaboration meetings of the MBNMS Research Activity Panel.
- Maintaining the longstanding Ricketts Memorial Award (33 years) and associated symposia.
- Maintaining a citizen science program to assess stranded marine birds and mammals, detecting an average of 2.5 natural and/or human-caused significant mortality events per year.
- Assessing long-term changes to kelp communities, in association with marine reserves, climate change, disease, and other factors.

- Expanding and maintaining the Sanctuary Integrated Monitoring Network website and data submission processes for four national marine sanctuaries along the West Coast.
- Conducting the only long-term monitoring program of a lost shipping container that sank to 4,200 feet, and becoming an international expert on the issue.
- Characterizing the extensive sand and mud habitats of the MBNMS continental shelf.
- Developing a regional soundscape monitoring program and linking it to national efforts.
- Developing a marine biodiversity observation network that integrates existing monitoring programs to share data through innovative web portals, and receiving an "Excellence in Partnering Award" for the effort from the National Oceanographic Partnership Program.
- Discovering unique areas such as the dense deep-sea coral gardens of Sur Ridge and the largest deep-sea octopus brooding area ever seen.
- Developing deep-sea coral restoration methods.
- Serving on advisory panels for a 61-acre wetland restoration project in Elkhorn Slough.
- Conducting oceanographic, water quality, and biological surveys on and above Davidson Seamount, making this seamount one of the best studied in the world since this area was added to MBNMS in 2008.
- Advising resource managers on permit applications on topics ranging from beach nourishment to deep-sea cable laying.
- Participating in numerous damage assessments associated with shipwrecks and water quality issues.
- Assessing black abalone and their habitats for sensitive species designations, and developing methods for minimizing impacts to these species. Participating in the first translocation of black abalone for habitat restoration.
- Participating in activities to characterize and protect maritime heritage resources, including visitor center docent training and exhibit development, survey to determine if oil was present aboard the sunken SS *Montebello*, and listing of USS *Macon* in the National Register of Historic Places.
- Publishing more than 40 scientific papers on topics ranging from deep-sea taxonomic guides to estuarine species invasions.

Focus and Accomplishments of the Resource Protection Program

One of the primary mandates of the NMSA is to protect and restore the biological, historical, and cultural resources in the sanctuary. A key objective of the management plan is to ensure human activities in MBNMS do not adversely affect natural resources, including habitats. This objective is accomplished through a variety of approaches, including collaborative planning efforts to prevent and reduce human impacts, regulations, permits, and enforcement efforts. Management efforts also involve helping to educate the public and MBNMS users about how they can minimize or eliminate harmful impacts. The resource protection program also supports the Sanctuary Advisory Council's Conservation Working Group (CWG), which serves as a forum for conservation issues, identifying resource protection needs and providing advice, views,

and factual information on resource protection, sanctuary management, and other issues.

The sanctuary's long coastline, including four harbors and several urban areas, creates multiple complex threats to the coastal ecosystem. In addition, changes to the climate are causing sea level rise, extreme storms, and ocean acidification. ONMS will need to focus on collaborative solutions at the local/regional and national level to adapt to these changes.

The resource protection program has accomplished many important objectives over the past decade such as:

- Full implementation of the Water Quality Protection Program, developed to improve and/or protect water quality (related to urban runoff, harbors, marinas, agriculture, and rural lands), as well as strengthen coordinated regional water quality monitoring by government agencies and citizen groups.
- 20 years of implementing the Citizen Watershed Monitoring Network, a consortium of citizen (community?) monitoring groups that monitor the health of the eleven watersheds flowing into the Sanctuary. This includes Snapshot Day, First Flush and Urban Watch programs
- Effective coordination with the National Marine Fisheries Service (NMFS) and the Pacific Fishery Management Council (PFMC) to protect sensitive habitat through modifications to groundfish Essential Fish Habitat (EFH).
- Identification of sanctuary ecologically significant areas in order to characterize and map biogenic hot spots, including sensitive habitats that may require additional research and protection.
- Publication of desalination guidelines in 2010, in coordination with NMFS and California Coastal Commission, which guide the design and planning for proposed desalination projects along the shoreline of MBNMS, as well as agency environmental review and permitting. Proposed technologies such as sub-surface and open water intake/outfall pipes are addressed, which would require coordination and permit oversight to identify potentially significant impacts to marine resources.
- Participation in research and a long-range management plan for Highway 1 to reduce impacts from landslide repair and disposal activities into the sanctuary.
- Continued coordination with NOAA Office of Law Enforcement (OLE) and an officer assigned to focus on MBNMS enforcement issues.
- Facilitated ongoing communication among law enforcement entities through coordination of the Law Enforcement Technical Advisory Committee (LETAC).
- Increased field surveillance by MBNMS staff to detect prohibited activities in an effort to ensure greater protection of sanctuary resources. Field surveys have included on-the-water presence and shoreline surveys.
- Implementation of action plans addressing submerged cables, coastal erosion, and cruise ship discharges. Strategies for these issues are now incorporated into new action plans.
- Conducted socioeconomic surveys of targeted user groups (e.g., wildlife viewing operators) to gather data on the non-consumptive market value of marine wildlife and other sanctuary resources.

- Implementation of a hazardous material/emergency response program for events such as spills and vessel groundings.
- Continued collaboration with the U.S. Coast Guard (USCG) to conduct random joint inspections of cruise ships visiting Monterey to verify their adherence with sanctuary and USCG regulations.
- Implementation of a permit program to review proposed activities that could otherwise harm MBNMS resources and issue permits or other authorizations with conditions to minimize or negate impacts.
- Coordinated review of projects, plans, and permits of other agencies to minimize impacts.

Focus and Accomplishments of the Education and Outreach Program

MBNMS education and outreach efforts help connect people to the marine environment and support resource protection and conservation science. With the goal to promote public awareness and understanding of our national marine sanctuaries, programs strive to empower citizens with the knowledge necessary to make informed decisions, ultimately leading to the responsible stewardship of marine ecosystems. Since the creation of two sanctuary interpretative centers, the Coastal Discovery Center in 2006 and the Sanctuary Exploration Center in 2012, hundreds of thousands of visitors have experienced education programs and interpretative exhibits focused on sanctuary research and conservation. Partnerships and collaboration have also played a key role in the development and implementation of the MBNMS educational and outreach efforts, with the sanctuary's visitor center facilities hosting numerous community partner programs, special events, film festivals, and conferences.

Overall, education and outreach programs have accomplished many important objectives of the sanctuary management plan over the past decade, increasing public awareness and providing issue-based education and programming for students and teachers. Some of the activities include:

- Hosting film festivals, science lectures, ocean fairs, and docent-led tours at our two sanctuary interpretive centers.
- Installing interpretive signs and displays at numerous state parks and along trails, beaches, and partner facilities adjacent to the sanctuary.
- Developing educational products and materials including curricula, books, brochures, posters, maps, newsletters, annual reports, videos, and an extensive website.
- Participating in public community events.
- Producing media and public relations stories, web stories, and social media content.
- Developing the SeaPhoto app for mobile devices to serve as a digital field guide to organisms seen in the sanctuary.
- Engaging with recreation, business, and hospitality sectors to expand and enhance public awareness and promoting sustainable recreation and tourism in the sanctuary.
- Producing episodes of *Your Sanctuary*, a public television series highlighting sanctuary resources, research, education, and community partnerships in ocean

protection that was broadcasted on Access Monterey Peninsula TV channel and YouTube.
- Hosting the annual Sanctuary Currents Symposium event for researchers, educators, students, and the public to learn about current research being conducted in the sanctuary to better understand sanctuary habitats and resources.
- Developing water quality products to address urban runoff and illegal pollution discharges.
- Promoting protection of endangered species, fragile habitats, and protected species through public presentations, special events, and video products.
- Developing and distributing outreach materials on important resource protection issues, such as reducing wildlife disturbances, tide pool etiquette, and addressing marine debris.
- Coordinating the volunteer interpretative programs Team OCEAN (Ocean Conservation Education Action Network) and Bay Net to educate the public about safe wildlife viewing and help prevent wildlife disturbances.
- Developing school curricula to support field trip programming, including the Multicultural Education for Resource Issues Threatening Oceans (MERITO) program and Voices of the Bay.
- Using sanctuary interpretive centers to host school field trip programs, such as beach explorations, wharf oceanography, marine debris, and plankton studies.
- Conducting in school classroom education programs, such as "Fisherman in the Classroom."
- Supporting exposure to careers through ocean exploration and research expeditions including Nautilus Live telepresence programs with Ocean Exploration Trust and Immersion Presents with the Mystic Aquarium and Institute for Exploration.
- Engaging with academic institutions, such as Cal Poly, UC Santa Cruz, and CSUMB, to support college student internships and professional development.

Focus and Accomplishments of Program Operations

Critical to MBNMS's successful operation is effective support for the research, resource protection, education, and outreach efforts.

Program operations accomplishments include:
- Developing and tracking of the MBNMS annual operating plan, and management plan to better assess milestones and needs.
- Complying with DOC/NOAA security requirements for computers, telephone systems, and associated networks to maintain a secure digital workplace.
- Facilitating geographic information systems (GIS) to enhance research and monitoring, resource protection, policy development, and education and outreach needs.
- Supporting a robust, safe dive and field operations program to better facilitate enforcement, emergency response, and research and monitoring of sanctuary resources.

- Supporting MBNMS's Sanctuary Advisory Council, working groups, and subcommittees (recruitment, meeting support, logistics, newsletters) to enhance public input into sanctuary management.
- Revising the Sanctuary Advisory Council charter to enhance meeting flow, streamline procedures, and enhance member selection processes.
- Completing the management plan review process (draft management plan, proposed regulations, and environmental assessment) as part of the sanctuary system's adaptive management model.
- Tracking and reporting management plan performance measures to aid in measuring progress to management goals.
- Supporting the development of the MBNMS Foundation to enhance sanctuary programs across education, resource protection, and research focus areas.
- Managing three staffed offices (Monterey, Santa Cruz, and San Simeon) to increase public interface with sanctuary staff and programming.
- Managing and maintaining two visitor centers and exhibits (the Sanctuary Exploration Center in Santa Cruz and the Coastal Discovery Center in San Simeon) to better engage the public, schools, and teachers.
- Supporting the human resource needs for 25 federal staff and affiliates and hundreds of volunteers required to accomplish the resource protection, education, outreach, monitoring, and citizen science activities outlined in MBNMS's management plan.

Public Participation and the Sanctuary Advisory Council

The citizens of central California are politically and socially engaged on issues affecting their communities and surrounding environment, including the coast and ocean. MBNMS owes its existence largely to the dedication and determination of thousands of local citizens and elected officials who strongly advocated for its designation. Public participation permeates nearly every aspect of sanctuary management and operation, including support and management of the Sanctuary Advisory Council and its working groups, volunteering for the many programs that help MBNMS achieve its education and research missions, and participating in community festivals and symposia.

The Sanctuary Advisory Council advises the superintendent on policy issues affecting the sanctuary, and is composed of 20 voting members with alternates and eight non-voting members representing various stakeholders. The council has played a vital role in many decisions affecting the central California coast. The Sanctuary Advisory Council has three standing working groups:

Conservation Working Group: Coordinates the efforts of existing conservation-focused organizations and helps promote and achieve comprehensive and long-lasting stewardship of MBNMS through continued advice, input, and advocacy.

Research Activity Panel: Provides scientific advice and objective information, assists in the implementation of programs to increase our scientific understanding of the sanctuary, promotes a comprehensive understanding of existing research activities and institutions, reviews research proposals, and advises on research priorities.

***Sanctuary Tourism and Recreation Working Group*:** strengthens economic partnerships with MBNMS and local businesses, and provides a forum for local businesses and MBNMS to coordinate and promote recreation and tourism opportunities in the sanctuary.

Monterey Bay National Marine Sanctuary Setting

Human Environment

Regional Context

Five counties border MBNMS: Marin, San Mateo, Santa Cruz, Monterey, and San Luis Obispo. Three additional counties, San Francisco, Santa Clara and San Benito, have watersheds draining directly into MBNMS. Each is diverse in terms of population and economic base.

The northern region borders Marin County and the San Francisco Peninsula, which includes San Mateo County and Santa Clara County, an inland county home to the San Jose metropolitan area commonly known as Silicon Valley due to the large concentration of high technology businesses. Coastal development has been somewhat constrained by limited water availability, few access roadways, and strong environmental advocacy. However, due to the rapid growth of the technology sector, the Silicon Valley area exerts significant development pressure to the south and west toward the coast. Monterey County, in the southern region, also faces significant growth challenges. Based on 2017 census data, the largest industries in Monterey County are agriculture, forestry, fishing and hunting, health care and social assistance, and hospitality and food services. San Luis Obispo County's economy focuses on agriculture, tourism, and education. These counties face significant challenges addressing population needs and impacts to the environment. Limited infrastructure and resources (e.g., transportation, affordable housing, water, workforce, municipal budgets) to accommodate coastal communities and protect natural resources necessitate cooperation and coordination among local, state and federal government. Having a national marine sanctuary (and other state and federal protected lands and waters) in this region helps make environmental protection a priority.

The central California coastal region is a mosaic of federal, state, county, and private lands with varying protections. The management of this region is highly collaborative and often involves overlapping jurisdictions. Federal partners in the region include the United States Forest Service (USFS) and the Bureau of Land Management (BLM), both of which manage federal lands adjacent to the sanctuary. California State Parks (CSP) manages state parks and beaches adjacent to the sanctuary; California Department of Fish and Wildlife (CDFW) manages 23 state marine protected areas within sanctuary boundaries; and the California Department of Transportation (Caltrans) works closely with MBNMS staff on slide and erosion issues along the Highway 1 corridor. The aforementioned counties and cities have small parks and beaches dotting the coast. Various non-governmental organizations (NGOs) like the Elkhorn Slough Foundation, Big Sur Land Trust, The Nature Conservancy, and other private conservation groups contribute to the protections of coastal lands, the ocean, and their associated watersheds.

Socio-Economic Environment

A rich history of human use of this region's marine resources begins with Native Americans and continues to the present. Today the sanctuary's spectacular scenery, moderate climate, abundance of marine life and relatively clean ocean waters all draw large numbers of divers, kayakers, boaters, fishers, surfers, tide poolers, and bird and mammal watchers. Coastal tourism, agriculture, education, and commercial fisheries are all pillars of the regional economy with direct links to MBNMS.

Travel and tourism is one of the most significant industries, with a total travel-spending revenue in 2017 of $10.3 billion for the five counties adjacent to MBNMS. San Mateo leads in total spending at $3.9 billion, followed by Monterey at $2.8 billion and San Luis Obispo at $1.7 billion (Dean Runyan Associates 2019. Two of the main reasons given for travel to the coastal region include natural and scenic beauty and recreational opportunities.

Agriculture is also an important industry in the region, which is a national leader in the production of artichokes, strawberries, and salad greens. In 2016, agriculture was valued at $6 billion for the five counties adjacent to MBNMS (California Department of Food and Agriculture 2017). Monterey County, valued at $4.25 billion (Monterey County 2016), is by far the most significant agricultural producer in the region and ranks fourth highest statewide.

The fishing industry constitutes a relatively small portion of the overall economy, both regionally and statewide. However, this industry reflects an important component to the historical, economic, and cultural fabric of the region. Most fish caught within MBNMS are landed at one of six main ports: Princeton/Half Moon Bay, Santa Cruz, Moss Landing, Monterey, Morro Bay, or Avila/Port San Luis. In 2017, more than 750 commercial vessels fished within MBNMS annually and more than 95% of the commercial landings by weight were comprised of market squid, anchovy, Dungeness crab, sablefish, hagfish, salmon, California halibut, spot prawn, thornyheads, and rockfish. In 2017, ex-vessel revenues for all species within MBNMS totaled almost $33.3 million dollars paid to commercial fishermen in California. Additional revenue is also generated from the businesses associated with fishing operations, including food processing, marinas, maintenance operations, and equipment. In a 20-year period from 1992 (when the sanctuary was designated) to 2012, over 1.4 billion pounds of fish were landed in the ports adjacent to MBNMS (and Morro Bay-adjacent) at a value of over $515 million.

The rich biodiversity and close proximity of the deep sea also provide unparalleled research opportunities for approximately 25 marine science institutions that, in 2014, employed more than 2,300 staff and researchers with combined annual budgets of more than $315 million. This includes government agencies, public and private university research institutions, and private facilities such as the Monterey Bay Aquarium and the Monterey Bay Aquarium Research Institute.

Other MBNMS-related industries include research, aquaculture, kelp harvesting, and commercial shipping (including cruise ships). The adjacent San Francisco/Oakland

ports and harbor complex is one of the largest on the U.S. Pacific Coast with millions of tons of cargo passing under the Golden Gate Bridge annually.

Human History and Resource Use

Humans settled in the vicinity of MBNMS as long as 10,000 years ago. At the time of Spanish arrival in the early 1700s, about 40 Native American tribes populated coastal areas from San Francisco Bay to Point Sur, consuming acorns, terrestrial plants, and animals, intertidal invertebrates, fish, and marine mammals. The Spanish called the indigenous peoples "Costanoans," meaning "coast dwellers." Today they are known as the Ohlone, meaning "people of the west." Shell midden piles left by the Ohlone have been found at most substantial waterways and shorelines between Morro Bay and Monterey Bay, composed primarily of remains of abalone, mussels, clams, snails, chitons, limpets, and other invertebrate groups. The quantity of shells suggests that the Ohlone were "a principal control of animal population sizes" in the intertidal zone in some areas. (MBNMS 1996) The Ohlone used fire to manage terrestrial vegetation for purposes such as enhancing growth and preparing plants for harvest.

Spanish settlements arose in the late 1700s and they began to exploit both natural resources and the Ohlone. These settlers established a pastoral lifestyle and an extensive network of missions that relied heavily on livestock and servant labor. Many European traders and explorers of the late 1700s wrote of the remarkable abundance and richness of wildlife in the Monterey Bay area. French explorer Jean Francoise de La Perouse, the first foreign visitor to the Spanish outposts, wrote his ships were "surrounded by pelicans and spouting whales. There is not a country in this world which more abounds in fish and game of every description."(MBNMS 1996)

Ohlone populations plummeted after establishment of the missions due to introduced diseases, cultural dissolution, and exploitation by the Spanish and later Mexicans and Americans. Sweeping changes in the resulting landscape included greatly enlarged pasturelands throughout fertile drainages of MBNMS and incidental importation of many non-native grasses and other plants. The Spanish also hired imported Russian or local Ohlone hunters to hunt sea otters. These valuable pelts were exported to Asia, Europe, and elsewhere in the Americas. Sea otters became scarce around Monterey Bay by the late 1800s. The Spanish also harvested abalone for trade with northwest coast Indians.

New England whalers often hunted along the central coast in the late 1700s and early 1800s, feeding a voracious East Coast market for whale oil, baleen, and meat. Portuguese whalers from the Azores originally brought to Monterey Bay as crew settled in Monterey Bay by the 1850s. The Portuguese worked in shore-whaling operations begun by Yankee whaler John Davenport, which targeted humpback and gray whales, though other species were also captured. As the price of whale oil decreased due to the production of kerosene in the 1880s, shore whaling died out. A brief resurgence in whaling occurred along the California coast in the 1900s, including a short-lived Norwegian-style and -owned modern whaling operation in Moss Landing.

In the 1850s, Chinese settled in Monterey to harvest kelp and to fish for abalone, squid, and shark. These products were dried and shipped to San Francisco and China. This

industry helped feed California's burgeoning Gold Rush population. By 1900, abalone were so scarce the commercial harvest was banned and the Chinese turned to other fisheries, especially as market demand from San Francisco increased.

The construction of the San Francisco-Monterey railway in the 1860s allowed for rapid transport of fresh fish. Genovese Italian immigrants established fishing settlements around Monterey Bay in the 1870s, providing a variety of fresh fish to the San Francisco markets via railroad. Sicilian fishermen followed in 1906 and soon focused on the sardine fishery. The sardine fishery peaked from 1910 to 1930, collapsed in the 1930s, and has not yet recovered to its former size.

Several other ethnic groups harvested natural resources from the sanctuary during this century, including Japanese hard-hat abalone divers (1900-1941), Vietnamese gillnet fishermen (1979-present) and offshore foreign (Russian, Polish, and others) fishing fleets. All adapted to become part of the multicultural population that continues to use the resources of this biologically rich region. (MBNMS 1996)

Physical Environment

Regional Geography

MBNMS contains one of the world's most geologically diverse and complex seafloors and continental margins. The sanctuary is located on a plate boundary separating the North American Plate from the Pacific Plate and is marked by the San Andreas Fault system. The active tectonic region frequently experiences earthquakes, submarine landslides, turbidity currents, flood discharges, and coastal erosion.

Coastal topography of the sanctuary varies greatly, encompassing steep bluffs with flat-topped terraces and pocket beaches to the north; large sandy beaches bordered by cliff and large dune fields in the sanctuary's mid-region; and predominantly steep, rocky cliffs to the south. Low- to high-relief mountain ranges and broad, flat-floored valleys are prevalent farther inland.

The Santa Cruz and Gabilan mountain ranges dominate the topography in the northern and central half of the region. Two major rivers (San Lorenzo and Pajaro) and Scott Creek enter Monterey Bay from these highlands through well-defined valleys as a major drainage system. Elkhorn Slough, an old river estuary occupied today only by tidal salt marshes, extends inland from Moss Landing for more than six miles (9.7 square kilometers). The broad, extensive Salinas Valley, the Gabilan Range, and the northern Santa Lucia Range are the dominant topographic features in the southern area of the region; the Salinas River is the major drainage system. South of Monterey, the west flank of the Santa Lucia Range drops abruptly into the ocean. Here, the valleys of the Carmel and Little Sur rivers are dominant topographic features and drainage systems. From Point Sur to Morro Bay, many streams and creeks drain the southern Santa Lucia Mountains and cut the steep western face of the mountain range.

The watersheds of much of northern and central California, including the Central Valley, drain into San Francisco Bay and Sacramento-San Joaquin Delta, which contain most of

the state's remaining coastal wetlands. More than a third of the state's land mass drains from the Central Valley and the Sierra Nevada and Cascade ranges into San Francisco Bay, which is the largest estuary on the west coast of North America.

Geology

MBNMS is within the active North American-Pacific Plate boundary along the western margin of the San Andreas Fault system. The San Gregorio-Palo Colorado and Monterey Bay fault zones are the main southeast-northwest trending fault zones in MBNMS. The San Gregorio-Palo Colorado fault zone is mapped as largely an offshore fault crossing nearly the entire MBNMS from offshore Partington Point in the Big Sur coast, to north of Montara Point near Half Moon Bay. The San Gregorio-Palo Colorado and Monterey Bay fault zone is considered active with a 10% probability of an earthquake of magnitude 6.7 or greater by 2032. The formation and linear shape of the Carmel Submarine Canyon is attributed to this fault zone. The Monterey Bay fault zone lies primarily offshore between the cities of Monterey and Santa Cruz and is approximately six to nine miles (9.7 to 14.5 kilometers) wide. It consists of a number of relatively short fault segments potentially affecting local submarine physiography.

Sediment of the continental shelf (less than 400 feet, 121.9 meters water depth) from the northern area of MBNMS varies from sand-dominated near shore and at the shelf edge to mud- and silt-dominated in mid-shelf areas. The thickest accumulations of modern sediments are in mid-shelf regions. Sediment accumulation patterns determine biological habitats. Organisms that are adapted to shifting substrate are found in dynamic areas with high sediment deposition. Organisms that depend on shelter and steady algal growth are found on rocky substrate that does not experience regular major changes.

Bluff erosion, dune erosion, and sediment input from rivers and streams are the most significant sediment sources to the continental shelf in MBNMS. The greatest concentrations of coarse sand deposits are found on the southern Monterey Bay shelf and on the shelf off the Big Sur coast. Submarine canyons, common to MBNMS, are thought to contribute sediment to the deep sea.

Erosion is greatest in winter months, especially during El Niño years. Beaches tend to rebuild annually, whereas sand dunes and cliffs continuously retreat. The organisms that inhabit beaches are adapted for life in a continually changing environment, while sand dune communities transform as the dunes and cliffs retreat from the water's edge. The highest erosion rates are found on dunes in southern Monterey Bay.

Oceanography

Oceanographic processes in MBNMS are influenced largely by the California Current and upwelling. The California Current is an eastern boundary current that is generally characterized as a broad, shallow, and slow-moving current, exhibiting high spatial and temporal variability. It is usually located several miles offshore, flowing north to south, beginning in Alaska and terminating off Baja California. The California Current is the eastward portion of the clockwise North Pacific Gyre and transports cool water with low salinity towards the equator. Associated with the coastal surface flow is an undercurrent

moving in the direction of the North Pole, the California Undercurrent, also referred to as the Davidson Current. Several agencies and research groups are studying the physical, chemical, and biological properties of this current system and how atmospheric conditions influence oceanic conditions, which in turn affect productivity of pelagic (i.e., open water) ecosystems.

The California Current has many semi-stationary jets and eddies. Satellite imagery has shown cold filaments approximately 30 miles (48.3 kilometers) wide, extending approximately 150 miles (241.4 kilometers) offshore. The importance of these features, which represent the highly variable oceanographic weather of the California Current, lies in their offshore transport of cool, nutrient-rich water from depths to the surface, referred to as upwelling. The surface and intermediate depth water masses in MBNMS are a mixture of Pacific Subarctic water having low salinity and cool temperatures and the warmer, saltier Pacific Equatorial water. The proportion of the types of water changes, as does the strength of the northward flowing Davidson Current. Nearshore surface temperatures vary from 46°F during winter and early spring to 62°F during fall. Nearshore surface salinities vary from 34.0 practical salinity units (psu) when upwelling is strong to 33.2 psu at non-upwelling times.

Three oceanic periods exist in the Monterey Bay area: the upwelling period from early spring to late summer; the oceanic period from late summer to early fall; and the Davidson Current period from late fall to late winter. The descriptions may be useful to describe the changing hydrographic conditions along MBNMS, but in reality, these periods overlap extensively and do not recur with clockwork punctuality. The timing reflects changes in local winds and external effects, such as El Niño and other long-term weather shifts. Within the coastal regime, sea surface flow undergoes a seasonal reversal. During the late fall and winter the direction is primarily poleward while equatorward flow dominates during the spring and summer. The flow towards the equator is coupled with the intensification of northwesterly winds that generally parallel the central California coastline. The sudden strengthening of the northwesterly winds, usually March through May, may result in the spring transition in which upwelling commences and local sea surface temperatures fall by as much as 5°F within a few days. During late fall, the North Pacific High weakens and migrates southward and the thermal low disappears. The surface flow reverses to poleward.

When winds are strong from the northwest, water from the surface to about 165 feet (50.3 meters) has an offshore component. The sea surface is lowest along the coast and tilts upward by about eight inches across the width of the California Current (620 miles, 997.8 kilometers). Surface waters that moved seaward are replaced by deeper upwelled waters that flow shoreward and upward.

Although the seasonal changes in MBNMS are important, longer term inter-annual variations, principally El Niño events, also affect local physical and biological systems. El Niño is a warming of nearshore waters of the Eastern Pacific, caused by relaxation of the trade winds in the equatorial Pacific. Cessation or weakening of the trade winds allows the sea surface, which usually tilts upward by about one mile from east to west, to relax, through an eastward propagating pulse or Kelvin wave taking several months to transit the equatorial Pacific. The wave propagates poleward along the coast of Central

and North America and eventually is observed locally as warmer surface waters and higher than normal sea level. Local temperature anomalies up to 5°F and sea level anomalies of up to eight inches occur more or less periodically at intervals of three to five years.

Tides, the periodic rise and fall of the seas, are caused by Earth's rotation and the gravitational pull of the moon, sun and other celestial bodies. MBNMS tides follow a mixed semidiurnal tidal pattern with two high water and low water phases per day. The tides are mixed because consecutive highs and lows have different tidal height. The internal tide in the Monterey Submarine Canyon is one of the remarkable oceanographic effects caused by the presence of the canyon cutting across the middle of Monterey Bay. Large internal underwater waves measuring up to 393 feet (119.8 meters) were recorded within three miles (4.8 kilometers) of the Monterey Canyon head. Internal waves lose energy when they break and again at the head of the canyon. This promotes a net upward canyon flow, similar to the effects of wind-driven upwelling. Internal waves may contribute up to 30% of the nutrients assimilated by phytoplankton during periods when upwelling is absent and perhaps 10% of the required nutrients during periods of upwelling. The Monterey Bay Submarine Canyon acts as a deep-water conduit bringing offshore waters and organisms directly into the Monterey Bay and at the same time acts as a sediment basin.

Natural Habitats of the Sanctuary

Rocky Shores

Rocky shores are one of the sanctuary's most accessible habitats, where at low tide, a wide diversity of organisms is exposed. The accessibility of organisms attracted early marine ecologists to develop experimental studies influencing our understanding of ecology beyond the marine realm. For example, Ed Rickets and Jack Calvin conducted their foundational studies in intertidal ecology along the sanctuary shoreline for *Between Pacific Tides* (Ricketts 1988*)*. Approximately 56% of MBNMS coast is rocky shore habitat. Particularly in central California, rocky shores are one of the most diverse, studied, and understood biological habitats of the world.

MBNMS has four zones of rocky intertidal organisms associated with different tidal heights. Starting from the top, the splash zone is usually exposed to air and has relatively few species. The periwinkle snail, *Littorina keenae*, is indicative of the splash zone. Microscopic algae are common in winter, when large waves produce consistent spray on the upper portions of the rocky shore. The high intertidal zone is exposed to air for long periods twice per day. The acorn barnacle, *Balanus glandula,* and red algae, *Endocladia muricata* and *Mastocarpus papillatus*, are indicative of this zone. The mid intertidal zone is dominated more by water and is exposed to air briefly once or twice per day and has many well-known organisms, including several species of sea stars, *Pisaster ochraceus* and *Patiria miniata*, and sea anemones, *Anthopleura xanthogrammica* and *Anthopleura elegantissima*. At wave-exposed sites, the California mussel, *Mytilus californianus*, can dominate this zone. The low intertidal zone is exposed to air only during the lowest tides and the presence of the seagrass

Phyllospadix is a good indicator of the mean lower low water tide level. The low intertidal zone is also where sponges and tunicates are most common.

Intertidal zonation can vary based on slope, wave exposure, orientation, and local geology. In addition to physical factors that influence patterns of intertidal zonation, biological interactions, such as predation and competition, alter zonation patterns. Within zones, patchily distributed organisms are common. Indeed, rocky shores are sometimes referred to as mosaics of patches undergoing succession after a variety of possible disturbance events. Disturbances that open up space for colonization are caused by waves, predation, substratum weathering, exfoliation, human collection, and trampling. Disturbances are common enough that some species persist, dispersing from one patch to another as the dominant competitors crowd them out.

Kelp Forests

Kelp provides a highly productive and diverse habitat used by numerous species, including marine mammals, fishes, other algae, and vast numbers of invertebrates. Adjacent to the rocky coastline but beyond the shore break, several species of kelp cling to hard substrates with their tenacious holdfasts and lend added vertical structure to the rocky reef habitat. Although some individual kelps can persist for up to three years, the overall age-structure of a kelp forest is very dynamic.

Kelp canopy cover varies seasonally. The canopy is thickest in late summer and thins or disappears in winter when large swells and old age combine to remove weakened adult algae. During the following spring, the next generation takes advantage of the thin canopy cover and increase in available light to grow rapidly. When coupled with upwelling, which brings cold, nutrient-rich waters to the surface, these conditions allow some species of kelp to grow up to 12 inches per day. The measured productivity (per square foot of seafloor) of a kelp forest is among the highest of any natural community in the world.

Kelp forests consist of canopy layers similar to terrestrial forests. In central California, the two primary canopy forming species in kelp forests are giant kelp, *Macrocystis pyrifera* and bull kelp, *Nereocystis luetkeana*, both of which are brown seaweeds. While both can be found within the same kelp forest, giant kelp is more typical of the Monterey Bay area and bull kelp is more common north of Santa Cruz and in patches along the Big Sur coastline. The understory is the layer three to six feet (1.8 meters) above the bottom of the seafloor and is dominated by stalked brown algae such as *Pterygophora californica* and *Laminaria setchellii*. The lowest layer, turf algae, consists of several red algae, including corallines. These layers support a rich diversity of fishes and invertebrates.

Some vertebrates, such as sea otters and many fishes, reside within kelp forests. Other vertebrates, such as seabirds, harbor seals, sea lions, and even gray whales will visit kelp forests while foraging for food. Giant kelp and other algae support large populations of benthic invertebrates, which in turn attract higher-order predators. Scuba and free divers are attracted to kelp forests and their rich invertebrate fauna, which make dive sites in Monterey Bay and along the Big Sur coast among the most scenic in the world.

Kelp forests and their associated flora and fauna are important resources for humans. The complex canopies serve as nurseries for juvenile rockfishes, providing refuge during vulnerable stages of the life cycle. As these rockfish grow, some leave the kelp forest for deeper waters and support commercial and recreational fisheries. Kelp forests and their associated marine life are also an important part of the aesthetic experience that attracts visitors to Monterey Bay from all over the world. In addition, kelp is itself a resource, harvested as food for abalone farms and as a source of algin, an emulsifying and binding agent used in ice cream, toothpaste, cosmetics, and other products.

Sandy and Mud Seafloor

Most of the ocean floor in the MBNMS is covered with sand or mud. Waves and currents create sand waves and ripples and organize sediment particles in different size groups. The lack of hard substrate and the shifting sand prevents algae from settling and therefore, these vast sandy plains appear to be lifeless deserts. However, many organisms live in the sand and mud. There are two broad zones, including a shallow region dominated by crustaceans and a deeper area dominated by sedentary polychaete worms. The crustacean zone continues through the surf zone and intertidal beach zone, areas where sediment is constantly moving around. The main crustacean groups include organisms like sand crabs (*Emerita analoga*) that burrow into the sand or are active on the surface of the sandy floor. All organisms burrow into the seafloor and flourish in wave-disturbed sandy floor. Only a few species live in relatively permanent burrows or tubes, like tube dwelling anemones (*Pachycerianthus fimbriatus)*. Most species live close to the seafloor surface and do not burrow deep.

Estuaries

The waters of MBNMS include the main channel of California's second largest coastal wetland, Elkhorn Slough. A slough, or estuary, is a coastal body of water connecting a watershed to the open ocean. The resulting mix of land, freshwater, and saltwater creates a mosaic of habitats and communities, changing from terrestrial to marine over small distances.

Estuaries are highly variable and are affected by both marine and terrestrial processes. Environmental variables influencing the communities found within an estuary include tides, salinity, temperature, currents, sediment type, and dissolved oxygen. Unlike purely marine or freshwater habitats with relatively stable salinities and temperature ranges, an estuary is subject to dramatic changes in both temperature and salinity. The dramatic changes in temperature and salinity can stress the flora and fauna that live in the estuary. As the tide flows in, fresh and saltwater mix to form a gradient, which can move up and down the estuary over the course of a day. Some animals burrow into the soft sediments to seek refuge from these fluxes. Other animals thrive, having broad physiological tolerances that evolved in response to these stressors. Some environmental variables change spatially as well as over time and influence the distribution of animals.

At the head of an estuary, where freshwater enters the system, salinity is very low, tidal influence is minimal, and the currents are dominated by watershed input and flow downstream. In the upper region of an estuary, there is a slight marine influence, which

leads to higher salinities and deposition of fine marine sediments. Topography of the area, as well as the extent and pattern of channels, determine the degree of the marine influence. In the middle reaches, sand may be present and mixed in with fine mud, and water is generally brackish (salinity 18 to 25 parts per thousand). At the lower reaches, the marine influence dominates the system, with more sand, high flow patterns dominated by the tides, and salinities near marine levels. At the mouth of an estuary, there is usually little mud on the bottom, but fine sediments suspended in the water column can make turbid plumes that are clearly visible from the surface and extend out into the open ocean.

Beyond the communities of invertebrates and fishes that spend most or all of their time underwater, terrestrial communities add to the tremendous diversity of an estuary. Estuary habitats and communities include mudflats, eelgrass beds, salt marshes, beaches, coastal dunes, coastal maritime chaparral, and oak woodlands. Many birds use estuaries as important rest or feeding stops while migrating along the Pacific Flyway.

Elkhorn Slough is located partially within MBNMS boundaries. It serves an important role in sustaining both resident and migratory birds, which use the resources generated by this highly productive ecosystem. In 2000, the American Bird Conservancy designated Elkhorn Slough as a Globally Important Bird Area, and it is a must-see site for avid bird watchers and visitors to Monterey Bay. Elkhorn Slough serves also as a nursery area for a number of commercially targeted flatfish species such as English sole and speckled sanddabs, and is also a popular hangout spot and haul out for a keystone species, the sea otter. Meeting all nine criteria set forth by the Ramsar Convention on Wetlands, the Elkhorn Slough was officially designated a “Wetland of International Importance” in October 2018. In addition, Elkhorn Slough National Estuarine Research Reserve is one of 29 National Estuarine Research Reserves established nationwide as field laboratories for scientific research and estuarine education. The reserve is administered by NOAA and managed by the California Department of Fish and Wildlife and is the only National Estuarine Research Reserve contiguous with a national marine sanctuary.

Open Ocean

The ocean covers 70% of Earth’s surface. Of that 70%, 65% makes up the open ocean ecosystem, which typically lies well offshore where the water depth is greater than 330 feet (101 meters). Only the remaining 5% consists of the highly productive marine ecosystems we generally see highlighted in the media, such as coral reefs or kelp forests.

The Pacific Ocean, one of four major ocean basins, accounts for nearly half of the total ocean surface area and is twice as large as the Atlantic Ocean. The waters of MBNMS are part of the eastern Pacific Ocean, and are cooler and more nutrient rich than the western Pacific waters found along the coast of Asia. In the eastern Pacific, recirculation of nutrients from deeper waters drives phytoplankton to bloom in the upper 330 feet (101 meters) of the photic zone (also known as the epipelagic zone). Phytoplankton in turn feed zooplankton and their predators. The open ocean, or pelagic zone, is further divided into different zones based on depth: mesopelagic zone, bathypelagic zone, and abyssopelagic zone.

The deep sea is a dark and cold environment, which includes a variety of habitats from the midwater (i.e., mesopelagic zone) to the abyss (i.e., abyssopelagic zone) that are populated by a wide array of animals. The mesopelagic zone starts at 656 feet (200 meters) below the surface and extends to about 3,300 feet (1,006 meters). Available light, nutrients, and dissolved oxygen decreases and water pressure increases with depth. Mesopelagic fish and some macroinvertebrates have large and elaborate eyes allowing them to see under low-light conditions. The bathypelagic zone starts below 3,300 feet (1,006 meters) and extends to the abyss, which starts at 13,100 feet (4,000 meters). The abyss ranges to approximately 19,700 feet (6,000 meters). Unlike mesopelagic fishes, bathypelagic fishes typically have small eyes or no eyes at all. To adapt to life in an environment with no other light than bioluminescence, the fishes developed other senses to attract mates, find food, and escape predators.

Bioluminescence is the production of visible light by living organisms. Most of the species living in the deep sea are bioluminescent and possess organs called photophores, which produce light from chemical reactions. Elaborate adaptation may provide many advantages in the deep sea. Deep-sea inhabitants may use bioluminescence to attract and capture prey, escape predators by scaring them or creating a diversion, or to communicate.

Plant life, including phytoplankton, needs light to thrive. However, light is absent or very low in the deep sea. After sunset, many small mesopelagic fishes and zooplanktons feed on phytoplankton by migrating from the deep sea to the surface layer. At dawn, these organisms return to the deep sea. The daily vertical migration to the surface may provide protection from surface water predators relying on sight to hunt. The range and intensity of the vertical migration varies seasonally and among species.

Deep Sea

The continental shelf is the gradually sloping submerged margin of the continent that extends from the nearshore to the shelf break. The deep sea begins at the continental shelf break (at a depth of approximately 650 feet, or 200 meters). Beyond the shelf break, the continental slope descends more steeply to the ocean floor. In MBNMS, the outer continental shelf is relatively broad from the northern boundary to southern Monterey Bay. The shelf narrows considerably south of Monterey Bay and remains narrow throughout most of the southern portion of the sanctuary, except around Point Sur and near the southern boundary. A large portion of the shelf in the sanctuary is composed of soft-bottom habitats, which cover approximately 1,384 square miles (3,584 square kilometers) from depths of 100 – 650 feet (30 to 200 meters). Sandy bottom is generally found in shallow waters of the shelf, less than 130 feet (40 meters). The percentage of mud, silt, and clay increases as depth increases on the shelf and beyond the shelf break. The lack of hard substratum for attachment prevents algae and some invertebrates from colonizing soft-bottom habitats.

The distribution of benthic communities appears to be patchy and the specific species assemblages differ at various sites between years and among seasons. Benthic invertebrate communities below 6,500 feet (1,981 meters) deep are not as well-known as the sedimentary invertebrate communities of the continental shelf. The most abundant

large invertebrates are sea cucumbers. The dominant invertebrates in terms of abundance are infaunal and all are deposit feeders. Specialized benthic invertebrates feed on marine snow, which is the minute debris left over from animals, plants, and non-living matter that sinks from the surface layer to the deep sea. Other abundant invertebrate groups include anemones, brittle stars, sea pens, and sea stars.

In the late 1980s, scientists discovered cold seeps deep in the axial valley of the Monterey Canyon 10,500 feet (3,200 meters) below the ocean surface. Cold seeps are sites where sulfide- or methane-rich fluids release from the seafloor. Specialized chemosynthetic communities are often associated with cold seeps. Unlike the other deep-sea communities that depend on food sinking from the above water column, chemosynthetic communities rely on chemical energy produced by fluid released from the seafloor. On Earth, most of the food web starts with plants dependent on sunlight as a primary energy source. In cold seeps, bacterial mats at the base of the food web use the chemical energy in a similar way plants use the energy from the sunlight. The concentrations of various chemical constituents, the mechanism regulating fluid flow and the biological communities differ among the cold seeps within MBNMS.

The ecology of cold seep communities is poorly understood. Cold seep communities are composed of species found only in cold seep areas and include vesicomyid clams and vestimentiferan worms basing all or most of their nutrition on chemosynthetic production by bacteria. Seep communities can be viewed as isolated oases in a relatively energy-poor deep seafloor landscape. A variety of cosmopolitan benthic fauna appear to benefit from foraging at cold seeps. The extent to which chemosynthetic production at these underwater oases fuels secondary productivity by the local non-seep biological assemblage is unknown. Little or no information is available concerning ecological processes that influence demographic rates of biological populations at cold seeps. Predation, competition, and disturbance likely play a major role, but few hypotheses regarding these ecological processes have been addressed.

Submarine Canyons

Within MBNMS, submarine canyons are prominent geomorphic features. These canyons share physical characteristics with onshore river valleys. Submarine canyons are erosional features carving into the seafloor and exposing older, underlying strata in canyon walls. These submarine features can have sinuous channel axes and may also have a number of branching channels, which may coincide with geologic faults. The positions of some channels of the Monterey Canyon coincide with geologic faults such as Carmel Canyon.

The deepest and largest submarine canyon on the coast of North America is the Monterey Submarine Canyon in the center of Monterey Bay. The canyon is 292 miles (469.9 kilometers) long, approximately seven miles (11.3 kilometers) wide at its widest point and has a maximum and rim to floor relief of 5,577 feet (1,699.9 meters). Numerous smaller canyons also exist in MBNMS and incise the continental shelf and slope. Canyons terminating at the shoreline are thought to be active and are major sediment transport conduits to the deep sea. The heads of Monterey Canyon, Carmel Canyon, and Partington Canyon reach the modern-day shoreline, whereas most of the

other canyons within MBNMS terminate near the continental shelf edge. Much of the sediment carried by longshore currents ends up in the axes of active submarine canyons. Approximately 14,125,000 cubic feet (399,975 cubic meters) of sand as well as large volumes of fine grain material descend into Monterey Canyon each year. The organic material associated with these sediments provides nutrients to deep-sea organisms. Submarine landslides from canyon walls are deposited in the canyons. Sand, gravel, mud, and skeletal remains of marine mammals have been observed in the axis of Monterey Canyon.

Submarine canyon sediment transport events are thought to be episodic. Potential triggering events include storms, earthquakes, moderate sea and surf conditions, tidal fluctuation, and flooding rivers. Repeat bathymetric mapping using high-resolution tools and installing instruments in the canyons enables scientists to determine locations where deposition and erosion take place. These advances allow scientists to quantify the frequency and intensity of sediment transport events. Submarine canyons in MBNMS are also ecologically important to many species of fish. Canyons provide habitat for larger sized rockfishes that seem to prefer structures of high relief such as boulders, vertical walls, and ridges. The cover and protection offered by submarine canyons allow pockets of rockfish populations to flourish, in contrast to more exposed areas where the populations are more easily fished. Monitoring programs in the sanctuary study the habitat use of rockfishes in submarine canyons and other deepwater habitats. These programs typically use crewed and remotely operated (ROV) submersibles to map the substrate type and quantify the amount of rock habitat available to fish.

Seamounts

Seamounts are defined as steep geologic features rising from the seafloor with a minimal elevation of 3,300 feet (1,006 meters) and a limited extent across the summit. However, steep undersea mountains are often referred to as seamounts regardless of size. Seamounts have a variety of shapes, but are most often conical with a circular, elliptical, or elongate base. Seamounts usually have volcanic origins. Estimates show more than 30,000 seamounts over 3,281 feet (1,000 meters) tall exist in the Pacific Ocean, compared to approximately 800 in the Atlantic Ocean. An unknown number exist in the Indian Ocean.

Seamounts create complex current patterns influencing sea life above them. Commercially valuable fish species often concentrate around relatively shallow seamounts. Current-topography interactions on seamounts include semi-stationary eddies called Taylor columns, internal wave reflection, tidally induced currents and eddies, trapped waves, and eddies shed downstream. Currents over seamounts measure up to 19 inches per second, or 0.9 knots. Evidence for concentrations of fish and zooplankton over seamounts due to enhanced primary productivity is sparse and some suggest productivity over seamounts is more influenced by the physical prevention of zooplankton diurnal migrations to deep water, making the zooplankton more vulnerable to predation. The proximity of the seamount summit to the sea surface is likely an important variable that could influence water column productivity but has not yet been definitively addressed.

Davidson Seamount is reported to be relatively pristine though it is relatively close to shore and one of the largest seamounts on the West Coast. Davidson Seamount has large assemblages of corals and sponges adjacent to each other, which has not been observed at other seamounts. Many of these species are rare or newly discovered. More than 1,500 brooding female octopuses were discovered within MBNMS near Davidson Seamount using ROVs in 2018. In March 2019, the human-occupied vehicle *Alvin* discovered additional populations of brooding octopuses in the area and confirmed that warm water (up to 9.9 degrees C) is diffusing out of the seafloor. Additional research in the area is planned for 2020 and 2021.

Living Marine Resources

Marine Mammals

The sanctuary has one of the most diverse and abundant assemblages of marine mammals in the world, including six species of pinnipeds (seals and sea lions), 29 species of cetaceans (whales, dolphins, and porpoises) and one species of fissiped (sea otter).

California sea lions are the most common pinnipeds in the sanctuary and their numbers continue to increase. During the El Niño event in 1997-1998, more sea lions were observed at Año Nuevo Island than ever before and the number of pups born also increased.

The marine mammal population likely to have grown the fastest in the sanctuary is the northern elephant seal, with haul-out sites at Año Nuevo, Point Piedras Blancas, and isolated Big Sur beaches. The most dramatic increase in their population occurred at beaches near Point Piedras Blancas, from 400 individuals in 1991 to over 24,000 in 2017.

The gray whale, a common cetacean in the sanctuary, has overall increased in number over the years (approximately 3.3% per year), resulting in the 1994 delisting of the California stock (or Eastern North Pacific stock) from the federal list of endangered and threatened species. In 1999-2000, however, there was a dramatic increase in the number of stranded gray whales on beaches along their migration route from Mexico to Alaska. Aerial surveys indicated there were fewer pregnant females that migrated south resulting in reduced calf production. The cause of this 1999-2000 mortality event is not understood but it is likely environmental conditions and food availability played a role. It was suspected the gray whale population had neared or reached its carrying capacity. Coincident with this hypothesis, scientists found the amphipod prey base of gray whales in the Arctic feeding grounds had decreased in the northern Bering Sea in the previous 10 years. At the time this draft management plan was being written, another mortality event of gray whales was unfolding.

Recent raw counts data of the California sea otter have made population trends difficult to interpret. Surveys from 2010 reported a 3.6% decrease in adults from the previous year and pup production was down 11%. Between 2012 and 2013, however, otter count increased by 3.2% and pup production increased by 29%. Surveys from 2018 showed

over 2,900 sea otters from Pigeon Point to Gaviota State Park, a 14% increase from 2017 surveys. On a longer time scale, the sea otter population has increased by approximately 40% since sanctuary designation in 1992.

Cetacean research, citizen monitoring and tourist whale watching has increased in Monterey Bay since sanctuary designation. However, relatively little is known about marine mammal ecology at the northern and southern borders of the sanctuary, although MBNMS anticipates expansion of research outward from the ports and research institutes bordering Monterey Bay. One of the most important ecological questions that needs more study is the relationship between the prey resources and the marine mammal populations, as well as a better understanding of threats due to whale ship strikes and fishing gear entanglements. Monterey Bay is an active feeding area for many large cetaceans, most of which are protected, and there continues to be interaction between whales and maritime and fishing industries.

Ship-based and aerial marine mammal surveys have occurred at Davidson Seamount since 2010, most recently in 2018. Additional projects conducted at Davidson include seabird observations, plankton tows, midwater fish trawls, conductivity, temperature, and depth readings, echo-sounder data collection, sea surface collection of microplastics, and water sampling for persistent organic pollutants and harmful algal blooms (HABs). Data will be used to relate the spatial patterns of bird and mammal distribution with prey and oceanographic patterns and identify resources at risk from human threats.

Seabirds and Shorebirds

The abundance and richness of birds in MBNMS reflect the diversity of habitats and productive environment that provides feeding grounds rich in plankton and fish. The sanctuary's seabird and shorebird community in the sanctuary is a mix of permanent and seasonal residents. Seabirds are those birds whose normal habitat and food source is the marine environment, whether coastal, offshore or pelagic. The majority of seabirds in this region are seasonal visitors. They can be divided into four groups by their feeding strategies, which are reflected in their anatomy, physiology, and habitat niche: (1) surface feeders, e.g., albatrosses, frigatebirds and pelicans; (2) surface swimmers/pursuit divers, e.g., alcids, cormorants, loons and grebes; (3) plunge-divers, e.g., terns, gulls, shearwaters, and pelicans; and (4) scavengers and pirates (those who steal from other birds), e.g., gulls, fulmars, and jaegers.

The term shorebird refers to any bird that relies on beaches or wetlands for feeding and nesting habitat. Shorebirds are classified by their feeding strategies. "Probers" use their long beaks to probe down into the sand for buried clams, worms, and other animals. Probers include dowitchers and sandpipers. "Gleaners" scurry back and forth along the beach, feeding on invertebrates they find on the sandy surface. Examples of gleaners include sanderlings and plovers. Elkhorn Slough attracts the third largest concentration of shorebirds in California, surpassed only by the much larger Humboldt and San Francisco bays. Shorebirds reach their greatest densities from October through March in Elkhorn Slough. This reflects the presence of individuals moving to and from northern breeding grounds as well as large numbers of over-wintering birds.

A number of ongoing multi-year studies are monitoring the distribution, abundance, and movement patterns of large pelagic animals, and seabirds. Beach COMBERS (Coastal Ocean Mammal/Bird Education and Research Surveys), Applied California Current Ecosystem Studies (ACCESS), California Cooperative Oceanic Fisheries Investigations (CalFOFI), Cornell's Lab of Orithology's eBird, are some examples of existing monitoring programs.

Fishes

The fish fauna in MBNMS constitute a diverse and significant ecological resource. At least 525 fish species are distributed across a wide variety of habitats, with each habitat having its own characteristic fish assemblage. The rockfish assemblage (*Sebastes* spp.) is iconic to this region, comprising 50+ species off California that are found in nearly all rocky habitats of the sanctuary's marine habitat, and can also be found midwater. The sanctuary is located at the southern end of the range of many species that are part of the very diverse, cold-temperate fauna that make up the Oregonian Province. Occasionally, southern species from the California Province (south of Point Conception) extend their ranges to central and northern California during warm oceanographic events, such as El Niño and the Pacific Decadal Oscillation. Biological effects from an El Niño include decreased primary productivity, which often cascades to recruitment failures of ecologically important fish species, particularly rockfishes. In addition, fish species with tropical affinities that are naturally associated with warm water (e.g., billfishes) appear further north.

The status of commercial and recreational fisheries, including the status or health of fish populations, is influenced by numerous social, economic, environmental, and biological variables and is characterized by constant change. About 200 species are typically caught in commercial and recreational fisheries in the sanctuary and most are landed at one of five main ports: Princeton/Half Moon Bay, Santa Cruz, Moss Landing, Monterey Bay, and Morro Bay/Avila/Port San Luis (Starr et al. 2002). MBNMS does not manage fisheries; however, it does play a role in protecting fishery habitat and conducting research on fish and fish populations as well as providing advice and recommendations to federal and state fishery managers.

Invertebrates

Tens of thousands of invertebrate species occur within MBNMS, including squids, sponges, anemones, jellies, worms, corals, tunicates, snails, octopuses, clams, and arthropods such as barnacles, crabs, and spot prawns. Most invertebrate species are not harvested commercially, with the exception of squid, spot prawn, Dungeness crab, rock crab, and octopus. Structure-forming invertebrates can provide habitat for others and are generally slow growing, patchily distributed, and sensitive to disturbance.

Algae and Surf Grass

Algae forms one of the primary components in the marine food web by converting solar energy using chlorophyll. The marine algae found in MBNMS are some of the most diverse in the world, from microscopic phytoplankton to surfgrasses and giant kelp, which can be found over 60 feet (18 meters) deep and can grow up to 10 inches a day (see Natural Habitats of the Sanctuary, Kelp Forests).

Species of Special Concern

Within the sanctuary reside 30 ESA-listed endangered or threatened species. Thirteen of these have been placed on the federal list of endangered and threatened wildlife since sanctuary designation in 1992. These new listed species include green sea turtle (threatened), winter run Chinook salmon (endangered), spring run and central California Chinook salmon (threatened), central California coho salmon (endangered), central and south/central California steelhead (threatened), southern green sturgeon (threatened), longfin smelt (consideration), tidewater goby (endangered), eulachon (threatened), black abalone (endangered), California condor (endangered), marbled murrelet (threatened), short-tailed albatross (endangered), and western snowy plover (threatened). Two species bring a hopeful sign for the future: the gray whale (Eastern North Pacific or California stock) was delisted in June 1994, and the American peregrine falcon was removed as a threatened species in August 1999. Other threatened or endangered species showing an increasing population trend include the blue whale, humpback whale, sperm whale, southern sea otter (slowly), California condor (slowly), and tidewater goby.

Table I-1: Special status species that may occur in MBNMS

Common Name	Scientific Name	Listing Status
Marine Mammals		
Southern sea otter	*Enhydra lutris nereis*	ESA Threatened; Marine Mammal Protection Act (MMPA) Listed
California sea lion	*Zalophus californianus*	MMPA Listed
Steller sea lion	*Eumetopias jubatus*	MMPA Listed
Harbor seal	*Phoca vitulina richardii*	MMPA Listed
Northern fur seal	*Callorhinus ursinus*	MMPA Depleted
Northern elephant seal	*Mirounga angustirostris*	MMPA Listed
Guadalupe fur seal	*Arctocephalus townsendi*	ESA Threatened; MMPA Depleted
Harbor porpoise	*Phocoena phocoena*	MMPA Listed
Risso's dolphin	*Grampus griseus*	MMPA Listed
Common dolphin – long-beaked	*Delphinus capensis*	MMPA Listed
Common dolphin – short-beaked	*Delphinus delphis*	MMPA Listed
Dall's porpoise	*Phocoenoides dalli*	MMPA Listed
Bottlenose dolphin	*Tursiops truncatus*	MMPA Depleted
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	MMPA Listed
Northern right whale dolphin	*Lissodelphis borealis*	MMPA Listed

Minke whale	*Balaenoptera acutorostrata*	MMPA Listed
Blue whale	*Balaenoptera musculus*	ESA Endangered; MMPA Depleted
Humpback whale	*Megaptera novaeangliae*	ESA Endangered; MMPA Depleted
Fin whale	*Balaenoptera physalus*	ESA Endangered; MMPA Depleted
Sperm whale	*Physeter macrocephalus*	ESA Endangered; MMPA Depleted
Gray whale	*Eschrichtius robustus*	MMPA Depleted
Killer whale	*Orcinus orca*	ESA Endangered; MMPA Listed
North Pacific right whale	*Eubalaena glacialis*	ESA Endangered; MMPA Depleted
Sei whale	*Balaenoptera borealis*	ESA Endangered; MMPA Depleted
Common Name	**Scientific Name**	**Listing Status**
Short-finned pilot whale	*Globicephala macrorhynchus*	MMPA Listed
Baird's beaked whale	*Berardius bairdii*	MMPA Listed
Cuvier's beaked whale	*Ziphius cavirostris*	MMPA Listed
Reptiles		
Leatherback sea turtle	*Dermochelys coriacea*	ESA Endangered
Green sea turtle	*Chelonia mydas*	ESA Threatened
Loggerhead sea turtle	*Caretta caretta*	ESA Endangered
Olive ridley turtle	*Lepidochelys olivacea*	ESA Threatened
Fish		
Chinook salmon (Winter-Run Evolutionary Signification Unit [ESU])	*Oncorhynchus tshawytscha*	ESA Endangered
Chinook salmon (Spring-Run ESU)	*Oncorhynchus tshawytscha*	ESA Threatened
Chinook salmon (Central California Coast ESU)	*Oncorhynchus tshawytscha*	ESA Threatened
Coho salmon (Central California ESU)	*Oncorhynchus kisutch*	ESA Endangered
Steelhead (Central California Coast Distinct Population Segment [DPS])	*Oncorhynchus mykiss*	ESA Threatened
Steelhead (South Central California Coast DPS)	*Oncorhynchus mykiss*	ESA Threatened
North American green sturgeon (Southern DPS)	*Acipenser medirostris*	ESA Threatened
Longfin smelt	*Spirinchus thaleichthys*	ESA Consideration

Tidewater goby	*Eucyclogobius newberryi*	ESA Endangered
Eulachon	*Thaleichthys pacificus*	ESA Threatened
Green sturgeon	*Acipenser medirostris*	ESA Threatened
Marine Invertebrates		
Black abalone	*Haliotis cracherodii*	ESA Endangered
Birds		
California condor	*Gymnogyps californianus*	ESA Endangered
Common Name	**Scientific Name**	**Listing Status**
California least tern	*Sterna antillarum browni*	ESA Endangered
Short-tailed albatross	*Phoebastria (=Diomedea) albatrus*	ESA Endangered
California clapper rail	*Rallus longirostris obsoletus*	ESA Endangered
Birds That Have Critical Habitat Adjacent to MBNMS and Feed in the Sanctuary		
Marbled murrelet	*Brachyramphus marmoratus*	ESA Threatened
Western snowy plover	*Charadrius nivosus nivosus*	ESA Threatened

Monterey Bay National Marine Sanctuary Condition Report

The preceding sections describe the sanctuary as a rich array of habitats, from rugged rocky shores and lush kelp forests to one of the largest underwater canyons in North America. These habitats abound with life, from microscopic plants to enormous blue whales. The sanctuary is home to a diversity of species including marine mammals, seabirds and shorebirds, sea turtles, fishes, invertebrates, and marine algae.

Diverse human activities put significant pressure on sanctuary resources. Some of the most prominent pressures include vessel traffic, commercial and recreational fishing, agricultural and urban runoff, harmful algal blooms, coastal development, marine debris, the introduction of non-indigenous species (i.e., introduced species), and disturbances to wildlife. In addition, larger, more global issues, such as climate change and ocean acidification, are significant areas of concern where some impacts are being detected, but long-term effects are not well understood.

NOAA uses a socioecological approach to assess, protect, and improve resources and societal well-being in national marine sanctuaries. MBNMS staff and partners in academia, the nonprofit sector, and business, as well as private citizens, use a host of observing technologies and approaches to measure and estimate the condition of natural and archaeological resources and the economic benefits of sanctuaries. Sanctuary condition reports combine the latest environmental and socioeconomic data with extensive expert input to provide the public, particularly stakeholders, with periodic updates of the status and trends for driving forces, pressures, natural and

archaeological resource conditions, and ecosystem services in national marine sanctuaries. The reports go on to describe the links between current management activities and issues of concern and the benefits of actions to resources and the public. With that information, not only is sanctuary management better prepared to respond to changing conditions with proactive management and sensible regulations, but the public is better equipped to make practical recommendations as participants in the management plan review process for their national marine sanctuaries.

Condition reports use the best available science and most recent data to assess the status of various parts of the sanctuary's ecosystem. Because of the considerable differences within the sanctuary among the estuarine, nearshore, offshore, and seamount environments, each question to determine resource status and trends is answered separately for each environment. Though many estuaries occur along the central California coastline, they are not within the sanctuary's boundaries. Elkhorn Slough is the only estuary located inside sanctuary boundaries and thus, is the focus of the estuarine environment section in the report. For condition report purposes, the nearshore environment is defined as extending from the shoreline boundary of the sanctuary (mean high water) to the 30-meter isobaths and includes the seafloor and water column. The offshore environment is defined as extending from the 30-meter isobath out to the offshore boundary of the sanctuary and includes the seafloor and water column. The seamount environment includes the seamount and surrounding seafloor and water column within the Davidson Seamount Management Zone (DSMZ). The DSMZ was added to MBNMS in November 2008 and was assessed for the first time in the 2015 condition report update.

The 2015 assessment of the estuarine environment of Elkhorn Slough reinforces the 2009 assessment that this is an area of concern within the sanctuary. Elkhorn Slough has a history of extensive alteration of habitat structures by humans. Natural processes strongly impact water quality, habitat quality, and abundance, and the structure and health of the faunal assemblage. Continued inputs of nutrients and contaminants, especially in areas of muted tidal influence, contribute to events such as frequent hypoxia, algal blooms, and impacts to sensitive species. Historical human modifications to this system have led to substantial changes in hydrology, erosion, and sedimentation that continue to impact the abundance and quality of habitats and living resources. There is a high percentage of non-native species competing with native species and impacting ecosystem health. Some key species, such as eelgrass, native oysters, and sea otters, are showing signs of improvement. The slough is the focus of new and ongoing conservation and restoration efforts. In the coming years, restoration projects and improvements in land management practices should result in some measurable improvements in water and habitat quality in portions of the slough.

The nearshore environment is the main zone of interaction between humans and the sanctuary. This is the zone where most residents and visitors interact with sanctuary resources and where most human activities have the strongest influence. As such, this environment receives significant research and resource management attention. Habitats in less impacted areas are in good condition (e.g., off of Big Sur), but overall there are concerns about localized ongoing activities, including sand mining, coastal armoring, inputs of contaminants, and marine debris. A high percentage of the sanctuary's beaches

regularly monitored for safety of swimming received good grades in the last five years, likely due to improvements in sanitary sewer infrastructure in coastal cities. On the other hand, the nearshore waters continue to receive nutrient enrichments from land-based activity, which can intensify the effects of harmful algal blooms (HABs) on sensitive species. Decreases in persistent organic pollutants (dieldrin, dichlorodiphenyltrichloroethane [DDT], and polybrominated diphenyl ethers [PBDEs]) were observed in mussels at five locations, but there is limited information available on new pollutants, such as current-use pesticides and pharmaceuticals. Recent drastic declines in sea stars, a key species in nearshore habitats, are a concern, but causes and potential impacts on ecological function and biodiversity will take time to understand.

In the offshore environment, which extends from 30 meters depth to the seaward boundary, most of the regularly monitored key species and species assemblages appear to be stable. Pollutants (e.g., polychlorinated biphenyls [PCBs]), marine debris, and toxins from HABs were detected in some key species. There are concerns about impacts to sensitive species from human-caused noise, vessel traffic, and entanglement in lines from buoys and lost and active fishing gear. Bottom trawl fishing has decreased in intensity and spatial extent, and has changed to less damaging gear and moved to less sensitive habitats. Recovery of formerly impacted habitats and structure-forming species is expected. The recent prevalence of unusually warm water along the U.S. West Coast has altered the distribution and abundance of some temperature-sensitive species and led to stranding events for some key species; however, more time is needed to determine if this phenomenon will have any persistent impacts on key species or the structure and function of the offshore ecosystem. Impacts from climate change, including acidification, warming, and shoaling of the oxygen minimum zone, are starting to be detected, but much more research and monitoring is required to better understand and predict current and future impacts.

This first assessment of the seamount environment found benthic habitats and living resources on or near Davidson Seamount to be in good condition. Due to its depth, distance from shore, and regulatory protections, the seamount area has not been impacted by human activities to the extent of other sanctuary offshore areas. Corals, sponges, and other benthic fauna appear to be in pristine or near-pristine condition. Some threats exist, such as vessel traffic and impacts from climate change, especially ocean acidification. More research and monitoring of water quality, habitat, and living resources associated with the seamount are needed to better understand the current status and predict potential impacts of human activities and changing climate.

Overall, the updated assessment of the state of sanctuary resources indicates the sanctuary is doing quite well in comparison to other parts of the world's ocean. As of the 2015 publication of the MBNMS condition report, the abundance and diversity of wildlife seen in Monterey Bay is remarkable compared to many parts of the world and many sanctuary resources are showing relative stability or improvement. Long-term monitoring along rocky shores and in kelp forests shows that biogenic habitat, including canopy-forming kelp, understory algae, and many structure-forming invertebrates, have been generally abundant and stable. The number of native species in sanctuary habitats, one measure of biodiversity, appears to be stable with no known losses of native species. Though some non-native species are present in the sanctuary, no new introductions are

known to have occurred in any of the sanctuary's environments. Most of the sanctuary's regularly monitored key species and species assemblages appear to be stable or slightly improving in status.

Nonetheless, a main purpose of the 2015 condition assessment was to identify problems with sanctuary health so management can focus on finding opportunities to improve conditions. The findings in the 2015 update, along with information from the 2009 MBNMS condition report, were used as a tool to support the process to review and update the MBNMS management plan. This new management plan builds on the 2008 management plan, which contained a number of management actions to address issues and concerns. The plan stressed an ecosystem-based approach to management, which requires consideration of ecological interrelationships not only within the sanctuary, but also within the larger context of the California Current ecosystem.
A summary of linkages between activities from this management plan and the 2015 condition report update can be found in Appendix C.

Sanctuary Regulations

All activities (e.g., fishing, boating, diving, research, and education) may be conducted in MBNMS unless prohibited or otherwise regulated by MBNMS. All activities are subject to liability for destruction, loss, or injury to MBNMS resources under Section 312 of the NMSA, as amended.

Scope of Regulations

The terms of designation of MBNMS identify the following activities as subject to regulation, including prohibition, to the extent necessary and reasonable to ensure the protection and management of sanctuary resources and qualities. Complete text of the revised MBNMS terms of designation can be found in published and on-line versions of the Federal Register, 73 FR 70488.

As described in the sanctuary terms of designation, the following activities are subject to regulation:

A. Exploring for, developing, or producing oil, gas, or minerals (e.g., clay, stone, sand, metalliferous ores, gravel, non-metalliferous ores, or any other solid material or other matter of commercial value) within the sanctuary;
B. Discharging or depositing, from within or into the sanctuary, any material or other matter, except dredged material deposited at disposal sites authorized prior to the effective date of sanctuary designation, as described in Appendix C to the regulations, provided that the activity is pursuant to and complies with the terms and conditions of, a valid federal permit or approval existing on the effective date of sanctuary designation;
C. Discharging or depositing, from beyond the boundary of the sanctuary, any material or other matter, except dredged material deposited at the authorized disposal sites described in Appendix D to the site regulations, provided that the activity is pursuant to and complies with the terms and conditions of, a valid federal permit or approval;
D. Taking, removing, moving, catching, collecting, harvesting, feeding, injuring, destroying, or causing the loss of, or attempting to take, remove, move, catch,

collect, harvest, feed, injure, destroy, or cause the loss of, a marine mammal, sea turtle, seabird, historical resource or other sanctuary resource;

E. Drilling into, dredging, or otherwise altering the submerged lands of the sanctuary; or constructing, placing, or abandoning any structure, material, or other matter on or in the submerged lands of the sanctuary;
F. Possessing within the sanctuary a sanctuary resource or any other resource, regardless of where taken, removed, moved, caught, collected, or harvested, that, if it had been found within the sanctuary, would be a sanctuary resource;
G. Possessing any sanctuary historical resource;
H. Flying a motorized aircraft above the sanctuary;
I. Operating a vessel (i.e., water craft of any description) within the sanctuary;
J. Aquaculture or kelp harvesting within the sanctuary;
K. Interfering with, obstructing, delaying, or preventing an investigation, search, seizure, or disposition of seized property in connection with enforcement of the act or any regulation or permit issued under the act; and
L. Introducing or otherwise releasing from within or into the sanctuary an introduced species.

Where necessary to prevent or minimize the destruction of, loss of, or injury to a sanctuary resource or quality, or minimize the imminent risk of such destruction, loss, or injury, any and all activities, including those not listed above, may be subject to immediate temporary regulation, including prohibition. A summary of prohibitions is included in Appendix D

Marine Zones

Certain human activities can pose significant negative impacts to special habitats and key physical and biological resources within the sanctuary. As a result, federal, state, and local agencies have attempted to protect resources present within MBNMS by designating discrete areas (e.g., marine life protection areas, dredged material disposal sites) where human activities are controlled through special regulatory zoning and seasonal/spatial restrictions. The 6,094 square-mile sanctuary contains over 75 such marine zones which are designated by numerous agencies and may be overlapping. Approximately 82% of these zones encompass nearshore waters and are managed by NOAA, Department of Defense (DOD), CDFW, California Department of Parks and Recreation (CDPR), State and Regional Water Control Boards (SRWCB) and National Park Service (NPS). The remaining 18% of zones encompass offshore marine habitats and are managed by NOAA, USACE, USCG, DOD, and EPA. While most special zones within MBNMS are restrictive in nature, some allow uses or activities otherwise prohibited (e.g., MPWC operations, dredge spoil disposal, and jade collection).

The following identify and describe the marine regulatory zones directly managed by ONMS or incorporated by reference within sanctuary regulations (see Figure I-5):

Jade Collection Zone: A 2-mile stretch of coastal waters along the Big Sur coast where traditional small-scale collection of loose jade is allowed within MBNMS below mean high water. Zone regulations allow small-scale collection to support local collectors,

geologists, and artisans while protecting the mineral resources and benthic habitat of the sanctuary from systematic mining and exploitation.

Dredged Material Disposal Zones (four zones): Areas designated by USACE as disposal sites for dredged material free of harmful contaminants. Periodic seafloor dredging is necessary to maintain multiple channels and basins of the four small-craft harbors adjacent to the sanctuary. Without such dredging, marine sediment transport processes would fill channels and basins, effectively closing harbors to vessel traffic. Disposal of dredge spoils is highly monitored and regulated by the EPA, USACE, MBNMS, and the state of California to prevent contaminated sediments from being discharged into the sanctuary.

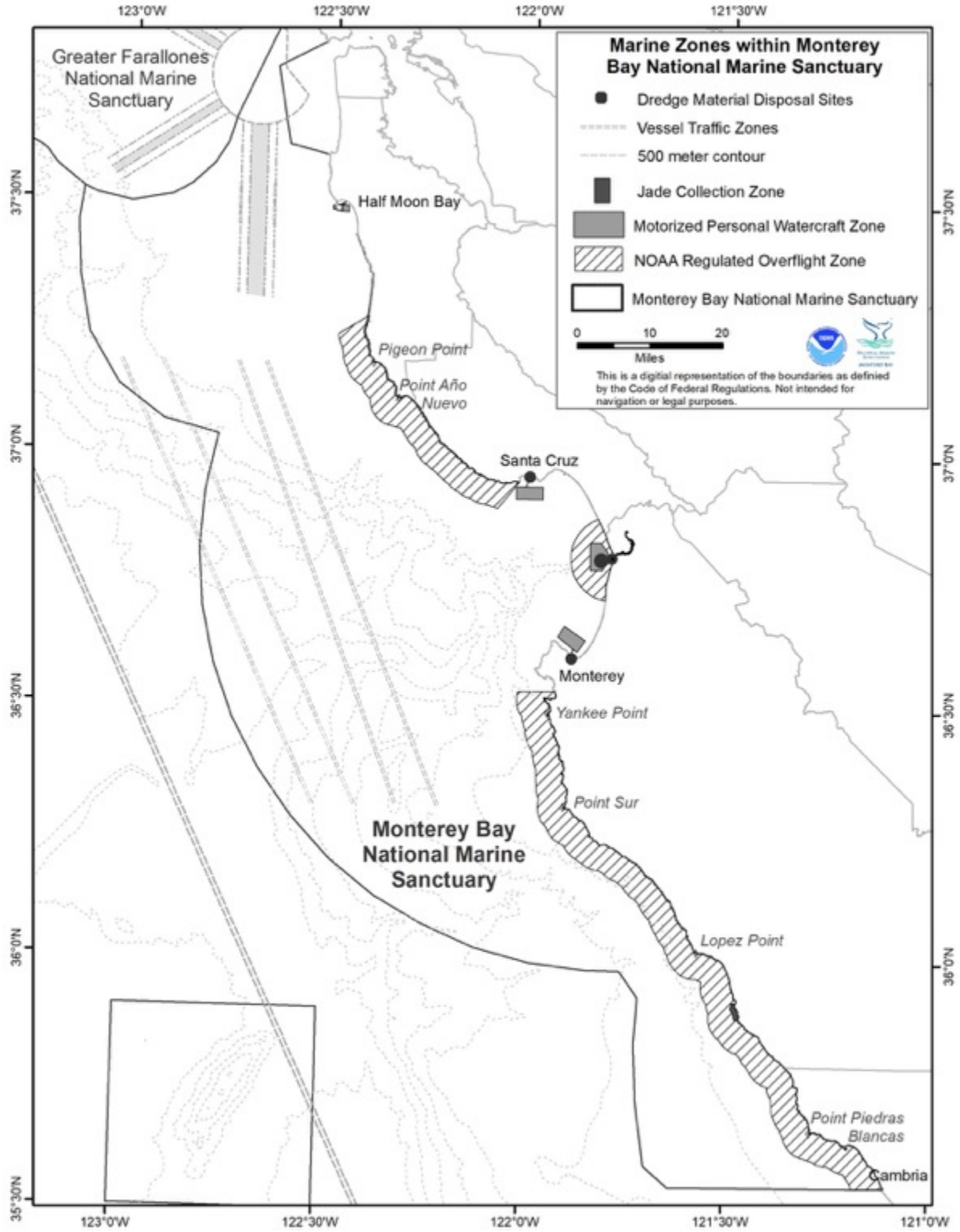
Restricted Overflight Zones (four zones): Nearshore areas over which motorized aircraft are restricted from flying below 1,000 feet (305 meters) to protect sensitive marine wildlife from visual, physical, and audible disturbance. These zones often encompass areas with high densities of marine mammals or seabirds, including key reproductive, foraging, and resting sites.

Motorized Personal Watercraft Zones (five zones): Areas designated for the use of MPWC. These zones allow this water-sport recreation while protecting nearshore marine life from disturbance or other injury and minimizing conflicts with other users, such as surfers and kayakers.

Davidson Seamount Management Zone: The DSMZ is a special zone prohibiting take or disturbance of any sanctuary resources below a depth of 3,000 feet (914 meters) of seawater. Though sanctuary regulations do not apply to fishery resources at the DSMZ, NMFS regulations prohibit fishing below 3,000 feet (914 meters) at the seamount. Thus, the two regulatory authorities establish a comprehensive prohibition against disturbance of resources on and around the underwater dormant volcano. The DSMZ was designated to protect the fragile and pristine seamount environment including rare corals and sponge communities. The DSMZ is an internationally significant study site for improving scientific understanding of deep-sea ecological communities.

Vessel Traffic Zones: Vessel traffic within the sanctuary was a major concern raised during the sanctuary designation process. The historical record of spills from transiting vessels is relatively small, but potential impacts could be enormous. Congress directed the Secretaries of Commerce and Transportation to evaluate potential threats from spills of oil or other hazardous materials to sanctuary resources and possible ways to reduce those threats. USCG and NOAA established a working group of key stakeholders with the goal to suggest a vessel traffic management system maximizing protection of sanctuary resources while allowing for the continuation of safe, efficient, and environmentally sound transportation. The resulting traffic separation schemes are based on an analysis of the anticipated response time for existing rescue vessels. Distances offshore of Point Sur and Pigeon Point strengthen informal patterns of current practices, and where necessary, shift certain types of vessels further offshore to reduce the level of threats to resources. Implementation is through Recommended Tracks approved by the United Nation's International Maritime Organization (IMO), an organization of the world's key shipping nations.

IR-5: MBNMS Marine Zones. Image: NOAA



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Regulatory Changes Proposed as Part of Management Plan Review

As part of this management plan review process, NOAA identified proposed regulatory changes to address resource protection concerns in the sanctuary. The proposed rule, published concurrently with this draft management plan, proposes to:

1. Add a definition for the "beneficial use of dredged material" and a regulatory clarification that the existing prohibition against disposal of dredged material in Monterey Bay National Marine Sanctuary at locations other than pre-1992 disposal sites does not apply to authorization of habitat restoration projects using clean dredged sediment material because such beneficial use of dredged material would not be considered "disposal."
2. Reduce the sea state condition required for motorized personal watercraft access to the Mavericks seasonal-conditional zone.
3. Correct an administrative error to properly document the list of exempted Department of Defense activities within the Davidson Seamount Management Zone.
4. Modify the boundaries of four existing year-round motorized personal watercraft zones.

A detailed description of these proposed regulatory changes and their anticipated environmental impacts is provided in the draft environmental assessment and notice of proposed rulemaking published concurrently with this draft management plan.

Implementing the Management Plan

Management Plan Review

The NMSA requires management plan review to be conducted by all national marine sanctuaries (16 U.S.C. §1434(e)) to ensure each site properly conserves and protects its living and cultural resources. Management plans describe regulations and boundaries, outline staffing and budget needs, present management actions and performance measures, and guide the development of future budgets and management activities. MBNMS last reviewed its management plan in 2008.

This management plan review fulfills the requirements of 16 U.S.C §1434(e) to (1) evaluate the substantive progress toward implementing the management plan and goals for the sanctuary, especially the effectiveness of site-specific management techniques and strategies; (2) revise the management plan and regulations as necessary to fulfill the purposes and policies of this chapter; and (3) include a prioritization of management objectives. Through the current process of reviewing the 2008 management plan, it was clear recent scientific discoveries, advancements in managing marine resources, and new resource management issues needed to be addressed/updated since 2008. Public meetings and formal public hearings on the draft management plan will help staff revise this document into a final management plan outlining the MBNMS priorities for the next several years.

The ONMS management plan review process is based on four fundamental steps:

1. Completion of the site's condition report;
2. Public scoping meetings;

3. The prioritization of issues and development of action plans;
4. The preparation of draft and final management plans and the relevant NEPA documentation, such as an environmental impact statement or environmental assessment.

Condition Report

Condition reports use the best available science and most recent data to assess the status of various parts of the sanctuary ecosystem. The condition report helps inform MBNMS staff, partners, and the public of current and emerging issues that may require additional focus in the revised management plan. See z

Public Scoping

Using community-based processes and providing numerous opportunities for public input, ONMS examined current issues and threats to the resources and determined if the current management plan is adequately protecting MBNMS resources. Four scoping meetings were held between September 2015 and October 2015 and over 220 comments were received. A report summarizing the scoping results (December 11, 2015) was used by the Sanctuary Advisory Council to help them provide advice on the highest priority issues (MBNMS 2015).

Identification and Prioritization of Issues

Following the public process of scoping, issues to be addressed were selected though a prioritization process. Through a binning exercise, the Sanctuary Advisory Council members provided feedback and recommendations on the resource issues and narrowed the number of issues to be addressed. The results from this exercise were published on the MBNMS website (MBNMS 2016). The resulting focused set of priority issues was presented at an April 2016 meeting of the Sanctuary Advisory Council. Following selection of the priority issues, ONMS staff developed a series of workshops and presentations for the Sanctuary Advisory Council in order to receive feedback on the scope and appropriate activities to address the issues. For three of the priority issues, working groups composed of staff, Sanctuary Advisory Council members, stakeholders, and subject experts were established to further characterize the issues and develop strategies to address them. Internal teams comprised of ONMS staff addressed other issues and developed proposed action plans and presented them to the Sanctuary Advisory Council for review.

Action Plan Development

The management plan is composed of action plans developed by staff, using input from the Sanctuary Advisory Council and external experts. Within the plans are the recommended strategies and activities addressing specific priority issues identified during the scoping and prioritization phases of the management plan review.

The action plans were then brought to the Sanctuary Advisory Council in February and April of 2018 for review. The council reviewed and made recommendations on action plans and generally recommended the strategies and activities as proposed by the staff and working groups.

Action Plan Components

Action plans are the means by which NOAA identifies and organizes the various management issues and the methods and tools with which to address a given issue. Each action plan has an overarching goal, an introduction of the issue and, in some cases, what has been done to date on the issue. Each plan consists of a series of strategies articulating what needs to be implemented and the various steps (activities) in the program or project. Each action plan contains a table of identified measures by which MBNMS will evaluate progress toward a desired outcome. These measures will be evaluated periodically and reported as explained in the Operations and Administration Action Plan.

Multidisciplinary Implementation

The action plans are grouped by common themes: issue-based action plans and program-based action plans. Each action plan is intended to be a discrete plan addressing the issue or problem. However, all issues require common tools of research, monitoring, education, outreach, enforcement, agency coordination, and partnership development. ONMS will seek to maximize the synergy between and among plans by exploring mutual research and monitoring needs for the various action plans and combining outreach needs to common audiences. Each of the action plans requires support from all four program areas to ensure the multi-disciplinary approach of the action plans and MBNMS staff are successful in implementing sanctuary management.

Performance Evaluation

Success will be evaluated through performance measures identified in each of the action plans and summarized in the Operations and Administration Action Plan. In addition to MBNMS staff members working toward the implementation of each of the action plans, MBNMS will work cooperatively with its partners, including federal, state, and local agencies and non-governmental organizations, as well as the Sanctuary Advisory Council and its working groups. Successful implementation of previous management plans relied on stakeholder and partnership coordination and collaboration, which will continue as MBNMS addresses the new and continued marine management issues outlined in this management plan.

Action Plan Prioritization

The action plans and strategies in this management plan comprise a body of work that is well beyond the standard of effective management and if fully implemented would require resources well beyond what is currently available to ONMS. ONMS staff worked with the Sanctuary Advisory Council and upper leadership to execture prioritization of the issues in order to identify the order in which to implement action plans. Implementation of some action plans may also be dependent on a variety of funding scenarios such as grant applications, funding priorities of outside parties, or reliance on partner participation. The implementation of various action plans in the management plan may occur at different stages based on urgency, benefit to sanctuary resources, and resource availability.

Management Plan Implementation and Funding Scenarios

The following table (Table I-2) provides an outline of how the various action plans and strategies in the management plan will be implemented. The implementation of these new action plans and strategies depends on various factors including:

- Status of strategy implementation;
- Level of implementation (with federal funding);
- Level of implementation with a 5% per year increase in funding;
- Level of implementation with a 5% decrease in funding;
- Coordination level necessary with partners for implementation; and
- Funding source for strategy implementation.

The current status column indicates the amount of work already completed on any given strategy at the time of the new management plan's release. Some strategies and activities from the 2008 plan are rolling over into this new plan, so will reflect partial implementation, while other strategies are completely new and will not be initiated until the future.

The level of implementation indicates the priority assigned to a strategy or action plan and subsequent level of effort that could be put into it, based on level funding. The table outlines the priority level (high, medium, or low) of the action and identifies the likelihood how increases or decreases in resources would affect the level of implementation possible for each strategy or action plan.

Implementing most of the strategies in this management plan will require input or coordination from partners, particularly other government agencies, research institutions, and non-government organizations. The table outlines the level of involvement expected from partners to achieve full implementation of each strategy. Many action plans and strategies are completely dependent on involvement from other agencies or dependent on research conducted by a research institution.

Funding for implementation of many of the strategies will require a mix of internal (federal) ONMS funds and funding from external sources such as grants, Monterey Bay National Marine Sanctuary Foundation, California Marine Sanctuary Foundation, or in-kind work from partner agencies. The table highlights the probable source of funding, primarily internal, external, or a mix of funding sources.

Table I-2: Implementation Table

Key:

Strategy status:
● – Existing w/o significant modification
◗ – Existing w/ significant modification
○ – New or future (not implemented)

Implementation (w/ federal funding):
H – High
M – Medium
L – Low

Partnership coordination:
● – Not possible w/o partners
◗ – Significant reliance on partners
○ – Little reliance on partners

Funding Sources:
● – External (e.g. Grants)
◗ – Internal and External
○ – Internal

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
ISSUE-BASED ACTION PLANS						
Climate Change						
Strategy CC-1: Develop capacity to address coastal resilience and adaptation planning	○	**M**	**M**	**M**	●	◗
Strategy CC-2: Reduce greenhouse gas emissions	○	**M**	**M**	**M**	○	○
Strategy CC-3: Communicate ocean-climate impacts and solutions	○	**L**	**L**	**L**	○	○
Strategy CC-4: Implement coastal sediment management plans	○	**H**	**H**	**H**	●	●
Strategy CC-5: Track and share ocean acidification research	◗	**L**	**L**	**L**	◗	○
Coastal Erosion and Sediment Management						
Strategy CESM-1: Track progress on coastal sediment management plans for MBNMS	◗	**L**	**L**	**L**	●	○
Strategy CESM-2: Collaborate on land management plan for CEMEX site	○	**L**	**L**	**L**	●	○
Strategy CESM-3: Implement site-specific beach nourishment programs	●	**L**	**L**	**L**	●	◗

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
Strategy CESM-4: Coordinate with regulatory agencies to determine appropriate disposal of dredge material	●	L	L	L	○	○
Strategy CESM-5: Track and reduce coastal armoring	◗	L	L	L	○	○
Strategy CESM-6: Reduce impacts to sanctuary resources due to landslides and subsequent emergency responses	●	L	L	L	○	○
Strategy CESM-7: Reduce impacts to sanctuary resources due to anthropogenic coastal changes to river mouths	◗	L	L	L	○	○
Davidson Seamount						
Strategy DS-1: Conduct site characterizations	●	H	H	M	●	●
Strategy DS-2: Conduct ecological processes investigations	●	M	H	M	●	●
Strategy DS-3: Conduct seamount education and outreach initiatives	◗	M	H	M	○	◗
Emerging Issues						
Strategy EI-1: Develop process to identify and track emerging issues	●	H	H	H	◗	○
Strategy EI-2: Develop process to address emerging issues	●	M	M	M	◗	○
Introduced Species						
Strategy IS-1: Manage pathways and promote prevention	●	L	L	L	●	◗

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
Strategy IS-2: Promote early detection and rapid response	●	L	L	L	●	◗
Strategy IS-3: Implement eradication or control	●	M	H	L	◗	◗
Strategy IS-4: Sustain research and monitoring	●	H	H	H	◗	◗
Strategy IS-5: Implement restoration	○	L	L	L	●	●
Marine Debris						
Strategy MD-1: Assess scope and scale of marine debris	◗	M	H	M	●	◗
Strategy MD-2: Foster public participation and support policies leading to reduced marine debris	○	M	M	L	●	◗
Strategy MD-3: Reduce marine debris threats by removing the debris and preventing point source inputs	◗	M	H	M	●	○
Water Quality Protection Program Strategies						
Strategy WQ-1: Facilitate and coordinate regional efforts to improve water quality through the Water Quality Protection Program Committee (and MOA), Agriculture Water Quality Alliance (AWQA), storm water programs, and Integrated Regional Water Management programs	●	M	M	M	●	◗
Strategy WQ-2: Understand the land-sea connection	●	M	H	L	●	◗
Strategy WQ-3: Quantify effectiveness of management practices	●	L	M	L	●	●

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
Strategy WQ-4: Monitor and reduce pollutant loads flowing into MBNMS	●	L	M	L	●	◗
Strategy WQ-5: Promote public engagement and stewardship through citizen science monitoring programs and other Water Quality Protection Program (WQPP) efforts	●	H	H	L	○	○
Strategy WQ-6: Communicate findings of projects and monitoring conducted by the WQPP	●	H	H	M	○	○
Wildlife Disturbance						
Strategy WD-1: Mitigate wildlife disturbance from marine vessels and shore-based activities	◗	M	H	M	●	◗
Strategy WD-2: Mitigate wildlife disturbance from aircraft	◗	M	M	M	●	◗
Strategy WD-3: Develop acoustic baseline profiles within MBNMS	○	H	H	M	●	◗
Strategy WD-4: Reduce underwater low-frequency mechanical sound emissions	○	M	M	M	●	◗
Strategy WD-5: Use administrative methods to reduce wildlife disturbance	●	H	H	H	○	○
Strategy WD-6: Use law enforcement resources to reduce wildlife disturbance	●	M	H	M	◗	◗
Strategy WD-7: Reduce the risk of wildlife entanglement in fishing gear	○	H	H	H	●	◗
Strategy WD-8: Respond to wildlife entangled in fishing gear	○	H	H	M	●	●
PROGRAM-BASED ACTION PLANS						

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
Education, Outreach, and Communications						
Strategy EO-1: Coordinate education programs through sanctuary visitor centers	●	H	H	H	◗	◗
Strategy EO-2: Enhance sanctuary interpretation and outreach programs	●	H	H	H	◗	◗
Strategy EO-3: Promote public engagement and stewardship through citizen science monitoring programs	◗	L	M	L	●	●
Strategy EO-4: Maintain and develop sanctuary-wide exhibits and interpretive signage	◗	M	M	L	◗	●
Strategy EO-5: Promote government and community relations	●	M	M	M	●	○
Strategy EO-6: Increase awareness of sanctuary through effective media and communication tools	●	M	M	L	◗	○
Strategy EO-7: Engage in local, regional, and national collaborations to leverage education and outreach opportunities	●	L	M	L	●	○
Strategy EO-8: Evaluate effectiveness of sanctuary education and outreach efforts	◗	M	M	L	○	○
Marine Spatial Planning						
Strategy MSP-1: Implement Sanctuary Ecologically Significant Areas (SESAs)	○	M	M	M	◗	◗
Strategy MSP-2: Track and monitor vessel traffic compliance	◗	M	M	M	◗	◗
Strategy MSP-3: Collaborate on fishery management issues	○	H	H	H	◗	○
Strategy MSP-4: Motorized personal water craft	○	M	M	M	○	○

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
Strategy MSP-5: Coordinate regionally, nationally, and internationally on MPAs	○	L	L	L	○	○
Strategy MSP-6: Aircraft overflight zones	◗	L	L	L	○	○
Strategy MSP-7: Track and respond to offshore wind and wave energy proposals	○	L	L	L	●	◗
Strategy MSP-8: Assess use of artificial reefs for recreation, restoration, or other uses in MBNMS	○	L	L	L	●	◗
Maritime Heritage						
Strategy MH-1: Maritime heritage program development	●	H	H	M	●	◗
Strategy MH-2: Threat assessment for shipwrecks and submerged structures	●	M	M	M	●	◗
Strategy MH-3: Protect and manage submerged archaeological resources	●	L	L	L	●	◗
Strategy MH-4: Develop maritime cultural landscape-focused education and outreach programs	●	M	M	L	●	◗
Operations and Administration						
Strategy OA-1: Management of MBNMS budget	●	H	H	H	○	○
Strategy OA-2: Support management priorities	●	H	H	H	◗	◗
Strategy OA-3: Coordinate and support Sanctuary Advisory Council	●	H	H	H	●	○
Strategy OA-4: Support training of MBNMS staff and maintain facilities	●	H	H	H	○	◗

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
Strategy OA-5: Oversee MBNMS facilities	◗	H	H	H	○	○
Strategy OA-6: Facilitate field operations	◗	H	H	H	◗	◗
Strategy OA-7: Provide general administrative support	●	H	H	H	○	○
Strategy OA-8: Administer human resources	●	H	H	H	○	○
Research and Monitoring						
Strategy RM-1: Characterize biological and physical features in MBNMS	○	H	H	H	●	◗
Strategy RM-2: Maintain and expand the Sanctuary Integrated Monitoring Network (SIMoN)	◗	H	H	M	●	◗
Strategy RM-3: Support science focused on priority sanctuary needs	○	H	H	H	●	●
Strategy RM-4: Facilitate the flow of science information among academic institutions, government agencies, and other institutions	○	H	H	H	●	○
Strategy RM-5: Coordinate with and participate in implementing research components of ONMS and West Coast Regional Office	○	M	H	M	◗	◗
Strategy RM-6: Coordinate with and participate in implementing policies of ONMS Conservation Science Program	○	M	H	M	◗	○
Strategy RM-7: Interpret select technical science information	○	H	H	H	◗	○
Resource Protection						

	Strategy Status	Implementation Level Funding	Implementation 5% Per Year Increase	Implementation 5% Decrease	Partnership Coordination	Internal/External Funding Sources
Strategy RP-1: Build partnerships and leverage opportunities for protecting sanctuary wildlife, habitats, qualities, and cultural resources through collaborative planning and management	◗	H	H	H	●	◗
Strategy RP-2: Enhance socioeconomic program through collaboration with ONMS headquarters socioeconomic team	○	L	L	L	◗	○
Strategy RP-3: Maintain and enhance permitting and environmental review program	●	M	M	M	○	◗
Strategy RP-4: Review projects, plans, and permits of other agencies	●	L	L	L	○	◗
Strategy RP-5: Implement enforcement programs	◗	L	L	L	●	○
Strategy RP-6: Interpret and distribute resource protection information	◗	L	L	L	○	○
Strategy RP-7: Coordinate resource protection programs including interpretive enforcement and citizen science programs	◗	M	M	M	◗	●
Strategy RP-8: Coordinate with and participate in implementing resource protection components of ONMS West Coast Regional Office	●	L	L	L	○	○
Strategy RP-9: Coordinate with and participate in implementing policies and programs of ONMS	●	L	L	L	○	○
Strategy RP-10: Review and revise the sanctuary's spill response plan and emergency response information in order to be prepared to respond to an incident	●	L	L	L	○	○
Strategy RP-11: Develop and implement restoration and recovery plans to address habitat damages and endangered species	●	M	M	M	○	○