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







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Challenges facing coasts and oceans

Human population is increasing. All over the world, people are moving toward the coasts. Wild marine fish landings have reached a plateau worldwide, but fishing effort is still rising. Marine and coastal resources and habitats are being used more intensively and in increasingly different ways and, thus, are degraded. Global climate change is affecting coasts and oceans through such phenomena as rising sea levels, changing habitats, migrating populations, and ocean acidification. Governance systems developed in the era of the “freedom of the seas” are struggling to keep up with modern technology and practices. Traditional single-sector management, in which human uses are managed separately, is inadequate and creates confusion and conflict. Together, these conditions have led in many cases to unsustainable development. The goal of marine conservation is to address these challenges by promoting sustainable development and use of coastal and ocean resources.



Sustainable road construction  includes locating roads further away from the coastline, constructing bridges to allow fish passage  , and using plant buffers  to reduce erosion of sediment  into the water, resulting in smaller sediment plumes  when it rains  and clearer water. Sustainable agriculture  includes minimizing sediment runoff, pesticide runoff, and land clearing. Encouraging ecotourism  and homestay developments  also helps to prevent erosion and maintain water quality. Sustainable fishing  includes harvesting marine resources at levels that maintain species populations, are not destructive to habitat, and ensure the health of the larger ecosystem. These sustainable development principles help to protect livelihoods, traditional ways of life  , and biodiversity  .

Unsustainable road construction  includes locating roads too close to the coast, blocking fish passage up and down rivers  , and cutting down trees and mangroves surrounding the road  , which leads to sediment runoff  during rain events  . Unsustainable mining practices include the operation of strip mines without plant buffers and without minesite rehabilitation  . Unsustainable agriculture, typified by palm oil plantations, includes destruction of natural habitat to create farm lands as well as sediment and pesticide runoff leading to reduced water quality. Unsustainable tourism developments  , which include placing developments too close to the shoreline, destroying mangroves to create land for development, and dumping improperly treated waste in the ocean, increase erosion, reduce water quality, and destroy critical habitat. Unsustainable and destructive fishing practices  , including harvesting at levels that deplete species populations or using methods that damage habitats, jeopardize fish stocks and the health of the larger ecosystem. These unsustainable practices lead to a highly degraded ecosystem  , which leads to reduced livelihood opportunities and losses in traditional ways of life  .

Marine managed areas defined

A comprehensive approach to conservation and management

One approach to the development of better coastal and marine policy and management is the concept of marine managed areas (MMAs). A MMA is an area of ocean, or a combination of land and ocean, where all human activities are managed toward common goals. MMAs are a form of ecosystem-based management, where all elements—biophysical, human, and institutional—of a particular system are considered together. There are several overarching principles under which MMAs should be developed:

- All human uses and their subsequent impacts on the defined area should be considered and their management integrated.
- Policy and management should be based on the best natural and social science available.
- All stakeholders in the defined area should be consulted and fully involved in the policy and management development and implementation processes concerning the MMA's conditions and uses.

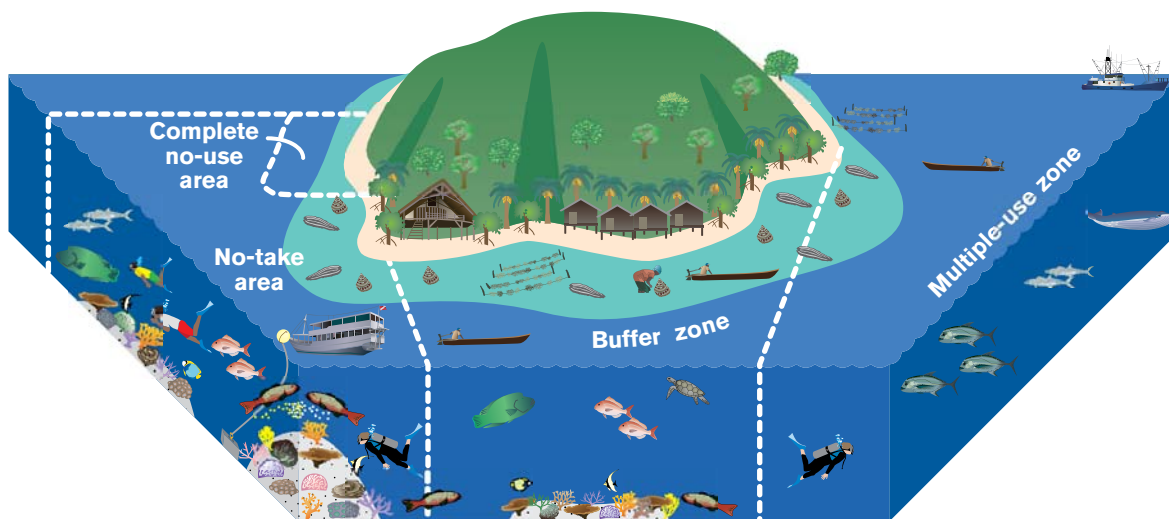
When such principles are fully implemented, the uses of the resources and habitats and the resulting benefits both to the environment and to humans can be optimized.

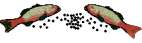


What are marine managed areas?




MMAs, as defined for this booklet, are multiuse, ocean zoning schemes that typically encompass several types of subareas, such as no-take areas (e.g., no fishing, mining), buffer zones with particular restrictions (e.g., no oil drilling), or areas dedicated to specific uses (e.g., fishing, diving).





MMAs can take many forms to address different issues and objectives. Some MMAs involve areas where multiple uses (e.g., fishing, tourism) are allowed under specific circumstances. Others involve areas where no extractive human uses (e.g., fishing, mining, drilling) at all are allowed. Still others restrict certain areas to one specific use (e.g., local fishing) that is judged to be the most beneficial use of that area to the exclusion of others.

The term 'marine managed areas' often is used interchangeably with 'marine protected areas' (MPAs) as an inclusive way of describing different types of MPAs ranging from those with multiple-use to areas of complete protection.



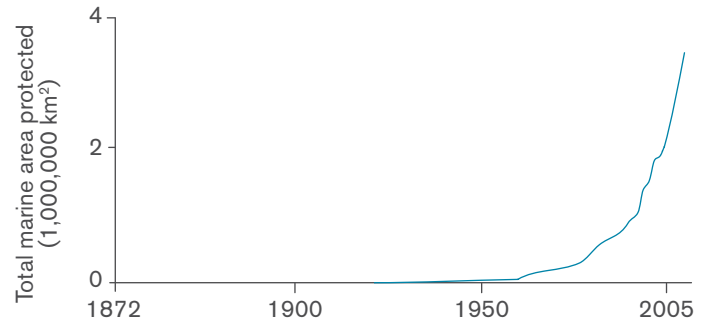
In no-take zones, fish are protected to support populations in the other zones. Spawning aggregations  and nursery grounds often are established as no-take areas. Only specified nonextractive activities, such as diving  and mooring , are allowed. Fishing and aquaculture are not permitted. Complete no-use areas, which ban all activities, are mechanisms for restoring highly degraded ecosystems.

Buffer zones, which are intended to be transition zones from more restricted use areas (i.e., no-take areas) to multiple-use zones, typically allow moderate activities, such as hook-and-line fishing , limited aquaculture , and limited tourism activities .

In multiple-use zones, all tourism activities, including diving  and snorkeling; all fishing activities, ranging from small-scale subsistence fishing  to large-scale commercial fishing ; and aquaculture , are permitted.

MMAs as global management tools

Management of marine resources through MMAs has been carried out effectively for thousands of years. Traditional Pacific Island cultures divided coastal areas within the community, such as the *qoliqoli* in Fiji and the *ahupua'a* in Hawai'i, where cultural practices, including fishing techniques and periods of no fishing, ensured the protection of important food and cultural resources. The spread of western culture during the 1800s led to the breakdown of these traditional management structures. Increased globalization and industrialization during the 1900s led to more efficient fishing and a more global fishery, which greatly increased the stress on marine resources.



The total marine area protected has increased significantly in the past 25 years. Graph and map data: IUCN and UNEP-WCMC 2010.



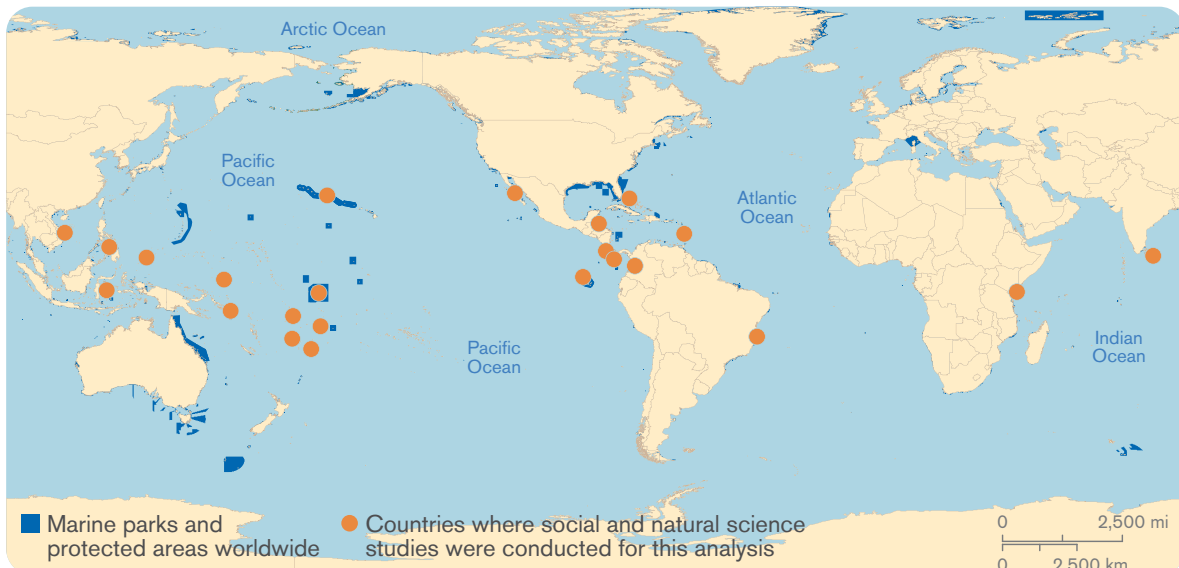
Locally managed marine areas, such as this tambu (no-fishing) area in Papua New Guinea, often are established based on cultural and social interests, such as to honor the deceased.



The Humpback Whale National Marine Sanctuary in Hawai'i, like many MMAs, was established to protect a particular species but has evolved to address larger ecosystem and human well-being priorities.

Since the 1950s, it has been recognized that a comprehensive framework for MMAs is needed to preserve marine resources. There are now thousands of MMAs worldwide; some are based upon traditional boundaries and cultural practices, and others are based on ecological priorities, such as habitat representation or species protection. MMAs are established to address

a wide range of problems and issues. Some have been established in very rural areas to address the effect of subsistence or commercial fishing. Others have been established on urban coastlines to address the cumulative effect of coastal development. Some address specific uses such as ocean mining. Most often, it is some combination of such uses and issues that is involved.



Important characteristics of MMAs

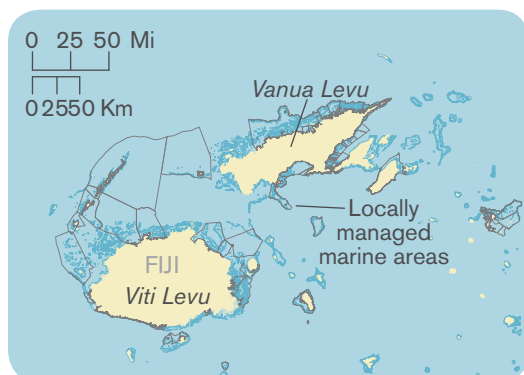
Effective development and implementation of a MMA involves several important characteristics.

Adaptive management—The resultant policy and management system for the MMA should be designed in a way that enables the system to adapt to changing biophysical (e.g., climate change) and human (e.g., population growth, economic development) circumstances.



The adaptive management cycle continually evolves to address changing ecological, socioeconomic, and governance circumstances.

Boundary definition—The boundaries of the system to be managed must be defined. This usually is done beginning with a specific portion of the ocean and coast, with important habitats and resources spatially identified on a map. Human uses and users of these areas as well as the institutions with public trust authority to manage those areas must also be identified.



The boundaries of most of Fiji's locally managed marine areas were originally set based on cultural priorities; however, the communities currently are incorporating ecological considerations.

Participatory and transparent process—The process of identifying problems and issues, developing goals and objectives, and evaluating management alternatives should be conducted in such a way as to keep lines of communication and participation open to all stakeholders, including the users of the resources and the institutions with authority for the habitats and resources.



Discussions with local people in West Papua about issues such as patrolling beaches for sea turtle nests helped to ensure active community engagement.

Scientific and traditional knowledge cut across the natural and social science disciplines—Solid research in the natural sciences (biology, ecology) and the social sciences (economics, law), combined with documented traditional knowledge of these topics, is necessary to the development of effective conservation programs, including MMAs. The research should be conducted by, or in close collaboration with, in-country scientists who are more accessible to advise on the management applications of the results and more likely to ensure long-term continuity of research than scientists visiting from abroad.



Brazilian marine ecologist Rodrigo de Moura serves on the advisory boards for MMAs in Abrolhos, Brazil, which enables him to share his results and discuss their applications directly with management authorities and stakeholders.

The scales of MMAs



Global

Through conventions such as the Convention on Biological Diversity, nations have agreed on the critical need for MMAs.



Regional (Mesoamerican Reef)

Often, nations work together to create a system of MMAs, which helps to ensure that ecologically important areas (e.g., spawning grounds) are managed and that there is coordinated enforcement.

National (Belize)

As the authority for establishing and managing marine resources, national governments play a critical role in ensuring coordination between MMAs and across agencies (e.g., fisheries departments, port authorities).

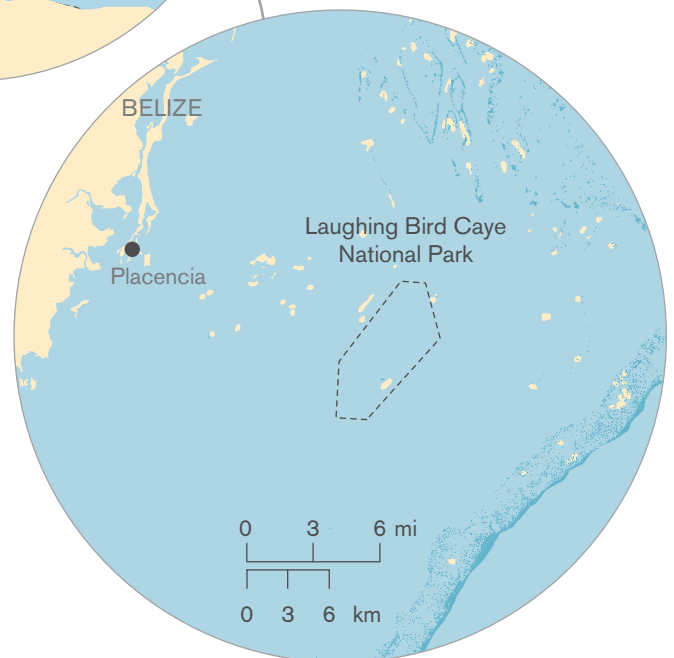


The development of a MMA sometimes will result in a new, comprehensive policy and management regime, but because of the multiple-use nature of most coastal and ocean habitats and resources, the development of a MMA most often will involve several different management regimes. That is, a MMA will not automatically result in a new, overarching policy and management authority, but it will rely on the integration and coordination of existing management regimes for such typical uses as subsistence and commercial fishing, shipping, mineral extraction, and tourism. MMAs typically will be imbedded in broader and more comprehensive national, regional, or global governance systems, such as exclusive economic zones or international agreements.

The emerging field of marine spatial planning is increasingly important in promoting planning and management across sectors (fisheries, oil and gas, habitat, water quality), levels of government (local, state, regional, national, international), and across the land-sea interface.

MMA (Laughing Bird Caye National Park)

By being imbedded in these larger management systems, MMAs are more likely to be successful because there are other larger efforts to manage activities.



The many forms of MMAs

MMAs can take many forms, addressing many different issues and objectives. Some are multiple-use areas; others ban all extractive uses. Still others restrict certain areas to one specific use that is judged to be the most beneficial use of that area, to the exclusion of other uses.

Complete no-use

Areas where no human use or impact is allowed, except research or monitoring activities.



Specified single extractive use

Areas where one specified extractive use, such as commercial fishing, is allowed.



MMAs

Multiple-use zones

Areas where several different uses, such as oil and gas exploration, fishing, and recreation, are allowed.



Specified nonextractive use

Areas where specific nonextractive uses, such as no-take recreational kayaking or diving, are allowed.



Buffer zones

Areas that allow moderate use because they are designed to be transition zones from more restricted use areas (i.e., no-take areas) to multiple-use zones.

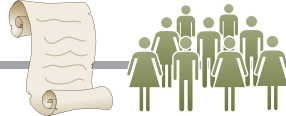
Governance for success

MMA also can vary in their structure and governance principles. Some are run by government agencies. Others operate through private-sector agreements. Most involve some form of cooperation between public (government) and private sector organizations (corporations, nongovernment organizations such as environmental groups), often called co-management. Some are subsidized, usually by governments, and others derive at least part of the revenue to run the MMA from user fees. In all cases, close monitoring of the uses of the MMA and strict enforcement are critical in attaining the objectives of the MMA. Effective monitoring and enforcement, in turn, depend on the transparency of, and the involvement of the stakeholders in, the management process.

National governance



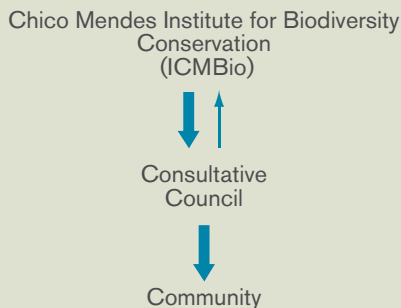
Co-management



Community governance



Abrolhos National Park, Brazil



The Brazil federal government created the first marine national park in Abrolhos in 1983. The park is managed by ICMBio, the Brazilian institute responsible for conservation units. ICMBio makes decisions with input from a Consultative Council (made up of community and stakeholder representatives). The decisions are then conveyed to the community.



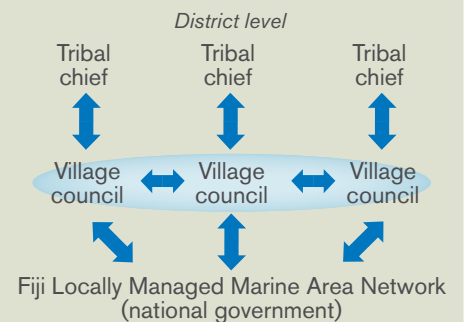
Coiba National Park, Panama



In Panama, new legislation designating Coiba National Park established a 12-member Directive Council composed of representatives of central government agencies, communities, nongovernmental organizations, and fishers. The council has ultimate decision-making responsibility for this island and surrounding waters.



Qoliqolis, Fiji



In Fiji, indigenous ocean management areas called *qoliqolis* have existed for thousands of years. Decisions about these management areas are made by tribal chiefs through the village council. Additionally, many village councils work together at the district level, supporting one another's decisions. These decisions are then conveyed to the Fiji Locally Managed Marine Area Network, which is a consortium of national government agencies, academia, and nongovernmental organizations.



Issues and challenges facing MMAs

All policy and management of coastal and marine resources involves tradeoffs with respect to particular objectives and impacts. Protection of a fish stock, for example, often involves reducing the economic, social, and nutritional benefits from the harvest of that species or population. Short-term reductions in use may be necessary to ensure the long-term viability of the population or habitat. There may not be enough of a resource to fulfill all of the needs and desires of

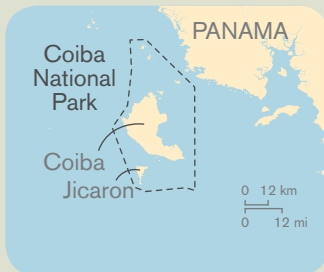
people who use the resource for different purposes. For example, commercial and sport fishermen who fish the same stock are different groups who wish to use the same marine area. If there were no issue of overharvest, habitat degradation, or competition for space or resources, there would not be a need for policy and management, but overuse, degradation, and competition do exist.

De facto protection

Coiba National Park, Panama

Coiba Island, off the west coast of Panama, was a penal colony since the early 1900s. The waters around the island were closely patrolled for security purposes, and no fishing was allowed. This constituted a de facto 'marine sanctuary'

around the island. In the early 21st century, the penal colony was closed by the Panamanian government, and a debate ensued about the future use of the island and the surrounding waters. Ultimately, the island and the surrounding waters were declared Coiba National Park, which protected both the land and the ocean resources around the island. Today, limited commercial fishing is allowed, and a vibrant recreational fishing and ecotourism industry has developed, following a management plan developed for the park.



Multiple-use MMA

Gladden Spit Marine Reserve, Belize

At Gladden Spit, the Belize Barrier Reef juts seaward to form an elbow that drops into deep water. The area has been fished by commercial and subsistence fishers from villages on the mainland. Because of the existence of spawning aggregations of snapper-grouper

species and the seasonal presence of whale sharks, the commercial fishery began to be overfished. Additionally, a tourism industry developed to view the whale sharks. This created multiple-use conflicts. To address these conflicts, fishers accepted a system of limited access for local fishers only and have agreed not to fish at night or for endangered grouper species as part of the reserve management. These arrangements have led to both increased local benefits and better conservation and management of the area.



MMA development process

There are several stages in the development of any new policy or management system:

1. Specifying the problems or issues to be addressed;
2. Setting specific objectives to be attained;
3. Developing alternatives and evaluating these alternatives by specific criteria;
4. Selecting and implementing an alternative, including enforcing regulations;
5. Monitoring compliance with, and enforcement of, the rules of the new system; and
6. Adapting management strategies to address problems raised from monitoring data.

Combining traditional methods with government

Locally managed marine areas, Fiji

In the Pacific Island nation of Fiji, near-shore marine areas traditionally were managed by local villages according to a system of territories called *qoliqolis*. When the British colonized the island, however, this system broke down but was never fully replaced by the new, centralized civil government. The result was that the near-shore resources began to be overfished, which led to conflicts among the villagers and other users. The establishment of locally managed marine areas, coordinated by the Fiji Locally Managed Marine Area Network and largely based on the traditional *qoliqolis* system, has reinstituted conservation measures and at the same time reduced user conflicts.



Extractive reserve

Corumbau Marine Extractive Reserve, Brazil

Near the village of Corumbau, Brazil, there are coastal reefs and shrimp banks that traditionally have been fished by small-scale, primarily artisanal fishers. However, trawl boats from other parts of Brazil started to come to Corumbau, applying much more fishing effort than the fish stock or the habitat could bear. The extractive reserve was created, and limited fishing in the area by traditional, small-boat fishers from local communities was allowed. This has protected the habitat from damaging fishing gear and has relieved pressure on the fish stocks.



Research themes for MMAs

Historically, research efforts for MMAs have focused on the biophysical (biology, ecology, oceanography) sciences. Increasingly, however, managers are recognizing the importance of understanding the human dimension of marine resources and services. Consequently, the social sciences (economics, anthropology, political science) are playing a more prominent role.

Biophysical

Assessing the what and where of the biophysical environment is an ongoing process essential to examining MMA performance and making good stewardship decisions. This assessment should include water quality parameters and the distribution, abundance, and health of sessile organisms (e.g., coral, seagrass, mangroves), fish, and other key organisms. These data can be recombined as measures of ecological health (e.g., coral cover, grazing pressure). A comprehensive methodology for assessing coral reef ecosystem health is provided in the Community Health Index (available at www.science2action.org).

Economic

Analysis of the flow of economic costs and benefits derived from the use of a resource or environment is a necessary companion to the biophysical characterization. Both extractive (e.g., fishing, mining) and nonextractive (e.g., diving, ecological services such as shoreline protection) uses need to be included in the analysis to fully capture the economic value of the resources. Economic analyses can be particularly useful in demonstrating the importance of the resources and their services in monetary terms, to which most people can relate.

Sociocultural

People's basic beliefs and attitudes regarding the coast and ocean affect all the uses and values associated with marine resources and habitats. Some of these values translate into monetary terms, while others do not. The spiritual value of a pristine, wonderful, or even threatening environment may be reflected in cultural histories, song, or dance. Communities and their residents may achieve status, recognition, and cultural identity in roles such as seamen or fishers. Understanding the sociocultural roles of marine resources can be useful in demonstrating the importance of ensuring the sustainable use of the marine environment.

Governance

There are many different forms of societal governance of human behavior that affect coastal and ocean resources and services. These can range from traditional and local governance systems to large-scale national systems. Gaining an understanding of these governance systems includes examining roles



Counting fish and surveying coral cover are standard methods for collecting biophysical data.



Interviews, observations, and reviews of relevant documents are typical methods for collecting social science data. Above: a researcher conducts an interview in Java, Indonesia, to understand local perceptions of management efforts.

and responsibilities, the legal system, and community perceptions regarding management efforts. It also involves examining the enforcement chain, including the phases of surveillance and detection, interception and arrest, prosecution, and sanctions. Analysis of governance systems is important to identifying strengths and weaknesses that need addressing.



Extensive field experience, mentoring, and training by senior scientists resulted in a young, highly qualified ecological monitoring team throughout Belize.



Discussions between scientists and village leaders regarding the results of studies demonstrating the uniqueness of Fiji's resources and the importance of management led to village interest in establishing new and more effective MMAs.

Integrated analysis

Integrated analysis of numerous, multidisciplinary studies is critical to maximizing learning and ensuring adaptive management. This is particularly critical for examining the drivers that can destabilize and degrade an ecosystem. Global drivers include climate change and global market forces, which require an understanding of a wide range of disciplines from oceanography to economics to behavioral psychology. The most important driver for local MMA performance is the sum of human population effects (i.e., fishing, deforestation, pollution), which requires understanding the economic basis of these activities; their ecological impacts; and the subsequent ramifications for ecosystem services, such as tourism and fishing. Understanding these interrelationships can enable managers to minimize costs and maximize benefits.

Capacity building

Unless local, onsite capacity is developed to maintain existing systems and initiate new ones without continual infusion of resources and expertise from outside, those systems are not likely to be durable over time. Capacity building means raising the abilities and awareness of in-country scientists through short-term efforts, such as training and mentoring, as well as through more long-term efforts, such as contributing to national databases, working with networks of professionals, and establishing long-term cross-institutional partnerships.

Science-to-Action

Feeding science into management is a complex process involving facilitation, translation, and communication. This process requires facilitating a partnership between scientists and decision-makers; translating the scientific findings into accessible, relevant information; and communicating this information to key stakeholders at the appropriate times. Guidance on how to feed science into action is provided in the guidebook *Science to Action* (available at www.science2action.org).

Science for MMAs

The Marine Management Area Science (MMAS) Program at Conservation International was initiated to ensure that the most complete, highest quality science in all appropriate areas is produced and available to those wishing to develop MMAs. MMAS was specifically designed to yield the broad and multi- and interdisciplinary science appropriate for the entire range of factors involved in the establishment and implementation of MMAs. Accordingly, research was done in areas of biology, ecology, economics, society and culture, governance, and the integration of these areas. This research has been instrumental in influencing the establishment of MMAs in Brazil, Panama, and the Central Pacific; zoning MMAs in Panama and Galapagos; and enhancing enforcement in Belize, Colombia, Ecuador, Panama, and Costa Rica.



Science-to-Action Coordinators are responsible for facilitating, translating, and communicating the science into decision making, which is instrumental in achieving conservation actions in Brazil, Panama, Belize, Fiji, and Galapagos, Ecuador.

Recommendations

The following recommendations stem from the social science analyses highlighted in this document and *People and Oceans*, and from the natural science analyses highlighted in *Living with the Sea* (both available at www.science2action.org).

Government agencies

- **Regulate** with appropriate penalties to enable managers to effectively police their MMAs.
- **Enforce** MMAs by surveillance and detection, interception and arrest, prosecution, and sanctions.
- **Invest** in MMAs by providing funding, personnel, and infrastructure support.
- **Plan** for sustainable regional development while recognizing global issues such as climate change.
- **Integrate** ocean management with land management.
- **Coordinate** scientific discovery and citizen scientist efforts to support MMAs.

Local community

- **Participate** in the design and establishment of MMAs so that stakeholders are vested in the success of the MMA.
- **Learn** about and **adapt** to the changing conditions and use MMAs as social learning experiments.
- **Celebrate** ocean resources through cultural events and engage broader groups of people in MMAs.
- **Engage** in alternative livelihoods to sustain marine resources as well as to engage in life-long learning activities afforded through MMAs.
- **Respect** the limits of the ocean and the patchwork of MMAs to maintain diversity of habitats.
- **Wait** long enough for MMAs to have desired effects; impatience with natural ecosystems often is not rewarded.

Marine scientists

- **Monitor** the effectiveness of MMAs in terms of both natural resources and management practices, such as economic incentives.
- **Develop** targeted research to help to decide among trade-offs, and capture the links between natural and cultural knowledge.
- **Disseminate** scientific knowledge to MMA managers and stakeholders for effective management and success of MMAs.
- **Establish** monitoring and research relevant to MMA issues, and draw on local community knowledge.
- **Investigate** the relationship between spatial size and arrangement of MMAs and their effectiveness for fisheries and for other ecosystem features.
- **Create** new scientific tools for professional scientists as well as citizen scientists to better monitor and interpret MMA effectiveness.

Marine managers

- **Seek** economic support for MMAs by matching fees to the willingness to pay (value) of the MMA and engage in fundraising activities.
- **Educate** visitors and stakeholders on how people depend on oceans (ecosystem services) and promote awareness of sustainable resource use for long-term benefits.
- **Maintain** compliance of the local community for MMAs using incentives and enforcement.
- **Manage** MMAs in an integrated fashion, encompassing the watershed and adjacent marine ecosystem beyond MMA boundaries.
- **Connect** MMA management to local community initiatives.
- **Facilitate** communication between MMA decision-makers and stakeholders to achieve climate adaptation, biodiversity maintenance, and habitat protection.

Private businesses

- **Allocate** a portion of profits to the establishment and operation of MMAs to assist in long-term conservation.
- **Educate** staff and visitors about conservation practices and improve environmental literacy.
- **Promote** sustainable use of resources and good conservation practices.
- **Develop** experiences in which a healthy ocean is the feature that attracts sustainable development.
- **Balance** the seemingly contradictory demands of protecting natural resources to be able to reliably obtain these same resources.
- **Focus** on biodiversity and locally unique (endemic) species or habitats to foster ecotourism.

Nongovernment organizations

- **Foster** long-term partnerships among natural resource agencies, conservation managers, and communities.
- **Inform** policy and influence decision-makers through environmental and conservation education, interpretation, and media outreach programs.
- **Develop** sustainable financing mechanisms, such as payments for marine ecosystem services, in order to provide ongoing economic incentives.
- **Build** capacity in the local community to manage MMAs through training programs and investments in conservation support.
- **Adopt** a systems-wide perspective to managing MMAs within the context of the landscape and seascape.
- **Educate** government officials, scientists, and resource managers about conservation values and economic values of MMAs.

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This document draws on the insights gained from more than 50 natural and social science studies conducted by the Marine Management Area Science Program. In particular, it draws from the following publications, which can be accessed at www.science2action.org.

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Our global network puts science into action so that the ocean can provide the multiple benefits needed by people today and tomorrow. Since 2005, we have conducted more than 50 studies in over 70 marine managed areas in 23 countries, using an integrated approach of natural and social sciences. Based on the scientific results, we develop conservation and management recommendations, and we engage directly with people at local to international scales to implement science-based solutions.

The following **Science-to-Action** publications present global research findings and lessons learned:

Marine Managed Areas: What, Why, and Where defines MMAs and discusses the challenges of implementation.

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Living with the Sea examines the role of MMAs in restoring and sustaining healthy oceans, particularly the importance of local management efforts.

Science-to-Action provides practical guidance for scientists and decision-makers on using science to inform ocean policy and management.

Economic Incentives for Marine Conservation provides guidance on how to select and implement incentive-based solutions: buy-outs, conservation agreements, and alternative livelihoods.

Coral Health Index provides a comprehensive methodology for monitoring the condition of coral reef ecosystems.

Economic Values of Coral Reefs, Seagrasses, and Mangroves: A Global Compilation provides statistics on the economic value of tropical marine resources organized by type of use and by region.

Socioeconomic Conditions Along Tropical Coasts: 2008 demonstrates people's dependence on marine resources for livelihoods, discusses people's perceptions of resource conditions, and highlights governance status worldwide organized by region.

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