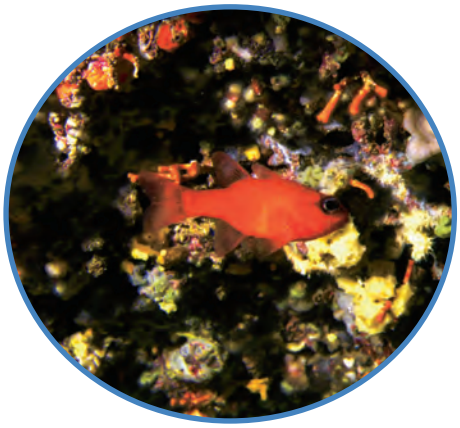
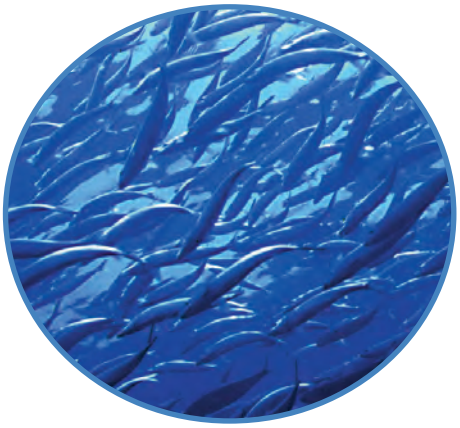
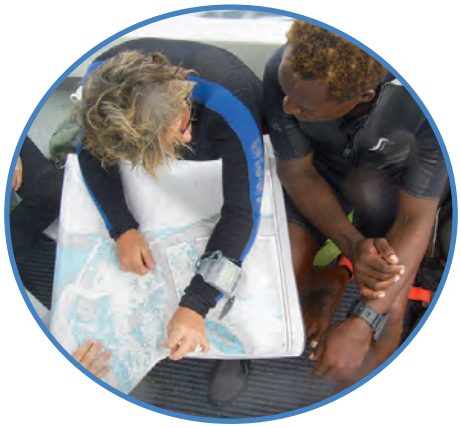




Global Ocean Protection

Present Status and Future Possibilities

Editors:
Caitlyn Toropova, Imèn Meliane, Dan Laffoley,
Elizabeth Matthews and Mark Spalding

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UNEP

Global Ocean Protection

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This publication has been made possible in part by funding from The Nature Conservancy, l'Agence des aires marines protégées and Wildlife Conservation Society. Support for the analysis described in Chapter 3 was provided through the 2010 Biodiversity Indicators Partnership (www.twentyten.net), a GEF-funded initiative providing information on biodiversity trends and global progress towards the CBD 2010 Target.

Published by: IUCN, Gland, Switzerland, The Nature Conservancy, Arlington, USA, UNEP-WCMC, Cambridge, UK, UNEP, Nairobi, Kenya, UNU-IAS, Tokyo, Japan, Agence des aires marines protégées, Brest, France

Citation: Toropova, C., Meliane, I., Laffoley, D., Matthews, E. and Spalding, M. (eds.) (2010). *Global Ocean Protection: Present Status and Future Possibilities*. Brest, France: Agence des aires marines protégées, Gland, Switzerland, Washington, DC and New York, USA: IUCN WCPA, Cambridge, UK : UNEP-WCMC, Arlington, USA: TNC, Tokyo, Japan: UNU, New York, USA: WCS. 96pp.

For individual chapters: Lead Authors. (2010). 'Title of the chapter'. In C. Toropova, I. Meliane, D. Laffoley, E. Matthews and M. Spalding (eds.) *Global Ocean Protection: Present Status and Future Possibilities*. Brest, France: Agence des aires marines protégées, Gland, Switzerland, Washington, DC and New York, USA: IUCN WCPA, Cambridge, UK : UNEP-WCMC, Arlington, USA: TNC, Tokyo, Japan: UNU, New York, USA: WCS 96pp.

ISBN: 978-2-8317-1311-3

Designed by: Georgios Sarantakos, IUCN

Cover photos: Upper left: © Mark Godfrey, TNC; Upper middle: © Mito Paz; Upper right: © Louise Goggin
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Printed by: Linemark Printing, Inc. an EPA Green Partner

Preface

Small island cultures, like ours in Micronesia, have been shaped by our surrounding oceans. Indeed, we would not know who we are, or what will become of us, without sustenance from our marine resources. Today, more than ever, greater and more innovative effort must be made to protect and maintain our biodiversity and ecosystem structure, functions and processes, as anthropogenic and natural threats continue to escalate. Equally important is increased and more effective effort to ensure that the benefits derived from these resources are equitably distributed among all users. With climate change currently identified as the greatest threat to biodiversity, there may be an inclination to neglect community-based marine protected areas, as more focus shifts towards a global system of protected areas, and while we certainly need to do this, we also cannot afford to forget or abandon the small-scale marine protected areas, because they are the foundation and starting point of any larger marine protected areas.

Without effective protected areas at the village or community level, there can never be a successful global protected areas system. Therefore, much effort and attention is still required at the local level, not only to provide assistance towards their success, but to also receive valuable lessons from them towards a successful global system of protected areas. For example, customary marine tenure, which has been practiced over centuries, tried and tested by islanders, must hold some of the answers and 'innovative' solutions we seek today towards our vision of a global system of protected areas.

The use of protected areas to facilitate the maintenance and recovery of biological resources has been practiced by Pacific island communities for centuries in accordance with customary practices and spiritual beliefs. Such concepts of ecosystem approach, adaptive management and marine protected areas are generally perceived to be relatively recent developments of Western origin, when in fact, they have been in practice in our small islands in Micronesia, as well as the rest of the Pacific Island countries, for over a millennium. Due to colonization, western influence and globalization, we have adopted new ways of using our marine protected areas (MPAs), exploring various forms of management and collaboration at the local level, the national level and even at the regional level.

At present, we have a wide range of MPA systems throughout the Pacific Islands, including those managed by communities, by local and national governments, as well as various types of co-management in between. However, in the Federated States of Micronesia, our traditional marine management system, based on our customs via our traditional chiefs, cultural beliefs and values remains one of our best marine management tools simply because it has proven to work and continues to be culturally appropriate for us. Without a doubt, in my country, in other Micronesian countries, and even many island nations across the globe, customary marine tenure and community-based management systems remain one of our most important approaches we use to protect our biodiversity, our livelihood and our future.

Micronesia has implemented efforts to establish nation-wide protected areas networks (PANs) and has initiated a regional collaborative effort, the Micronesia Challenge initiative, to further drive our individual and collective efforts in marine biodiversity conservation. The Micronesia Challenge (MC) is fully described in this publication and we are proud to be seen as a leader and innovator in marine protection.

This publication provides a much needed and timely tool to assist us in our collective effort to find new and better solutions to address the various threats to our marine biological diversity and productivity. It provides evidence-based recommendations on improving and accelerating actions on delivering ocean protection and management through marine protected areas and facilitates the sharing of experiences and lessons learned.

Emanuel (Manny) Mori
President
Federated States of Micronesia

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Executive Summary

The important commitments made by the international community at the 2002 World Summit on Sustainable Development and the Convention on Biological Diversity to put in place ecologically representative and effectively managed networks of MPAs by 2012 and to effectively conserve at least 10% of each of the world's marine and coastal ecological regions have sparked important efforts towards ocean conservation.

The total ocean area protected has risen by over 150% since 2003. The total number of MPAs now stands at approximately 5880, covering over 4.2 million km^2 of ocean. This figure equates to only 1.17% of the marine area of the world, but the focus remains largely on continental shelf areas where MPA coverage is some 4.32%. Off-shelf protection stands at just 0.91%. Although it is not possible to develop an exact account, fully protected, no-take areas cover only a small portion of MPA coverage, while a large proportion of MPAs are ineffective or only partially effective.

Rather than ecologically representative, MPA coverage is very uneven and does not adequately represent all ecoregions and habitats important for conservation. In addition to the almost universal lack of MPA coverage in offshore waters, there are major gaps in protection of coastal and continental shelf waters, particularly in temperate regions. Some 44 coastal ecoregions have more than 10% MPA coverage but 102 (44%) have a coverage of less than 1%.

One clear trend in the recent growth of marine protection has been the designation of very large MPAs – 11 MPAs are larger than 100,000km^2 and together these make up over 60% of the global coverage. While such sites are to be welcomed, their overall influence on statistics masks a disproportionate lack of protection in some areas, notably in areas where human population densities are high and pressures may be more intense.

From a political perspective, almost all MPAs are located within areas of national jurisdiction and when the high seas are excluded, MPA coverage stands at some 2.88% (of areas within 200nm of the coastline). Only 12 of 190 States and territories have MPA coverage at or above 10%.

In addition to national efforts, we are witnessing an increase of regional approaches for marine protected areas networks across entire regions and seas. This is fostering collaborative management and partnerships among multiple sectors and stakeholders. Aligning data, effective communication and efficient stakeholder and community engagement are essential for success.

The last few years have also helped advance global tools and efforts for the conservation and management of open oceans and deep seas, in particular in areas beyond national jurisdiction. A biogeographic classification system of open oceans and deep seabed, including criteria for selecting biologically and ecologically significant areas, provides a scientific and technical basis for conserving marine areas beyond the limits of national jurisdiction. Though various regional and sectoral conventions and instruments are increasing efforts to conserve marine biodiversity in open oceans and deep seas, there is an urgent need for further institutional improvements, cooperative mechanisms and agreements on common principles and goals for spatial management of human activities in areas beyond national jurisdiction.

Over the last few years, climate change has become more dominant on the environmental agenda. Today we know that climate change is already affecting the ocean in many different ways and the scale and extent will continue to increase as effects take hold. By protecting important habitats and ecosystem functions, such as coastal carbon sinks, MPAs provide the foundation for ecosystem-based mitigation and adaptation strategies. Important changes in the way that MPAs are designed, managed, and governed are needed now more than ever to help assure that key components of marine ecosystems are resilient in the face of climate change.

Looking ahead at the coming decades, the combination of acute climate change impacts and a growing world population are adding ever increasing pressures on, and competition for, coastal and marine resources. To ensure that the coastal and marine capital is sustainably managed to continue to provide for the needs of the present and future generations, the ocean conservation agenda needs to shift to integrate marine management at ecologically meaningful scales. We are witnessing visionary leaders banding together to create large-scale initiatives like the Micronesia and Caribbean Challenges and the Coral Triangle Initiative with bold aspirations that explicitly link ocean protection to the well-being of their people and the development and prosperity of their nations. Moving forward globally, we need to secure greater political will, increased human and financial capacity and improved governance and engagement with ocean stakeholders.

Marine protected areas remain a strong foundation to address ocean challenges. However, they cannot be a panacea to the heavy pressures on the coasts and oceans. For them to achieve their objectives, they need to be designed and managed effectively, taking into considerations the socio-economic needs of their surrounding communities. They also need to be part of an effective broader framework that addresses management across all sectors. Policies, planning and management have to be expanded to look beyond MPAs, to consider biodiversity conservation and management needs across the entire ocean space, within and beyond national jurisdictions.

Marine spatial planning is emerging as one of the most promising tools for creating an ecosystem-based management (EBM) approach and ensuring that coasts and oceans are managed to meet current and future demands on ocean resources. It focuses on the most concrete aspects of EBM – area-based planning and management – and addresses multiple human uses, their cumulative impacts and interactive effects.

The inevitable conclusion is that the CBD target for achieving effective conservation of 10% of marine ecological regions will not be met in time. There still remains much progress to be made for the development of comprehensive, effectively managed, and ecologically representative national and regional systems of protected areas by 2012. As the global community is charting a new course to reduce biodiversity loss while achieving development goals and greener economies, we offer specific recommendations to strengthen the MPA foundation and move towards multi-objective integrated planning and management frameworks that embed MPAs and conservation objectives within a wider context and integrate ecological, economic and social needs.

Mangrove in Aldabra Atoll lagoon, Seychelles © J Tamelander / IUCN

Chapter 1
Introduction

The world's oceans and coasts are crucially important to humankind; the goods and services they provide have underpinned human activity for more than a millennium (Roberts 2007). Oceans and coasts host some of the most productive ecosystems on earth, providing food and livelihoods to millions of dependent local communities, sustaining local and national economies, and supporting cultural services to human communities. They also are the largest carbon sink on the planet. Ocean services were once believed to be infinite. However, the past decades have proved that marine ecosystems and resources are limited, vulnerable and becoming increasingly degraded.

As early as the late 19th century, there were many local examples of fisheries collapse and estuarine and coastal degradation (Roberts 2007). Over the last century, the degradation and overexploitation of the coastal and marine ecosystem and resources has continued and intensified. Today oceans and coasts are among the most threatened ecosystems of the world (Millennium Ecosystem Assessment 2005. Halpern et al. (2008) analysed the current extent of human impacts on marine ecosystems, and showed that no area of the oceans is unaffected by human influence and that 41% of the ocean is strongly affected by multiple drivers, with the highest impacts concentrated closer to shores.

The 1970s marked an era of recognition that management of marine resources and habitats was insufficient which led to a growing interest in approaches to ensure the continuing viability of marine ecosystems. In 1975, the first international conference on Marine Parks and Reserves was hosted by IUCN in Tokyo, Japan. The report of that conference noted increasing pressures upon marine environments and called for the establishment of a well-monitored system of marine protected areas representative of the world's marine ecosystems. Marine protected areas (MPAs) have been proposed as an integral component of broader marine and coastal zone management schemes, with establishment of networks of MPAs as a means to improve the overall governance of the ocean. Marine areas were again in the spotlight at the 1988 IUCN General Assembly that called on governments to seek cooperative action between the public and all levels of government for development of a national system of marine protected areas as an integral component of marine conservation and management (IUCN 1988).

As our understanding of the many and synergistic impacts of human activities on marine biodiversity and resources increases, so does the need for more innovative and integrated approaches to ocean management. Indeed, management approaches for the marine and coastal environment are rapidly evolving, including the theoretical guidance and practical advice for effective implementation and management of MPAs. MPAs have been used increasingly over the last century, and they remain a fundamental tool that is widely recognized as one of the most pragmatic and effective means for achieving ecosystem-level conservation, protecting marine biodiversity and sustaining local human communities. MPAs and MPA networks that recognize and display connectivity are increasingly being used to respond to some of the key threats and pressures on the marine and coastal environment and resources. They are able to fulfil both broader conservation goals and fisheries management objectives, as well as providing a foundation for delivering ecosystem-based management (Agardy & Staub 2006; Compass 2004; IUCN-WCPA 2008; Mora et al. 2006; Parks et al. 2006).

Still, the already high pressures on coastal and marine resources are anticipated to continue to increase, and with them the continued concern of the international community. The World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa in 2002 once again put ocean conservation high on governments' agenda. Through the WSSD plan of implementation, governments committed to improving ocean conservation and management through actions at all levels, giving due regard to the relevant international instruments. Particularly, they committed to:

"Develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/area closures for the protection of nursery grounds and periods, proper coastal land use and watershed planning and the integration of marine and coastal areas management into key sectors."(Para 31.c of the WSSD Plan of implementation)

By setting a time-specific target to establish representative networks of MPAs, governments have put a particular spotlight on MPAs as an important tool for achieving marine conservation and management. In addition to the 2012 MPA target, governments made other important and time-bound ocean-related commitments at WSSD, these include: "encourage application of the ecosystem approach to fisheries and ocean management by 2010"; "maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas within and beyond national jurisdiction"; "and maintain or restore depleted fish stocks to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015".

A few months prior to WSSD, the Parties to the Convention on Biological Diversity (CBD) adopted a strategic plan of the Convention that contained a global target to "achieve by 2010 a significant reduction in the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth." The following CBD Conference of the Parties (COP), decided to develop a framework to enhance the evaluation of achievements and progress in the implementation of the Strategic Plan and, in particular, to establish goals, sub-targets and indicators for each of the focal areas of the convention. The same COP adopted a new programme of work on Protected Areas (POWPA) and a revised programme of work on marine and coastal biodiversity, and both programmes reinforced the WSSD outcomes.

In particular, the POWPA included a series of targets including the following "By 2010 terrestrially and 2012 in the marine area, a global network of comprehensive, representative and effectively managed national and regional protected area system is established as a contribution to (i) the goal of the Strategic Plan of the

Convention and the World Summit on Sustainable Development of achieving a significant reduction in the rate of biodiversity loss by 2010; (ii) the Millennium Development Goals - particularly goal 7 on ensuring environmental sustainability; and (iii) the Global Strategy for Plant Conservation." Also, through their decision on marine and coastal biodiversity, Parties agreed that the overarching goal for work under the Convention relating to marine (and coastal) protected areas should be establishing and maintaining "effectively managed and ecologically based MPAs that built upon national and regional systems in contribution to a global MPA network and the WSSD approach". The decision states that such MPAs should include a range of levels of protection, where human activities are managed, and be delivered through regional programs and policies and international agreements, in order to maintain the structure and functioning of the full range of marine and coastal ecosystems and provide benefits for both present and future generations.

In 2006, COP 8 further refined the biodiversity target by adopting a number of biome-specific sub-targets, some of which relate to effective conservation of marine and coastal areas. Specifically, these focused on the agreement that 'at least 10% of each of the world's ecological regions [should be] effectively conserved' (target 1.1), and that 'areas of particular importance to biodiversity [should be] protected' (target 1.2). Connections between these various targets and sub-targets and their deadlines often get confusing. In general, there's a widespread interpretation that the MPA target (under both WSSD and CBD) is to achieve 10% coverage of ecologically representative and effectively managed MPAs by 2012. Furthermore, protected areas coverage was selected as a specific indicator to evaluate progress towards the implementation of the CBD targets, and 2010 goal.

Eight years after the initial 2002 commitments, in a year where Parties to the CBD are revising the strategic plan of the convention, and where the global community is also preparing for the upcoming UN conference on sustainable Development in 2012 (Rio+20), the immediate questions that many are asking is "how are we doing at meeting the 2010/2012 targets?", "what have we learned from the implementation of these targets?", and "what other additional actions are needed to improve ocean conservation?".

This report is not intended to provide a comprehensive review of ocean conservation and management tools or even of marine protected areas – current knowledge simply does not allow such assessment. However, it provides an overview of the different types of marine protected areas and other area-based management measures and the benefits they provide. The report particularly focuses on examining and analysing a commonly agreed global indicator- global MPA coverage - looking both at the jurisdictional and the biogeographic coverage and identifies areas where more progress may be needed, what efforts have been particularly successful, and that may be useful models for replication at larger scales elsewhere in the world. Based on achievements to date, the report highlights national and regional experiences that have successfully established marine protected areas and networks. It also identifies some emerging new directions and approaches that hold promise in addressing some of the major impediments to scaling up conservation efforts and averting the continued degradation of the marine environment and associated loss of ecosystem services. In particular, we examine multi-objective planning tools that have been used to address the cumulative impacts of ocean threats and to reconcile conservation and development needs.

Lastly, the report provides reflections on some of the trends observed through the implementation of the targets, as well as broader considerations that need to be better articulated as the global community accelerates its efforts to achieve effective conservation of the oceans.

Sperm whale off Kaikoura peninsula, New Zealand ©Imèn Meliane

Chapter 2
Benefits and Challenges of MPA Strategies

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Key Messages:

- Marine protected areas have been considered and promoted as an important and interactive tool to achieve effective ocean conservation, nested in a broader framework of integrated management.
- There are various management categories of MPAs ranging from strict protection to management for sustainable use, all have an important role, both in conservation and in maintaining critical ecosystem services.
- MPA benefits go beyond biodiveristy conservation, and contribute to social and economic aspects for local communities and economies.
- Stewardship of marine and coastal resources by indigenous peoples and local communities should be encouraged.

Context and Definitions

During the 1950s and early 1960s, as coastal and marine ecosystems became increasingly degraded by human activities and heavily exploited by fishing, the calls for management and protection of the marine environments and resources became more stressing. The international community started to develop a response to the need for effective conservation and management of coastal and marine systems. National and global policies were developed around concepts of integrated marine resources and environmental management, and were fostered by several international initiatives, including the United Nations Conference on the Human Environment, held in Stockholm in 1972 (United Nations 1972), the protracted negotiations leading to the United Nations Convention on the Law of the Sea (UNCLOS; United Nations 1982) and the creation of the UNEP Regional Seas Programme in 1972.

Marine protected areas (MPAs) have been considered and promoted as an important and interactive tool to achieve effective ocean conservation when nested in a broader framework of integrated management.

The World Conservation Strategy (IUCN, UNEP & WWF 1980) and Our Common Future (WCED 1987) have both highlighted the need for an integrated strategy for managing oceans and coasts. This comprehensive strategy was further enhanced when it adopted a policy statement (IUCN 1988) on the protection and conservation of the marine environment (IUCN GA resolution 17.38) that recognized the high degree of linkage between marine environments and their connection to terrestrial activities and called for an overall marine conservation strategy "to provide for the protection, restoration, wise use, understanding and enjoyment of the marine heritage of the world in perpetuity through the creation of a global representative system of marine protected areas and through the management, in accordance with the principles of the World Conservation Strategy, of human activities that use or affect the marine environment." IUCN specifically called for development of a national system of marine protected areas "as an integral component of marine conservation and management".

IUCN and its World Commission on Protected Areas have played a key role in providing guidance to foster initiatives in marine and coastal protection, conservation and management at government and agency levels and amongst non-government organizations and individuals. Particularly, various guidelines for the establishment and management of marine protected areas have been produced, the most used and cited being Kelleher and Kenchington (1992) and Kelleher (1999), which state that MPAs are essential tools for marine conservation. However, the seas will only be conserved effectively through integrated management regimes that deal with all the human activities that affect marine life, and that the establishment of an MPA should be integrated with other policies for use of land and sea.

In another important IUCN guide for MPA planning and management, Salm et al. (2000), clearly state that 'coastal ecosystems include both land and water components and that they should be managed together is considered fundamental'. And that 'the management of [MPAs] should be integrated with that of the larger, multiple use areas and regional initiatives whenever possible. Broad proactive programmes of management which seek to deal comprehensively with marine conservation are needed…[and] this can best be done by officially nesting the MPA into a coastal zone management jurisdiction with powers to control development impacts.'

Table 2.1: A Brief History of Marine Protected Areas (modified from: National Research Council 2001)

Year or Period	Activity or Event	Significance for MPAs
Historical and pre-history	The closing of fishing or crabbing areas by island communities for conservation for example, because the chief felt the area had been overfished or in order to preserve the area as a breeding ground for fish to supply the surrounding reefs	Established the concept of protecting areas critical to sustainable harvesting of marine organisms
1950s and 1960s	Decline in catch or effort ratios in various fisheries around the world	At the global level, the need to devise methods to manage and protect marine environments and resources became strongly apparent
1958	Four conventions, known as the Geneva Conventions on the Law of the Sea were adopted. These were the Convention on the Continental Shelf the Convention on the High Seas, the Convention on Fishing, and the Convention on Conservation of the Living Resources of the High Seas	Established an international framework for protection of living marine resources
1962	The First World Conference on National Parks considered the need for protection of coastal and marine areas	Development of the concept of protecting specific areas and habitats
1971	The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (known as the Ramsar Convention) was developed	Provided a specific basis for nations to establish MPAs to protect wetlands
1972	Convention for the Protection of the World Cultural and Natural Heritage (known as the World Heritage Convention) was developed	Provided a regime for protecting marine (and terrestrial) areas of global importance
1972	The Governing Council of the United Nations Environment Programme (UNEP) was given the task of ensuring that emerging environmental problems of wide international significance received appropriate and adequate consideration by governments. UNEP established the Regional Seas Programme. The first action plan under that program was adopted for the Mediterranean in 1975. The Caribbean Environment Programme action plan was adopted in 1981, and the Cartegena Convention was adopted in 1983, including the Protocol on Specially Protected Areas and Wildlife of the Wider Caribbean Region	Provided a framework and information base for considering marine environmental issues regionally. MPAs were one means of addressing some such issues
1973-1977	Third United Nations Conference of the Law of the Sea	Provided a legal basis upon which measures for the establishment of MPAs and the conservation of marine resources could be developed for areas beyond territorial seas

1975	The International Union for the Conservation of Nature and Natural Resources (IUCN, now the World Conservation Union) conducted a Conference on MPAs in Tokyo	The conference report called for the establishment of a well-monitored system of MPAs representative of the world's marine ecosystems
1982	The IUCN Commission on National Parks and Protected Areas organized a series of workshops on the creation and management of marine and coastal protected areas. These were held as part of the Third World Congress on National Parks in Bali, Indonesia	An important outcome of these workshops was publication by IUCN (1994) of *Marine and Coastal Protected Areas: A Guide for Planners and Managers*
1983	The United Nations Educational, Scientific, and Cultural Organization (UNESCO) organized the First World Biosphere Reserve Congress in Minsk, USSR	At that meeting it was recognized that an integrated, multiple-use MPA can conform to all of the scientific, administrative, and social principles that define a Biosphere Reserve under the UNESCO Man and the Biosphere Programme
1984	IUCN published *Marine and Coastal Protected Areas: A Guide for Planners and Managers*	These guidelines describe approaches for establishing and planning protected areas
1986-1990	IUCN's Commission on National Parks and Protected Areas (now World Commission on Protected Areas) created the position of vice chair, (marine), with the function of accelerating the establishment and effective management of a global system of MPAs	The world's seas were divided into 18 regions based mainly on biogeographic criteria, and by 1990, working groups were established in each region
1987-1988	The Fourth World Wilderness Congress passed a resolution that established a policy framework for marine conservation. A similar resolution was passed by the Seventeenth General Assembly of IUCN	These resolutions adopted a statement of a primary goal, defined "marine protected area," identified a series of specific objectives to be met in attaining the primary goal, and summarized the conditions necessary for that attainment
1992	United Nations Conference on Environment and Development, also known as the Earth Summit	Agenda 21 called on coastal states to maintain biological diversity and productivity of marine species and habitats under national jurisdiction through inter alia establishment and management of protected areas
1994	The United Nations Convention on the Law of the Sea (UNCLOS) and the Convention on Biological Diversity (CBD) came into force. UNCLOS defines the duties and rights of nations in relation to establishing exclusive economic zones measuring 200 nautical mile from baselines near their coasts. While facilitating the establishment and management of MPAs outside a country's territorial waters, UNCLOS does not allow interference with freedom of navigation of vessels from other countries	These two international conventions greatly increase both the obligations of nations to create MPAs in the cause of conservation of biological diversity and productivity and their rights to do so. It is notable that the United States has not ratified eighth Conference of Parties of the CBD has identified MPAs as an important mechanism for attaining the UNCLOS objectives and intends to address this matter explicitly in the next few years
1995	The Great Barrier Reef Marine Park Authority, the World Bank, and the IUCN published *A Global Representative System of Marine Protected Areas* (Kelleher et al. 1995)	This publication divided the world's 18 marine coastal regions into biogeographic zones, listed existing MPAs, and identified priorities for new ones in each region and coastal country
1999	IUCN published *Guidelines for Marine Protected Areas*	These updated guidelines describe the approaches that have been successful globally in establishing and managing MPAs
2002	World Summit on Sustainable Development Plan of implementation	Called for the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 as part of a suite of tools to promote the conservation and management of the oceans through actions at all levels
2004	CBD adopted the programme of work on protected areas (POWPA)	Objective of POWPA is the establishment and maintenance by 2010 for terrestrial and by 2012 for marine areas of comprehensive, effectively managed, and ecologically representative national and regional systems of protected areas that collectively, inter alia through a global network contribute to achieving the three objectives of the Convention and the 2010 target to significantly reduce the current rate of biodiversity loss;
2006	CBD adopts sub-targets and indicators for its strategic plans	"at least 10% of each of the world's marine and coastal ecological regions to be effectively conserved" by 2010

Following the WCED and other international initiatives, various countries started establishing and managing MPAs. The concept of what marine protected areas are defined as and what they can accomplish was further elaborated, often with varying interpretations.

Many nations have established marine protected areas; however, these differ considerably in their extent and objectives. At one extreme, MPAs could be used in a relatively small area for strict protection of biological diversity, nature-based recreation, and tourism. At the other they may be the basis of comprehensive ecosystem-scale approaches to planning and management for conservation, sustainability of multiple human uses, and impacts on biological diversity and ecosystem processes. In general, the relative roles of MPAs and other marine management measures are not clearly defined. A World Bank (2006, Table 2.2) report listed 32 acronyms for marine management tools and developed a typology based on objectives and extent of environmental protection. That list is not exhaustive, but it reflects the social and political challenge of integrating competing sectoral approaches and interpretations for particular situations.

Dudley (2008) describes the evolution of protected areas categories, some of which are presented in Table 2.2. As protected areas in the modern sense were set up in one country after another during the twentieth century, each nation developed its own approach to their management; therefore there were initially no common standards or terminology. One result of that lack of common vocabulary is that many different terms are used at the national level to describe protected areas and a large variety of international protected area

systems created under global conventions (e.g., World Heritage sites) and regional agreements (e.g., Natura 2000 sites in Europe). The first effort to clarify terminology was made in 1933, at the International Conference for the Protection of Fauna and Flora, in London. This set out four protected area categories. In 1942, the Western Hemisphere Convention on Nature Protection and Wildlife Preservation also incorporated four types, or categories, of protection (Holdgate 1999). In 1962, IUCN's newly formed Commission on National Parks and Protected Areas (CNPPA), now the World Commission on Protected Areas (WCPA), prepared a *World List of Guidelines for applying protected area management categories in National Parks and Equivalent Reserves*, for the First World Conference on National Parks in Seattle, with a paper on nomenclature by C. Frank Brockman (1962). In 1966, IUCN produced a second version of what became a regular publication now known as the *UN List of Protected Areas*, using a simple classification system: *national parks*, *scientific reserves* and *natural monuments*.

Finally, by 1972, the Second World Parks Conference called on IUCN to "*define the various purposes for which protected areas are set aside; and develop suitable standards and nomenclature for such areas*" (Elliott 1974). However, these categories soon proved to be inadequate and the IUCN Congress developed standards and nomenclature that was more comprehensive. In January 1994, the IUCN General Assembly meeting in Buenos Aires approved the new system. Guidelines were published by IUCN and the World Conservation Monitoring Centre later that year (IUCN 1994). These set out a definition of a "protected area" – *An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means* – and six categories which protected areas could be classified into. At the Durban Worlds Parks Congress (2003) and the Bangkok World Conservation Congress (2004), proposals were made to add a governance dimension to these categories.

Management Regimes

One of the primary challenges of effective MPAs is managing them well in the midst of multiple uses and stakeholders. MPAs often have complex governance systems. They can be managed by the state, trusts, indigenous peoples, local communities, companies and private individuals and various combinations thereof. Due to the fact that the marine environment is used by many groups and fall under the jurisdiction, stewardship and interests of a large and diverse set of stakeholders, the management of a single marine space within competing agencies can be a herculean task. Therefore, effective MPAs and MPA Networks require collaboration and the resolution of multiple overlapping needs.

In many cases, there needs to be strong inter-governmental coordination to ensure that the appropriate management is carried out or the responsibility of all activities within the MPA can be designated to a single government department. In addition, whether government departments are coordinated in their efforts or not, local and regional stakeholders are often the ones on the ground who are best equipped to oversee and manage the MPA (See Chapter 4 for examples). Their adherence to MPA regulations has been found to be more aligned with management intents if they have been involved in MPA creation and they understand the rationale for the measures being enacted (Christie & White 2007). On-the-ground stakeholders are often most impacted by protected areas due to the displacement of their fisheries efforts, so they need to understand the benefits of the MPA if they are going to adhere to their restrictions. It has been found that management measures that include both 'bottom up' (community-based) and 'top down' (legislative) approaches, or a combination that ensure co-management, are most effective in ensuring the conservation objectives of protected areas are met.

Marino Bellana National Park, Coast Rica© Link Roberts

Table 2.2: A range of 'MPA' types and their attributes (Reproduced from World Bank 2006, with permission)

Increasing ecological protection → Increasing managed use and social protection

Country Profiles	Marine Protected Area Tools: Primarily for Biodiversity Conservation and Habitat Protection	Multiuse Marine Management Tools: Primarily for Balanced Conservation and Socioeconomic Uses	Sustainable Use Marine Resource Management Tools: Primary for Extractive Use	Culture-Ecological/ Social Protection Reserves: Primarily for Indigenous and Traditional Non-indigenous Communities
Philippines	• Community-based MPA • No-take Marine Reserve • MPA Network • National Marine Park • World Heritage Site • Ramsar Site	• Integrated Coastal Management • Multiuse MPA	• Fishery Management Reserve • Ecosystem-based Fishery Reserve • Locally Managed Marine Area	
Chile	• National Marine Park • Marine Sanctuary • Regional Seas MPA Network • Community-based MPA • Ramsar Site	• Large Marine Ecosystem • Multiuse MPA	• Extractive Reserve (Management and Exploitation Area for Benthic Resources) • Fishery Management Reserve	
Brazil	• National Marine Park • Ramsar Site	• Integrated Coastal Management • Multiuse MPA (Environmental Protection Areas)	• Sustainable Development (Sustainable Development Reserve)	• Culture-ecological Reserve Traditional (Non-indigenous) Communities (Marine Extractive Reserves) • Marine Sacred Sites • Culture-ecological Indigenous Peoples Territory
Tanzania	• MPA • Ramsar Site	• Integrated Coastal Management • Multiuse MPA • Community-based MPA • MPA Network	• Collaborative Management Area	
Australia	• National Marine Park • Ecosystem-based Reserve • MPA Network • No-take Marine Reserve • Ramsar Site	• Integrated Coastal Management • Treaty-based MPA • World Heritage Site • Biosphere Reserve	• Fishery Management Reserve	• Culture-ecological Indigenous Peoples Territory • Customary Marine Tenure-based MPA • Indigenous MPA • Indigenous Landscape Management Area • Marine Sacred Sites
Solomon Islands	• MPA • World Heritage Site	• Integrated Coastal Management • Treaty-based MPA • Large Marine Ecosystem	• Wildlife Management Area MPA • Fishery Management Reserve	• Customary Marine Tenure-based MPA • Marine Sacred Sites
Papua New Guinea	• MPA	• Integrated Coastal Management • Treaty-based MPA	• Wildlife Management Area MPA • Fishery Management Reserve	• Customary Marine Tenure-based MPA • Marine Sacred Sites

Examples of successful management categories

Multiple types of management categories and regimes exist for ocean protection. Within the context of MPAs, Christie and White (2006) described distinct management categories that have all shown some success: Bottom-Up categories of MPAs can often represent community-based MPAs, which are designed to meet both artisanal fishery management and biodiversity conservation goals. This type of MPA has been most commonly implemented in the tropics, although attempts are underway in developed country contexts; Centralized Management often involves large-scale, centrally-planned MPAs who require strong institutions, considerable financial resources to implement and, as such, are likely most appropriate for developed country contexts. Governance mechanisms which ensure meaningful consultation with the public about design and management are possible and essential to success. Finally, co-management categories, such as traditional MPA systems as found in the West Pacific and various private reserves, is a compromise between bottom-up (led by resource users in the strict sense) and centralized management, potentially represents the best of both models—engaging resource users and government officials in an equitable and transparent planning process that is formally recognized and sanctioned (Christie & White 2006).

Regardless of the category, when using MPAs, a more complete

Grunts Schooling - Elkhorn coral and grunts, Ambergris Caye, Belize © Mito Paz

management system should be in place to give that MPA the best opportunity for success. In this context, there are three main elements of management specifically relevant to MPAs:

- Include 'no-take areas', where no fishing or collecting of marine products is allowed. This is consistent with IUCN Category I and Category II except to the extent that category II may permit recreational fishing;
- Ensure habitat protection is paramount - where benthos damaging activities, including trawling and dredging, are not allowed. This is consistent with the definition of IUCN Category IV except to the extent that Category IV is defined as applying to small areas; and
- Create an overarching regime that provides for verifiably sustainable human use and impacts consistent with conservation in the sense of maintaining biological diversity and ecosystem processes. This is consistent with IUCN category VI with inclusions of no-take and habitat protection areas but generally more likely to be achieved through multi-objective planning and management regimes. (Kenchington 2010).

A deeper look at 'bottom up' categories: LMMAs

Many types of management exist and often involve multiple categories described above. For example, traditional systems were generally not applied with biodiversity conservation in mind, but were instead aimed to benefit communities. For example, in Hawaii, kapu areas, or fishery closures, were often put in place to ensure catches for special events or as a cache for when resources on the regular fishing grounds ran low. Thus, while the primary aim of these traditional management practices was to benefit communities, they have in most cases been successful in also delivering fisheries and biodiversity outcomes (Vierros et al. in press).

During the last decade, there has been a revitalization of traditional management systems and traditional tenure (Govan et al. 2009; Ruddle & Hickey 2008; Vierrros et al. in press). These revitalized customary practices have changed through the years in response to societal and economic changes (Johannes and Hickey 2004). One aspect of this has been the proliferation of community-based marine managed areas. An example is provided by Locally Managed Marine Areas (LMMAs) which constitute areas of nearshore waters actively being managed by local communities or resource-owning groups, or being collaboratively managed by resident communities with local government and/or partner organizations. An LMMA differs from what is commonly known as a Marine Protected Area (MPA) in that LMMAs are characterized by local ownership and/or control, whereas MPAs are typically designated by local or national governments, often via a top-down approach. Marine managed areas in the Pacific Islands region mainly correspond to IUCN management categories V ("The preservation of longterm and sustainable local fishing practices or sustainable coral reef harvesting") and VI ("predominantly natural habitats but allow the sustainable collection of particular elements, such as particular food species or small amounts of coral or shells"). One or more MPAs or other management techniques or "tools", including commonly a variety of fisheries management tools (such as no-take areas, seasonal harvest and rotational harvest areas, species-specific harvest refugia, and restriction of fishing or harvesting effort) may be employed within an LMMA. In using an LMMA approach, some coastal communities are reviving methods that have been used traditionally as part of their culture for many generations. Others are using a combination of local knowledge and western science (LMMA network 2010).

Recently, many community-based resource management practices haves been strengthened by their incorporation into national law, and into national strategies for biodiversity conservation and natural resources management. For example, Papua New Guinea, Vanuatu, Fiji and Samoa acknowledge the value of community law in their national legislation and have recently made progress in forming partnerships between communities and national agencies for conservation. However, the integration of traditional practice and national law are not always without challenges, as demonstrated by a recent study on the synergies and discord between national laws and community management rules in Kubulau District, Fiji (Clarke and Jupiter 2010).

MPAs and fisheries management

In recent years, MPAs are increasingly being considered as an important tool for achieving effective fisheries management. Marine conservationists and fisheries managers have begun to re-assess the exclusive value of conventional management measures, such as gear regulations and catch quota adjustments for sustaining fish stocks (Carr & Raimondi 1999), and to add effectively designed and managed MPAs as a tool within an integrated and ecosystem-based approach to both marine conservation and fisheries management (Willis et al. 2003) and that they have positive effects for fisheries (Russ et al. 2004; Halpern 2003; McClanahan & Mangi 2000).

Privately managed areas

Marine conservation agreements (MCAs) are increasingly being recognized and used by NGOs, governments, and conservation-minded businesses as adaptive mechanisms to meet ocean and coastal protection needs. They can serve to formally recognize and potentially shift governance arrangements over ocean and coastal resources. MCAs include any formal or informal contract in which one or more parties commit to delivering explicit economic incentives in exchange for one or more other parties committing to take certain actions, refrain from certain actions, or transfer certain rights and responsibilities to achieve agreed-upon ocean or coastal conservation goals.

Benefits of MPAs

MPAs provide a range of benefits for fisheries, local economies and the marine environment including:

- Conservation of biodiversity and ecosystems;
- Halting and possibly reversing the global and local decline in fish populations and productivity by protecting critical breeding, nursery and feeding habits;
- Raising the profile of an area for marine tourism and broadening local economic options;
- Providing opportunities for education, training, heritage and culture; and
- Providing broad benefits as sites for reference in longterm research.

Properly designed and managed MPAs play important roles in:

- Conserving representative samples of biological diversity and associated ecosystems;
- Protecting critical sites for reproduction and growth of species;
- Protecting sites with minimal direct human impact to help them recover from other stresses such as increased ocean temperature;
- Protecting settlement and growth areas for marine species so as to provide spill-over addition in adjacent areas;
- Providing focal points for education about marine ecosystems and human interactions with them;
- Providing sites for nature-based recreation and tourism; and
- Providing undisturbed control or reference sites serving as a baseline for scientific research and for design and evaluation of management of other areas.

Potou Locally Managed Marine Area (LMMA), Kimbe Bay, West New Britain province, Papua New Guinea. © Mark Godfrey, TNC

Fisheries benefits (including spillover)

Traditionally MPAs and no-take reserves (including specific fisheries management measures such as closures and catch restrictions) have benefited fisheries through stock enhancement and management. Protection of habitat is important to key life cycle stages including spawning, juvenile settlement, nursery grounds and major feeding grounds. Strategically located protected areas provide sites for settlement and early growth of juveniles which when mature, spill over into adjacent fished areas.

Natural refuges in the ocean have long provided an *in situ* reservoir of genetic material. These natural refuges were once areas that were too remote or too difficult to fish, but they are now being rapidly lost with advances in fishing techniques. MPAs are generally considered to provide four basic benefits to fisheries (see Commonwealth of Australia 2003 for further details):

- Protection of specific life stages (such as nursery grounds);
- Protection of critical functions (feeding grounds, spawning grounds);
  - — provision of spillover of an exploited species; and
  - — provision of dispersion centres for supply of larvae to a fishery.
- Improved socio-economic outcomes for local communities;
- Support for fishery stability; and
- Ecological offsets
  - — trade-off for ecosystem impacts; and
  - — better understanding of impacts and options.

Although expected to increase fish biomass inside of reserves, MPAs are also expected to contribute to fisheries outside of their boundaries as a result of recruitment of exported eggs and larvae and from spillover of adults to adjacent fishing grounds. Measuring recruitment of fin fish is challenging. As a result, protection-driven enhanced recruitment has been demonstrated mainly in molluscs (e.g. Queen conch in the Bahamas, Stoner & Ray 1996; scallops in Georges Bank, Murawski et al. 2001; clams in Fiji, Tawake et al. 2001; and scallops and murex in the Gulf of California, Cudney-Bueno et al. 2009).

Evidence is also mounting quickly for the existence of density-dependent spillover of organisms beyond reserve boundaries. After MPA implementation, the catch per unit effort (CPUE) of some exploited species becomes higher just outside reserve boundaries (e.g, Murawski et al. 2005, Russ et al. 2004, Abesamis et al. 2006, Goñi et al. 2008, Stobart et al. 2009), causing fishers to 'fish the line' and potentially reduce the spatial scale of this benefit. However, net movement of organisms out of reserves is highly variable among species and may be linked to habitat topography and connectivity (e.g. Tupper 2007, Forcada et al. 2009).

The biodiversity benefits of MPAs are not usually immediate but they increase over time (e.g. Claudet et al. 2008). Molloy et al. (2009) found that while some MPAs boasted higher fish densities within 5 years of implementation, all MPAs did so after 15 years of protection. Most importantly, early performance (as measured by relative fish density) did not predict later performance.

Tourism benefits

The establishment of a marine protected area is an excellent way to raise the profile of an area for marine tourism and to broaden the local economic options. The global tourism industry has grown into a major economic driver for many developing and developed countries. For many island states and developing countries, tourism is the primary contributor to GDP and provider of employment (Burke et al. 2000), the source of foreign exchange for some 83 developing countries, and the primary export for one-third of the poorest countries (Mastny 2001).

Table 2.3: Summary of results of meta-analyses of ecological effectiveness of MPAs (findings for inside reserves)

Indicator	Main findings	Region	# of MPAs	Source
Biomass Density Size Richness	446% increase 166% increase 28% increase 21% increase	Global (for fish, invertebrates, algae)	124	Lester et al. 2009
Fish density	1.66 x higher	Global	33	Molloy et al. 2009
Density Biomass Species richness	1.4-1.92 x higher 0.107-3.67 x higher 1.27-1.68 x times higher	Global, temperate only (for fish, invertebrates, algae)	30	Stewart et al. 2009
Biomass Density Size Richness	352% increase 151% increase 29% increase 25% increase	Global (for fish, invertebrates, algae)	81	Halpern 2003
Fish density Species richness	1.25-3.7 x higher 1.11 x higher	Global	19	Mosqueira et al. 2000/ Côté et al. 2001
Fish density Biomass	1.2 x higher 2.1x greater	Mediterranean	12	Guidetti & Sala 2007
Fish density Species richness	2.46 x higher No effect	Mediterranean	12	Claudet et al. 2008
Fish density	1.64 x higher (2.5 x for exploited species)	Philippines	19	Maliao et al. 2009b

Tourism boats in the Galapagos Marine Reserve, Ecuador. © Imèn Meliane

While the numbers of tourists who visit coastal areas are not specifically reported, the lure of "sun, sand and sea" attracts a large number of travelers, bringing an estimated $19.9 billion in visitor expenditures to the Caribbean in 2004 (CTO 2004) and making up 85% of national tourism revenues in the US (Leeworthy 2000). The growth of ecotourism and nature tourism outpaced the overall tourism industry in 2004 (UNWTO 2004), with most new tourism markets developing near natural areas (Christ 2005). Coastal and marine areas that are healthy and intact can bring in more tourism revenue than those areas that are degraded. Marine protected areas can help contribute to local incomes directly by ensuring tourism areas remain desirable and intact. However, there is also the need to carefully manage and minimize negative impacts of tourism on coastal habitats, such as damage from careless snorkelers and pollution from coastal development.

Marine and coastal biodiversity may not always be the specific draw to a visit to the coast; however, the quality of the natural systems enhances the overall experience (Brander et al. 2006), and users are often willing to pay more for their maintenance and preservation. Such user fees can help fund MPA management efforts, ensuring financial sustainability of the MPA. Access fees generated through nature-based activities (e.g. diving, snorkeling, recreational fishing, birdwatching, and whale watching) can also offset MPA costs.

Sustainable tourism development has been recognized as a means to meet Millennium Development Goals, as it provides a host of employment opportunities, especially for women, young people and indigenous communities (UNWTO 2005). Tourism in MPAs can benefit coastal communities through income and employment, infrastructure, and alternative livelihoods that offset lost income from fisheries closures. Some communities opt to save a portion of funds for projects benefiting its members, such as health initiatives, education or sanitation, as found in an analysis of four Pacific Island MPAs (Leisher et al. 2007). These sites also indicated an improvement in community relations through management of the MPA.

Spiritual, cultural, historical and aesthetic values

Ecosystem services, those benefits humans receive from natural systems, are not only utilitarian, they also embody issues of cultural, spiritual or aesthetic values that are impossible to measure in economic terms but have immense value in other terms (Fiske 1992). Sacred natural sites are places that have high value for one or more faith groups and include many marine areas such as sacred coves, islands and designated coastal waters. Such areas, being carefully conserved by local communities, have often been incorporated into MPAs; in some cases faith groups are actively seeking to have their sites incorporated into MPAs in order to ensure their protection.

- **Tanzania – local population defending a sacred place for Islam**: The island of Zanzibar is predominantly Muslim and many people there believe that Misali Island Marine Conservation Area, an MPA, is a holy place because it points towards Mecca. In 1999, CARE International invited the Islamic Foundation for Ecology and Environmental Sciences to help use Islamic principles to promote the management of the MPA. A management plan was developed based on ethical principles laid down by the religion. A guide book for religious leaders, schools, and *madrasa* was prepared and translated into Swahili, with the result that the majority of fishermen now support the MPA (Higgins-Zogib 2006).

- **Bijagos islands /Guinea Bissau – local culture preserving dozens of islands**: The Bijagos archipelago in the south western part of Guinea Bissau covers more than 80 islands and islets of which half are not inhabited. A large part of these islands are sacred natural sites which play a crucial role in the traditional Bijagos culture. Local management rules and practices have largely contributed to preserving those sites from exploitation and even access. Traditional sacred sites have been integrated in the management planning in the Bolama-Bijagos biosphere reserve and have been also formally recognized as parts of the core zones in the three existing MPAs.

Arranmore Island Lighthouse off the Donegal coast during the recent storms. © John Rafferty

Disaster mitigation benefits

Natural ecosystems within MPAs can play an important role in protecting coastal human communities against extreme events, such as typhoons and tsunamis, as well as regular erosion, all of which are predicted to increase as a result of climate change. Coasts are buffered by coral reefs, seagrass beds, mangroves and coastal wetlands: alteration and loss of natural wetlands was identified as one of the key reasons why Hurricane Katrina was so devastating to New Orleans in 2005 (Freudenberg et al. 2009). MPAs can provide an effective management framework to protect or, if necessary, restore such natural buffers. For example:

- **Jamaica – protection**: The Black River Lower Morass is the largest freshwater wetland in Jamaica. The Morass lies on the coastal floodplain and protects the lower reaches of the Black River, Jamaica's largest river. The marsh acts as a natural buffer, both against flood waters from the rivers and against incursions by the sea and is an important economic resource for some 20,000 people (Garrick 1986).

- **Vietnam – restoration**: Since 1994 local communities have been planting and protecting mangrove forests in northern parts of the country as a way of buffering against storms. An initial investment of US$1.1 million saved an estimated US$7.3 million a year in sea dyke maintenance. During typhoon Wukong (2000) the project areas remained relatively unharmed while neighbouring provinces suffered significant losses of life and property (Brown et al. 2006).

- **Bangladesh and India – need for further protection**: The mangrove forests of the Sundarbans support vital ecosystem services supplied by the Sundari trees (*Heritiera fomes*) that grow in brackish coastal regions. In the world's most flood-prone countries the roots stabilise coasts, break up storm waves and buffer inland areas from cyclones and flooding (Mascarenhas 2004), although currently only 15% are protected and the area is under severe threat.

Education and research benefits

Marine protected areas are particularly important to the local community because they provide opportunities for people to experience and study marine plants and animals that are undisturbed by fishing and other impacts; therefore they can become places where people can observe and compare with the impacts from disturbance. Education centres and their staff based in and around MPAs have an important role in helping children and students learn about marine animals and their habitats. As children learn and then take that knowledge to their families and the wider community, they play a significant role in developing community understanding and demand for sustainable management of their marine environments. Repeated field surveys by student classes over many years can provide good information about long-term change that cannot be obtained in any other way. Participants in these activities are also more likely in later years to be informed contributors to future decisions about marine environments and resources.

A further important educational role of MPAs is in the training of resource management staff. Typically most staff come from backgrounds with little exposure to the nature and values of marine plants, animals and ecological processes. Courses at MPA field stations can provide a valuable introduction and contribute to the understanding of these values (Commonwealth of Australia 2003).

Creating stewardship for ocean awareness and protection

MPAs also serve a purpose that is more difficult to define. It is a combination of the all tangible benefits described above, but also of that intangible effect of awareness. When people are exposed to a healthy marine system, there is often a sense of stewardship that develops. This sense often can lead to protection from individuals that can come in many forms such as cleaning up litter off of beaches, talking to friends and family members about the value of such areas, and a newfound respect for the species found within the site. Such sites are also important for developing local understanding of rights and responsibilities in using and caring for marine environments.

Another role MPAs can have is as a framework for Peace Parks. Transboundary MPAs are particularly important in areas where a single marine ecological unit is shared by the jurisdictions of two or more countries. Where there is a history of rivalry or conflict between adjacent nations, the conservation of a shared resource can be an important step in building mutual understanding and cooperation.

Costs of MPAs

Although MPAs are an integral tool for protecting coastal and marine areas, there are limitations that do exist. The costs of MPA implementation, maintenance and adaptive management can be high and are not often incorporated accurately, if at all, when proposing or designating an area of protection. One of the limitations in accurately accounting for MPA cost is the limited data available on MPA and MPA network creation and management costs. Gravestock (2002) examined the annual costs for running individual MPAs, which ranged from USD$9,000-6 Million to meet minimum management objectives. Balmford et al. (2004) estimated that the cost for a global MPA network that met a 20-30% protection goal would be USD$ 5-19 billion. However, such a network would likely create around one million jobs and cost less than current fishing subsidies.

In addition to monetary considerations, there are often costs to livelihoods and impacts on local communities and other interests such as tourism or commercial fishing (IUCN-WCPA 2008). Restrictions of certain activities can result in changes in participation and loss of access and/or income (Scholz et al. 2004; IUCN-WCPA 2008), requiring former participants to seek alternatives. However, in some cases, ventures encouraging alternative livelihoods may be impractical or unavailable. Although many success stories exist of, for example, fishers becoming tourism operators, that is not always an option. Not including these costs in the design process can be detrimental to the success of the MPA.

Because of these financial and societal considerations, MPA establishment and, more importantly effective long term management, involve a series of trade-offs that must be balanced to meet goals. The initial capital costs for research, consultation, planning and establishment should also provide a robust long term foundation for the harder decadal task of funding recurrent costs of the institutional capacity for maintenance, enforcement, oversight, monitoring and robust review that are a perpetual necessity for effective management. In many cases, the costs of MPAs can be reduced by incorporating single MPAs into networks (Jones 2006; Laffoley et al. 2008), or incorporating the management of MPAs into a more cohesive framework (e.g. Zoning, Integrated Coastal Management, Ecosystem-Based Management).

Complementarities with Other Management Tools

As discussed earlier, since the first calls for establishing MPA networks, there was a clear recognition that they are to be considered within a broader framework of ocean management and hence act in synergy with other conservation and management tools. Internationally, the earliest marine agreements targeted conservation of marine living resources and the management of fisheries (starting in the North Atlantic) and sources of marine pollution (from ships, at-sea disposal of wastes, offshore minerals development, and pollution borne to the sea by rivers and air or from estuaries, coastal development, pipelines, and other land-based sources).

Fisherman landing Pacific angelshark in Puerto Lopez, Ecuador © Imèn Meliane

Tuna boat fleet - Each boat is equipped with a host of high tech equipment including a helicopter used to spot schools of tuna. Pago Pago Bay, Tutuilla - American Samoa © Wolcott Henry

The decades of the seventies, eighties, and nineties have revealed new ocean threats and increasingly complex problems. In the fishing sector, national measures to conserve domestic stocks have been inadequate and major international fisheries are seriously overfished. The growing array and intensity of threats to the ocean extend well beyond sea-based activities. There was an increasing recognition that human activities on land, in the large drainage basins of major river systems and the many sources of airborne pollutants are amongst the predominant source of ocean stress. Additionally, scientific research and technological innovations have spurred mineral extraction further and further offshore. The worldwide movement of ships, fueled by a globalized world economy introduces non-indigenous species to new areas where they establish and become invasive, undermining ecosystem stability and established human uses.

The increased scientific understanding of ocean threats illustrates how isolated impacts from individual sectors concentrate, go beyond enclosed areas and seas and interact synergistically, impacting not only the local species and human communities that are dependent on marine and coastal ecosystems, but increasingly the larger natural systems and human societies of which they form a part.

This led to an evolution of ocean management from a single sector approach to a growing recognition for the need to move towards an ecosystem-based management approach that addresses the consecutiveness of the ecosystem and the cumulative impacts of human uses.

Spatial in nature, marine protected areas have been a laboratory of designing effective management systems that takes into account divisions and overlaps in the biological and ecological features of the ecosystem. The design and management of MPAs has involved the use of various ocean management tools, such as fisheries management, impact assessments, zoning and spatial planning. Implementation provided important lessons learned with regards to schemes of governance arrangements and jurisdictional status of marine areas resources as well as a range of socioeconomic tools.

The scope of the six IUCN categories of protected areas provides a framework for ecosystem-based management (Kenchington 2010). They overlap substantially with the principles elaborated in the voluntary FAO Code of Conduct for Responsible Fisheries and the ecosystem-approach to fisheries. MPAs have consistently been identified for their important role in supporting fisheries to become both ecologically and economically sustainable. Although the primary focus of the MPAs is conservation and sustainable use (often of fishery target species), they also address species belonging to the same ecosystem as or dependent upon target species (FAO principle 6.2). They also assign priority to research and data collection in order to improve scientific and technical knowledge of fisheries, including their interaction with the ecosystem (principle 6.4). Despite more than a decade of this overlap the relationships of biodiversity and fishery management and the roles of MPAs remain matters of continuing sectoral contention.

MPAs: From the Concept to the Target

This chapter provided an overview of the history of MPAs and some of their benefits. The body of evidence documenting the benefits of well designed and effectively managed MPAs clearly shows that MPAs are a vital instrument to contribute to ocean conservation.

However, it is interesting to pause and reflect about the evolution of various international calls and initiatives with regards of MPAs. Though MPAs have been suggested as an integral part of an overall strategy for ocean management, over the last few years we observe a tendency to use them as a strategy to achieve ecosystem-based management.

Realistically, MPAs are one of the most pragmatic elements of ocean management that countries can establish, and further efforts should be made to increase their number and improve their management. However it is important to remember the context in which they operate. Halpern et al. (2010) have undertaken a global analysis of where and how much marine protected areas and no-take marine reserves can be expected to contribute to ecosystem-based management goals, specifically by reducing the cumulative impacts of stressors on ocean ecosystems. While they revealed large stretches of coastal oceans where reserves can play a major role in improving overall ocean condition, they also highlighted important limitations of marine protected areas as a single tool to achieve comprehensive ecosystem-based management.

The World Summit on Sustainable Development called for improving ocean conservation and management, and has highlighted MPAs along with a series of other tools (paragraph 32 (c)). While the CBD endorsed the WSSD goal and approach, it particularly focused on the notion of MPA networks, further focusing on a specific target for MPA coverage. The notion of integration in an ecosystem-based management, and the application of the other management tools, particularly the “proper coastal land use and watershed planning and the integration of marine and coastal areas management into key sectors” have received less attention in international efforts.

Chapter 3 and 6 will further elaborate on this trend, by respectively providing an analysis of the global MPA coverage and new efforts to establish MPAs across the globe, and by outlining the efforts needed to increase the effectiveness of marine protected areas and embed them and other conservation tools within development planning in larger seascape.

Small-scale fishers on the coral reef surrounding Siquijor island, Philippines. © Rebecca Weeks

Rock island, Palau © Imèn Meliane

Chapter 3
The 10% Target: Where Do We stand?

Lead Authors: Mark Spalding, Louisa Wood, Claire Fitzgerald and Kristina Gjerde

Key Messages:

- Current MPAs number 5878 and cover over 4.2 million km^2 of ocean (1.17% of the global ocean surface).
- MPA coverage of continental shelf areas is now 4.32%, and 2.86% of waters within 200nm of coastlines.
- A few large MPAs have accounted for the greatest increase in coverage over the last 5 years.
- Only 12 out of 190 states and territories with marine jurisdictions have an MPA coverage of 10% or more in the areas under their jurisdiction.

Introduction

In 2004, when the Contracting Parties to the Convention on Biological Diversity (CBD) set the first targets for protected areas, about 11.5% of the world's terrestrial surface was already covered, while marine protected areas (MPAs) extended over only 0.5% of the ocean surface (Chape et al. 2003). The challenge for marine conservation was immense. Initial goals were for the establishment of "systems" of MPAs that would be "comprehensive, effectively managed and ecologically representative" (Convention on Biological Diversity 2004). These three elements were forefront in a tighter specification of targets in 2006 which called for "at least 10% of each of the world's marine and coastal ecological regions effectively conserved" (Convention on Biological Diversity 2006)[1]. This paper explores progress that MPAs provide towards the 10% target and the patterns and trends which are taking marine protection forward.

Two earlier publications have provided valuable interpretations of progress towards these targets. Both showed a significant shortfall. Wood et al (2008) provided projections of observed growth in marine protection over time, which suggested that targets would not be reached for several decades. They also found little evidence of any "network" in the sense of "systems" of protection, or connectivity that might form part of effective conservation. This work also explored coverage of several better-known habitats, and found that three tropical coastal systems – coral reefs, mangrove forests and seagrasses – had levels of protection well above global averages, while others such as seamounts were under-represented. Spalding et al (2008) explored in more detail the biogeographic representation of the continental shelf area [2], and found considerable variation across a range of spatial scales from realm to ecoregion, with temperate systems showing particularly low coverage. They also showed relatively high levels of MPA coverage (although still with considerable regional variation) in a 2km coastal belt (spanning 1km seaward and landward of the coastline), demonstrating the strong focus of attention on intertidal areas, many of which form the only "marine" components of terrestrial protected areas.

This chapter updates and expands upon these studies – using the same underlying data sources and methodologies as the previous studies, but with two additional years of data. We examine the global MPA coverage in mid 2010, looking both at the jurisdictional and the biogeographic coverage, including, for the first time, an assessment of the biogeographic coverage of off-shelf waters.

1 The 10% target is not strictly about MPAs, as "effective conservation" was more broadly defined to include "other means of [area based] protection, for which management plans exist" (Convention on Biological Diversity, 2005). This broader interpretation was originally intended to acknowledge the contribution of other management measures (such as well-functioning integrated marine and coastal area management regimes, fisheries management areas and control of land-based sources of pollution), however there are concerns that this would also mean that Parties have only agreed to effectively manage 10% of the oceans, which is inconsistent with the obligations that States have with regards to the marine environment under UNCLOS and other treaties.
A further degree of ambiguity exists over the deadline: the CBD Programme of Work on Protected Areas (POWPA) continues to talk about a 2012 date for marine protection targets (Convention on Biological Diversity 2009) even though the 2006 decision mentions only 2010. This slightly later date was proposed in 2004 in recognition of the considerable lag in MPA coverage, and matches the target set by the WSSD.
Regardless of these various interpretations, CBD Parties have clearly agreed that protected areas coverage is a relevant indicator for assessing progress towards achieving effective conservation; and most of the CBD deliberations with respect to these targets have remained focused on MPAs; and MPAs remain one of the only extensively tools being used directly for conservation purposes. Following the adoption of the 10% target, a number of countries have, in fact, set percentage-based MPA targets.

2 defined as areas where the seabed is less than 200m deep, with the inclusion of a 5km buffer beyond these to capture errors in bathymetric resolution and to allow for inclusion of more mobile or wide ranging shelf-related fauna

Coral reef of Restoff Island, an MPA in Kimbe Bay west New Britain Papua New Guinea © Mark Godfrey

Methods

The analytical work in this study is conceptually simple, an overlay of multiple spatial datasets using Geographical Information Systems (GIS). The very large and complex nature of a number of these datasets means that such work can still be very challenging. The primary database used in this work is the World Database on Protected Areas (WDPA, www.wdpa.org)[3] . This database has been fully updated and harmonised with MPA Global (Wood et al. 2008), and provides the most comprehensive global source on MPAs world-wide. Although regularly updated, the process of data verification and licensing can take time. As such, there are often lags between new MPAs being designated and the data being incorporated into the WDPA, however, the WDPA is currently being redeveloped to facilitate and accelerate data provision to and reconciliation of datasets (www.protectedplanet.net). For the current work we added a small number of additional datasets that are not yet formally incorporated into WDPA, but soon will be. As with the previous works we also performed a rapid review of the sites listed as marine in the database, and a) added sites that were clearly marine but not listed as such, and b) removed sites that were either not marine, or were considered not to fully meet the definition of an IUCN protected area (see box).

The final MPA dataset consisted of some 5878 sites, over 800 more than the next most recent review (Spalding et al. 2008). Of these sites, polygon boundary information is held for some 5462 sites (92% of sites). This represents a substantial increase in the availability of spatial boundary data from earlier studies, and, given that these sites include most of the largest MPAs, it is representative of an even larger proportion of total global MPA area. For the remaining sites, central co-ordinates and known total area were used to develop an approximate spatial representation of each site as a buffered circle of the total recorded area.

Many MPA boundaries also include terrestrial area, which needed to be excluded in order to calculate marine areal coverage. This exclusion of terrestrial area was done using a standardized global coastline, the World Vector Shoreline (USDMA not dated), at 1:250,000 resolution. For the jurisdictional analysis, we used a map of what might best be termed potential national marine jurisdictions, which approximate the geographical space that has been or could be claimed under UN Convention on the Law of the Sea, including Territorial Waters, Exclusive Economic Zones (EEZ), or their equivalents[4]. Such boundaries are approximations based on the VLIZ Maritime Boundaries Database (Flanders Marine Institute 2009), and are used to generate indicative statistics only. They do not imply any opinion whatsoever concerning the legal status of any country, territory or area, or concerning the delimitation of its frontiers or boundaries.

MPAs – Definitions and Exclusions

The present work focuses only on MPAs as defined by IUCN (Dudley 2008). These lie at the heart of conservation efforts in almost all countries, and are spatially the most widely used conservation tool in terms of geographic extent and conservation impact. They are also the only conservation measure for which global, consistent data are available (see discussion). Although data on some other conservation measures, such as fisheries regulations, are held for a few locations in the WDPA, this is not globally complete and such sites were excluded to ensure we used a consistent dataset. As with the previous studies we did not include internationally inscribed / approved sites (e.g. World Heritage, Ramsar and UNESCO-MAB Biosphere Reserves), because such sites are typically also designated nationally through statutory or non-statutory means, and where such sites lie outside of national designations, there are often few legal protections.

For the biogeographic boundaries we utilised three main data layers:

1. **Marine Ecoregions of the World, MEOW** (Spalding et al. 2007), a biogeographic classification of the world's continental shelves and overlying waters which extends from the coast out to a buffer 5km seaward of the 200m depth contour.

2. **Pelagic provinces** (Spalding et al. in review), a new biogeographic classification of the off-shelf pelagic waters of the world, refined from an earlier version (UNESCO 2009), with the inclusion of semi-enclosed seas. This forms a contiguous classification alongside the MEOW classification.

3. **Benthic provinces** ((UNESCO 2009), as modified by L. Watling and J. Guinotte, unpublished), a biogeographic classification of bathyal and abyssal benthic areas, refined from earlier concepts described in (UNESCO 2009). Bathyal systems are described from the 300m depth contour down to 3500m, while abyssal systems extend from 3500 to 6500m. As such they are not contiguous with the continental shelf classification (0-200m), and also contain gaps around deep ocean trenches (below 6500m), but are the first available global benthic habitat classification.

All 5878 sites were included in all the biogeographic overlay analyses. Although some MPAs in off-shelf areas were specifically designated to target either pelagic or benthic systems, this is not always the case. Furthermore, this level of information is not presently held in the WDPA (primarily due to limited data availability). As such, we did not make any distinction between MPAs in terms of pelagic / benthic conservation objectives.

Total counts of MPAs by jurisdiction were taken directly from the MPA dataset. For the spatial coverage analysis, MPAs were intersected with each of the layers listed above in a GIS. This was done with a "dissolved" version of the global MPA site layer in which site boundaries are dissolved to form a single, flat, global protected area layer. This eliminates double counting of MPA area where MPAs are either a) genuinely overlapping designations (for example strict reserves within

3 The WDPA is a joint project of UNEP and IUCN, produced by UNEP-WCMC and the IUCN World Commission on Protected Areas. It is committed to serving the best possible data on protected areas, as defined by IUCN.

4 The Exclusive Economic Zone is the area beyond and adjacent to the territorial sea out to a maximum of 200 nm from coastal baselines which can be claimed under the United Nations Convention on the Law of the Sea (UNCLOS 1982) where states have rights over the resources and jurisdiction over activities including fisheries, environmental protection, and scientific research. Not all states are signatory to UNCLOS, and several who are have not claimed EEZ areas, or have declared more limited jurisdictions, such as fishing or environmental protection zones over the equivalent geographic footprint as an EEZ. The dataset used here (Flanders Marine Institute 2009) provides approximate boundaries for all national jurisdictional areas: territorial seas, protection zones, fishing zones, EEZs or hypothetical EEZs (areas that could likely be claimed if the country were signatory to UNCLOS and / or were to claim an EEZ). It does not differentiate between them. Given the complexity of existing claims and the large number of disputed areas it is important to note that this dataset is only a basic approximation, and inevitably contains errors. Further, given that some countries have not claimed EEZs, our estimates of total area under potential jurisdiction are considerably larger than the areas currently under jurisdiction. One of the most notable areas is the Mediterranean where only a few countries have jurisdictional claims extending beyond territorial seas.

Table 3.1: Summary of recent growth in number and areal extent of marine protected areas globally

	2003[a]		2006[b]		2008[c]		2010[d]	
Number of MPAs	4116		4435		5045		5850	
MPA area coverage statistics	million km²	%	million km²	%	million km²	%	million km²	%
Global total	1.64	0.45	2.35	0.65	2.59	0.72	4.21	1.17
Within EEZs	1.64	1.14	2.35	1.63	2.59	1.80	4.12	2.86
On continental shelf					1.20	4.09	1.27	4.32
Off-shelf					1.39	0.42	3.01	0.91

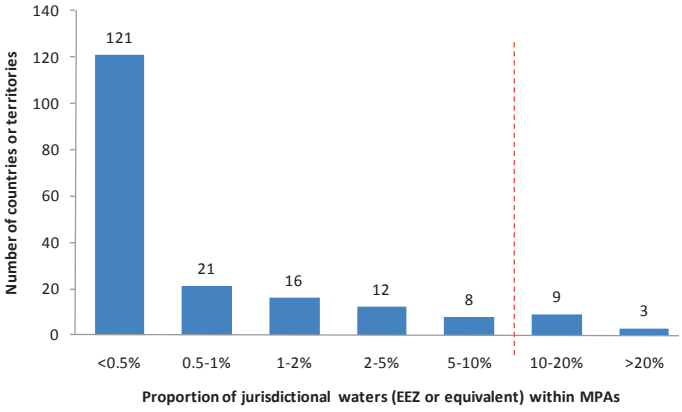
[a]Chape et al (2003) [b]Wood et al (2008) [c]Spalding et al (2008) [d]This study

larger protected seascapes) or b) where inaccuracies in the GIS show apparent overlap. In these overlays, some 600 sites occur completely on land and have no marine area. All of these sites had been annotated in the WDPA as marine by expert sources, and a manual review indicated that they are indeed coastal sites. This apparent non-overlap can be explained by the sites not including any subtidal waters, and/or by an artefact of the GIS analysis (positional inaccuracies and/or mismatches in the spatial resolution of the coastline or the protected area polygons). As such, these sites are included in the counts of MPAs, but do not influence any of the GIS area calculation results.

Results

The total number of MPAs now stands at approximately 5878, covering over 4.2 million km² of ocean (Map 3.1). This equates to 1.17% of the global ocean area and represents a notable increase on previous records, largely thanks to the inclusion of just a small number of very large new MPAs[5]. Table 3.1 gives some general summary information,

Figure 3.1: Proportion of MPA coverage by jurisdiction. Estimates of areas of potential national jurisdiction are based on an unofficial map of Economic Exclusion Zones or equivalent areas (see Methods). Given that many such areas are disputed and that there may be inaccuracies in the source map we have placed countries grouped into broad groupings. Only 12 countries and territories lie to the right of the line representing 10% coverage.



5 Recently declared large sites include the 180,000km² Prince Edward Islands (South Africa) MPA declared in mid-2009 and the 94,000km² South Orkney (Antarctica) MPA designated in November, 2009. The former is still awaiting final legal gazetting, but is already being actively managed (Belinda Reyers Council for Scientific and Industrial Research (CSIR) South Africa, pers comm., July 2010). Others include the 226,000km² network of Commonwealth Marine Reserves in SE Australia in 2007, the 600,000km² of Benthic Protection Areas around New Zealand, also in 2007, and 500,000km² of Marine National Monuments around the US Pacific territories declared in 2009. We have not included Chagos Protected Area, declared by the UK government in April 2010. At over 500,000km² this will be the world's largest MPA and will substantially alter a number of statistics in this chapter. At the time of writing, however, negotiations as to the legal status were still ongoing, no regulations had been applied beyond the former existing MPAs (which are included) and no boundary had been decided (Joanne Yeadon, Foreign and Commonwealth Office, pers comm., July 2010).

High Seas Protection

The Pelagos Sanctuary is widely regarded as the first MPA to be designated in the High Seas (i.e. areas beyond national jurisdiction). This site was designated under a trilateral agreement between France, Italy and Monaco, which entered into force in 2002. This site straddles the territorial waters of all three nations and the high seas beyond, covering some 87,500km². The Pelagos Sanctuary set a number of critical precedents in terms of international co-operation, but also has highlighted the considerable challenges of management in international waters (Notarbartolo-di-Sciara et al. 2008). Focused on the protection of cetaceans, the "regulations" at present largely focus on applying pre-existing European regulations on limiting the size of drift nets and an agreement to control boating activities (speed boating and whale watching) if or when these should become a serious threat to cetaceans. Such regulations would be insufficient for the site to be classed as an IUCN protected area (it was therefore omitted from the global analysis in this chapter), although it may qualify under the CBD definition. An important observation, for this and other sites that currently have less strict levels of protection, is that they do still provide a management framework through which additional regulations and/or management activities may be introduced over time (See Chapter 4 for further data issues relating to Pelagos).

More recently, in 2009, the South Orkneys MPA was designated by the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR) as the first step in the development of a representative network of MPAs in the waters in the Southern Ocean surrounding the Antarctic continent. CCAMLR operates as a fisheries management framework for the Southern Ocean, but unlike a conventional Regional Fisheries Management Organisation, it has wider conservation responsibilities for the region (i.e. it looks at the impact of fishing on the whole food-chain). CCAMLR operates as part of the wider Antarctic Treaty System, which also contains a Protocol for Environmental Protection mandating the development of a representative system of terrestrial and marine protected areas. The MPA came into force in May 2010 to conserve important foraging areas used by albatrosses, petrels and penguins, and unique oceanographic features and to allow scientists to better monitor the effects of human activities and climate change on the Southern Ocean. The site covers some 94,000km², within which no fishing activities are permitted, nor dumping, discharges or transhipments between fishing vessels.

A number other large areas in the high seas have been declared, mostly fisheries closures by Regional Fisheries Management Organisations (RFMOs). Many of these are described and mapped on www.highseasmpas.org (see also Ardron et al. 2008). These sites again show important progress towards the use of spatial management tools for conservation of the high seas, however most are temporary, or only include narrow restrictions on single fishing gears or on particular target species, which means they cannot be included under the IUCN definition of a protected area used in this analysis.

comparing these statistics to those published in earlier studies.

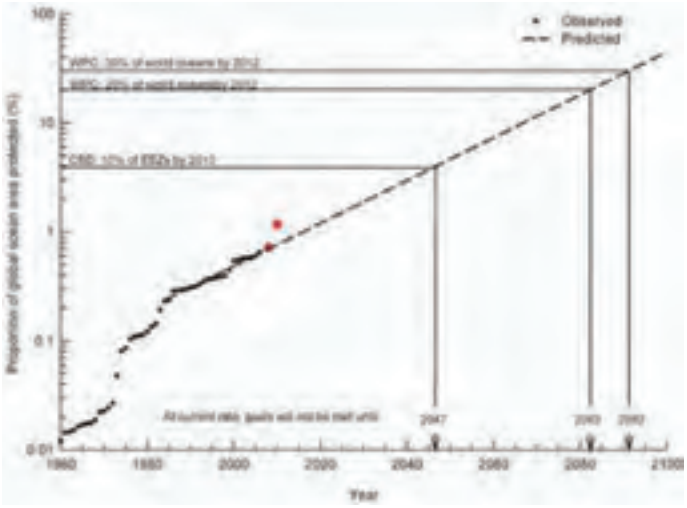
With the exception of 38 sites in Antarctica, these MPAs are located entirely within potential national marine jurisdictions, as estimated by the VLIZ Maritime Boundaries Database (note earlier disclaimer). Our results thus suggest that MPA coverage within 200nm of the global coastline is now 2.86%, but this coverage is highly variable – around three-quarters of all states and overseas territories (143) have less than 1% of their potential national marine jurisdiction within MPAs, while 12 have met or exceeded the 10% target (Figure 3.1).

Numerically, almost all MPAs are located over the continental shelf, and overlap the continental shelf biogeographic ecoregions (Map 3.2). Here nearly 1.3 million km² of ocean are protected (4.32% continental shelf, Table 3.2). Only 308 sites extend off-shelf, however these include many of the world's largest MPAs and cover some 3 million km² of off-shelf waters (Map 3.3), clearly a large extent, but only constituting 0.91% of the global off-shelf ocean area. MPA coverage of the off-shelf benthic provinces breaks down to 1.32% of bathyal areas and only 0.67% of abyssal areas (Table 3.3 and Map 3.4).

The size of MPAs is highly variable, with a mean marine area of 741km², but a median figure of only 1.6km². Some 2700 sites cover less than 1km² of ocean area. The total global MPA area coverage is thus largely composed of a relatively small number of very large MPAs (Table 3.4) combined with many very small sites; there are eleven MPAs whose marine area is at least 100,000km². In combination, these eleven sites cover almost 2.5 million km² of ocean area, and just over 60% of the entire global estate of MPA coverage. As noted in earlier assessments therefore, the coverage of MPAs is heavily influenced by a very small number of very large sites.

New large MPAs are likely to rapidly alter current statistics. At the time of writing, an MPA covering a large part of the Chagos Archipelago was under development (legally gazetted but with no boundary or regulatory framework, see Footnote 5), while another large site was approved for development around Sala y Gomez Islands in the south-east Pacific (WCPA, 2010). Both are projected to be largely or entirely no-take, and will likely be the first and second largest MPAs in existence covering over 900,000km² in total. Inclusion of the Chagos MPA will bring the total MPA coverage to 4.7 million km², and combined these sites will raise global coverage of MPAs by over 20%, to over 5.1 million km², covering 1.42% of the global ocean and 3.49% of EEZ areas.

Figure 3.2: Updated graph of global growth in MPA coverage from Wood et al (2008), showing recent increases in MPA coverage (red points).



Map 3.1: Marine protected areas of the world – 5878 sites. The background shading shows an approximation of areas of potential national jurisdiction (200 nautical miles from all coasts).

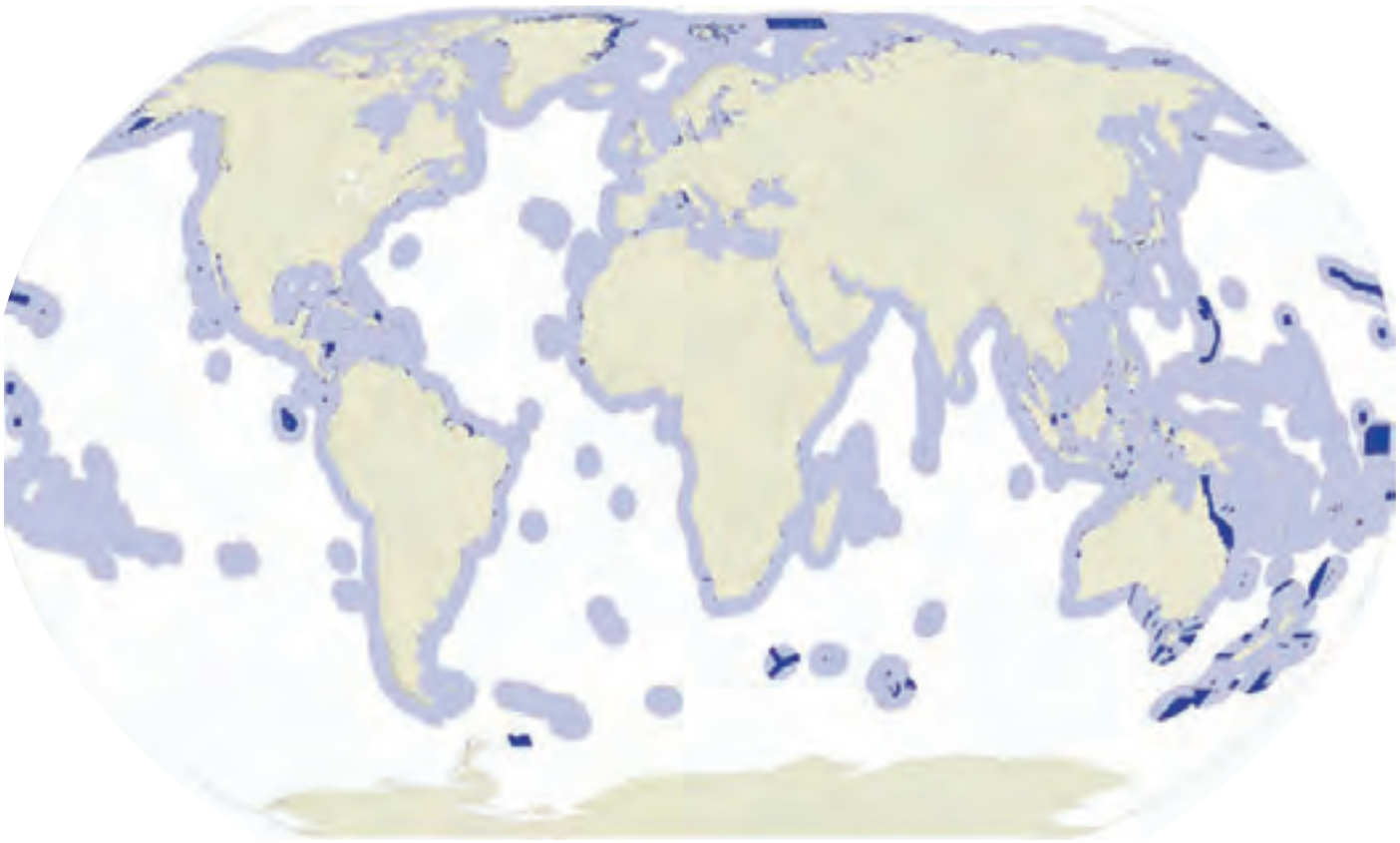
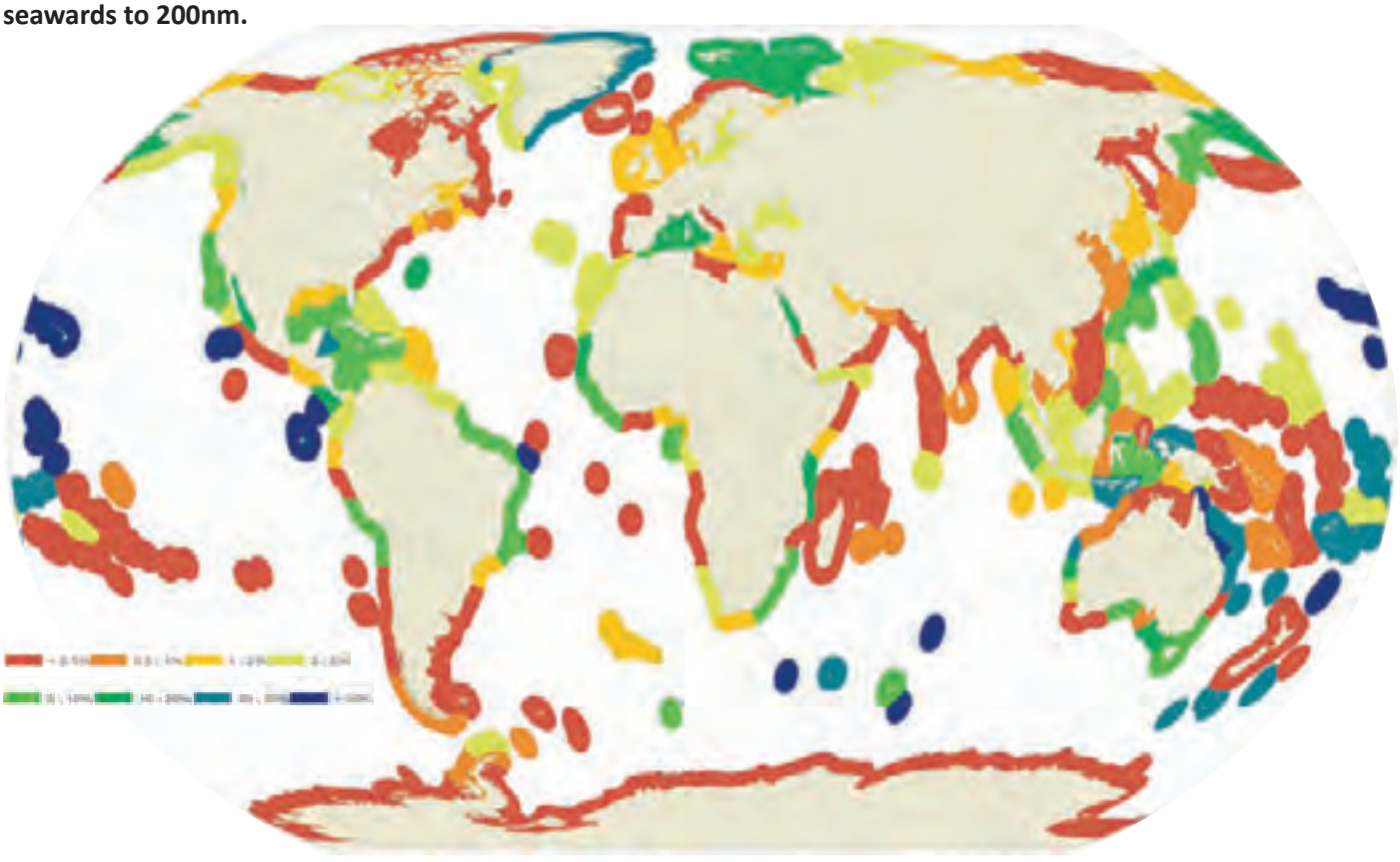


Table 3.2: MPA coverage on the continental shelf summarised into Realms and provinces. Area figures are based on calculations made in GIS and are subject to error, so should be interpreted as approximations. Map 3.2 shows the results at the ecoregional level.

	Province	Shelf area (km^2)	Proportion protected (%)	MPA Area (km^2)	No of eco-regions	No of ecoregions with MPAs
Arctic						
1	Arctic	7,636,248	4.87	372,132	19	19
Temperate Northern Atlantic		**4,178,449**	**1.58**	**66,113**	**25**	**23**
2	Northern European Seas	1,751,687	1.85	32,423	7	6
3	Lusitanian	306,872	2.05	6,304	3	3
4	Mediterranean Sea	688,638	2.66	4,242	7	7
5	Cold Temperate Northwest Atlantic	890,075	0.76	6,778	5	4
6	Warm Temperate Northwest Atlantic	370,865	1.39	5,142	2	2
7	Black Sea	170,311	2.59	4,413	1	1
Temperate Northern Pacific		**3,029,022**	**2.45%**	**74,156**	**17**	**17**
8	Cold Temperate Northwest Pacific	1,620,446	1.39	22,506	6	6
9	Warm Temperate Northwest Pacific	663,789	2.32	15,377	2	2
10	Cold Temperate Northeast Pacific	558,551	2.86	15,960	6	6
11	Warm Temperate Northeast Pacific	186,236	10.91	20,313	3	3
Tropical Atlantic		**2,162,800**	**6.42**	**138,764**	**25**	**22**
12	Tropical Northwestern Atlantic	1,013,910	6.78	68,774	9	9
13	North Brazil Shelf	502,608	6.98	35,080	2	2
14	Tropical Southwestern Atlantic	197,339	7.63	15,048	5	3
15	St. Helena and Ascension Islands	1,256	0.13	2	1	1
16	West African Transition	73,354	10.44	7,660	2	1
17	Gulf of Guinea	374,333	3.26	12,201	6	6
Western Indo-Pacific		**2,233,848**	**1.75**	**39,119**	**25**	**22**
18	Red Sea and Gulf of Aden	284,818	3.74	10,643	3	3
19	Somali/Arabian	391,400	1.16	4,548	4	3
20	Western Indian Ocean	489,958	1.70	8,310	9	7
21	West and South Indian Shelf	387,427	0.51	1,965	2	2
22	Central Indian Ocean Islands	78,847	1.56	1,227	2	2
23	Bay of Bengal	288,246	0.45	1,307	2	2
24	Andaman	313,152	3.55	11,119	3	3
Central Indo-Pacific		**5,881,372**	**7.17**	**421,679**	**40**	**37**
25	South China Sea	542,091	0.58	3,129	3	2
26	Sunda Shelf	1,833,967	2.50	45,890	4	4
27	Java Transitional	66,834	3.65	2,437	2	2
28	South Kuroshio	42,498	7.61	3,235	1	1
29	Tropical Northwestern Pacific	58,103	2.29	1,328	4	4
30	Western Coral Triangle	979,509	7.83	76,720	8	7
31	Eastern Coral Triangle	229,785	0.46	1,049	4	3
32	Sahul Shelf	1,314,415	0.75	9,801	4	4
33	Northeast Australian Shelf	290,837	83.64	243,263	2	2
34	Northwest Australian Shelf	304,796	2.03	6,188	2	2
35	Tropical Southwestern Pacific	209,260	12.57	26,297	5	5
36	Lord Howe and Norfolk Islands	9,277	25.24	2,342	1	1
Eastern Indo-Pacific		**150,287**	**19.59**	**29,448**	**12**	**10**
37	Hawaii	31,545	76.21	24,041	1	1
38	Marshall, Gilbert and Ellis Islands	49,243	2.21	1,089	2	2
39	Central Polynesia	16,539	25.00	4,134	3	3
40	Southeast Polynesia	47,617	0.30	143	4	3
41	Marquesas	4,629	0.88	41	1	1

42	Easter Island	714	0.00	-	1	0
Tropical Eastern Pacific		**254,137**	**10.84**	**27,558**	**11**	**10**
3	Tropical East Pacific	237,555	4.62	10,978	8	7
44	Galapagos	16,582	99.99	16,580	3	3
Temperate South America		**1,704,401**	**0.36**	**6,052**	**15**	**10**
45	Warm Temperate Southeastern Pacific	149,783	1.23	1,839	4	1
46	Juan Fernández and Desventuradas	1,821	0.00	-	1	0
47	Warm Temperate Southwestern Atlantic	561,700	0.44	2,487	4	4
48	Magellanic	989,211	0.17	1,701	5	4
49	Tristan Gough	1,885	1.34	25	1	1
Temperate Southern Africa		**284,261**	**2.54**	**7,225**	**5**	**4**
50	Benguela	160,880	2.25	3,620	2	2
51	Agulhas	122,449	2.37	2,905	2	2
52	Amsterdam-St Paul	932	0.00	-	1	0
Temperate Australasia		**1,025,333**	**5.49**	**56,288**	**17**	**15**
53	Northern New Zealand	49,253	3.57	1,758	3	3
54	Southern New Zealand	240,894	0.13	323	4	2
55	East Central Australian Shelf	68,843	18.15	12,495	2	2
56	Southeast Australian Shelf	241,183	7.86	18,954	3	3
57	Southwest Australian Shelf	334,593	3.96	13,263	3	3
58	West Central Australian Shelf	90,567	10.48	9,494	2	2
Southern Ocean		**792,253**	**3.58**	**28,330**	**21**	**13**
59	Subantarctic Islands	93,188	19.08	17,784	7	6
60	Scotia Sea	163,301	0.94	1,541	5	4
61	Continental High Antarctic	499,328	0.01	35	6	3
62	Subantarctic New Zealand	36,437	24.62	8,970	3	3

Map 3.2: MPA coverage by marine ecoregions. The same data are summed up into provinces and realms in Table 3.2. Note that these percentages refer to the continental shelf area only (down to a depth of 200m and buffered seawards by 5km). For ease of visualisation this map exaggerates the area of these ecoregions extending them seawards to 200nm.



Discussion

Currently, global MPA coverage represents 1.17% of the global ocean surface. This represents an increase of over 60% of the area recorded as protected 30 months earlier and over 150% more than the statistics reported from 2003 (Chape et al. 2008). These increases can be partly attributed to improvements in the accuracy of global datasets, but they largely reflect a very real increase in effort to protect the marine environment over the last decade. This increase is evidenced by the declaration of several new very large MPAs since mid-2008, including four which alone have contributed an increase of almost 750,000km^2 or 17% of the total MPA area. Despite this success, 1.17% remains a far cry from the 10% target set by the CBD and although other tools than MPAs might help to achieve this target, at the present time few such tools are in place. This target will not be met in 2010, nor even by 2012, and seems unlikely to be met even in the near term thereafter.

Patterns across jurisdictional zones

The geographical spread of protection shows a clear weighting of protection towards North America (including Mexico), Southeast Asia, Australasia and the Pacific. Only 12 out of 190 states and/or territories with a marine component have already reached or surpassed the

Table 3.3: MPA coverage of off-shelf biogeographic provinces – pelagic, bathyal and abyssal coverage. Area figures are based on calculations made in GIS and are subject to error, so should be interpreted as approximations.

Province	Biome	Province area (km^2)	MPA area (km^2)	Percentage protected (%)
Pelagic				
Agulhas Current	Boundary – western	2,109,096	14	0.00
Antarctic	Polar	29,511,842	94,217	0.32
Antarctic Polar Front	Polar	14,038,776	342,958	2.44
Arctic	Polar	12,203,263	46,987	0.39
Benguela Current	Boundary – eastern	1,328,969	7,216	0.54
Black Sea	Semi-enclosed sea	292,027	-	0.00
California Current	Boundary – eastern	1,473,269	3,844	0.26
Canary Current	Boundary – eastern	1,796,491	175	0.01
Eastern Tropical Pacific	Equatorial	11,743,973	143,411	1.22
Equatorial Atlantic	Equatorial	15,996,871	236	0.00
Equatorial Pacific	Equatorial	9,124,046	121,701	1.33
Guinea Current	Boundary – eastern	626,188	-	0.00
Gulf Stream	Boundary – western	1,189,309	1,358	0.11
Humboldt Current	Boundary – eastern	3,120,839	562	0.02
Southern Indian Ocean	Gyre	18,461,939	3,496	0.02
Northern Indian Ocean	Gyre	19,034,649	1,083	0.01
Indonesian Through-Flow	Semi-enclosed sea	3,571,343	42,895	1.20
Inter American Seas	Semi-enclosed sea	3,321,482	65,256	1.96
Kuroshio-Oyashio Current	Boundary – western	1,063,826	11	0.00
Leeuwin Current	Boundary – eastern	1,359,848	230	0.02
Malvinas Current	Boundary – western	685,365	-	0.00
Mediterranean	Semi-enclosed sea	1,840,859	4,382	0.24
Southwest Pacific	Transitional	7,787,574	200,102	2.57
North Atlantic Current	Transitional	6,186,594	-	0.00
North Central Atlantic	Gyre	12,132,822	13,012	0.11
North Central Pacific	Gyre	36,137,158	665,819	1.84
North Pacific Current	Transitional	7,388,208	-	0.00
Red Sea	Semi-enclosed sea	229,964	2	0.00
Sea of Japan/East Sea	Semi-enclosed sea	740,969	2	0.00
Somali Current	Boundary – western	2,596,329	40	0.00
South Central Atlantic	Gyre	14,718,463	-	0.00
South Central Pacific	Gyre	41,364,059	624,077	1.51*
South China Sea	Semi-enclosed sea	1,586,354	6.62366	0.00
Subantarctic	Polar	16,855,986	275,274	1.63*
Subarctic Pacific	Gyre	8,234,506	827	0.01
Southern Subtropical Front	Transitional	21,837,584	345,893	1.58*

Bathyal				
Antarctic	n/a	6,265,125	56,488	0.90
Arctic	n/a	4,704,449	2,491	0.05
Cocos Plate	n/a	4,730,774	128,364	2.71
Indian	n/a	14,284,191	32,194	0.23
Nazca Plate	n/a	1,183,807	-	0.00
New Zealand Kermadec	n/a	4,300,385	262,404	6.10
North Atlantic	n/a	8,437,208	58,881	0.70
North Pacific	n/a	1,376,522	153,560	11.16
Northern North Atlantic	n/a	3,432,488	1,160	0.03
Northern North Pacific	n/a	3,256,403	5,776	0.18
SE Pacific Ridges	n/a	7,539,536	25	0.00
South Atlantic	n/a	6,108,929	555	0.01
Subantarctic	n/a	7,359,484	287218	3.90
West Pacific	n/a	10,080,869	104,658	1.04
Abyssal				
Angola and Sierra Leone Basins	n/a	7,438,812	-	0.00
Arctic	n/a	1,333,575	-	0.00
Argentine Basin	n/a	5,605,402	-	0.00
Brazil Basin	n/a	6,860,975	-	0.00
Central Pacific	n/a	18,276,942	285,367	1.56
East Antarctic Indian	n/a	25,502,050	108,028	0.42
East Pacific Basins	n/a	14,207,765	6,179	0.04
Indian	n/a	39,080,942	217,153	0.56
North Atlantic	n/a	26,782,413	7,873	0.03
North Central Pacific	n/a	33,574,876	409,019	1.22
North Pacific	n/a	14,582,507	268	0.00
South Pacific	n/a	30,861,315	548,893	1.78
West Antarctic	n/a	12,094,177	1,296	0.01
West Pacific Basins	n/a	1,234,346	2,461	0.20

* These statistics may be overestimates, as over 600,000km^2 of MPAs in New Zealand which occur in these provinces are benthic protection areas, with regulations only for the sea bed and a buffer of 100m above the sea bed.

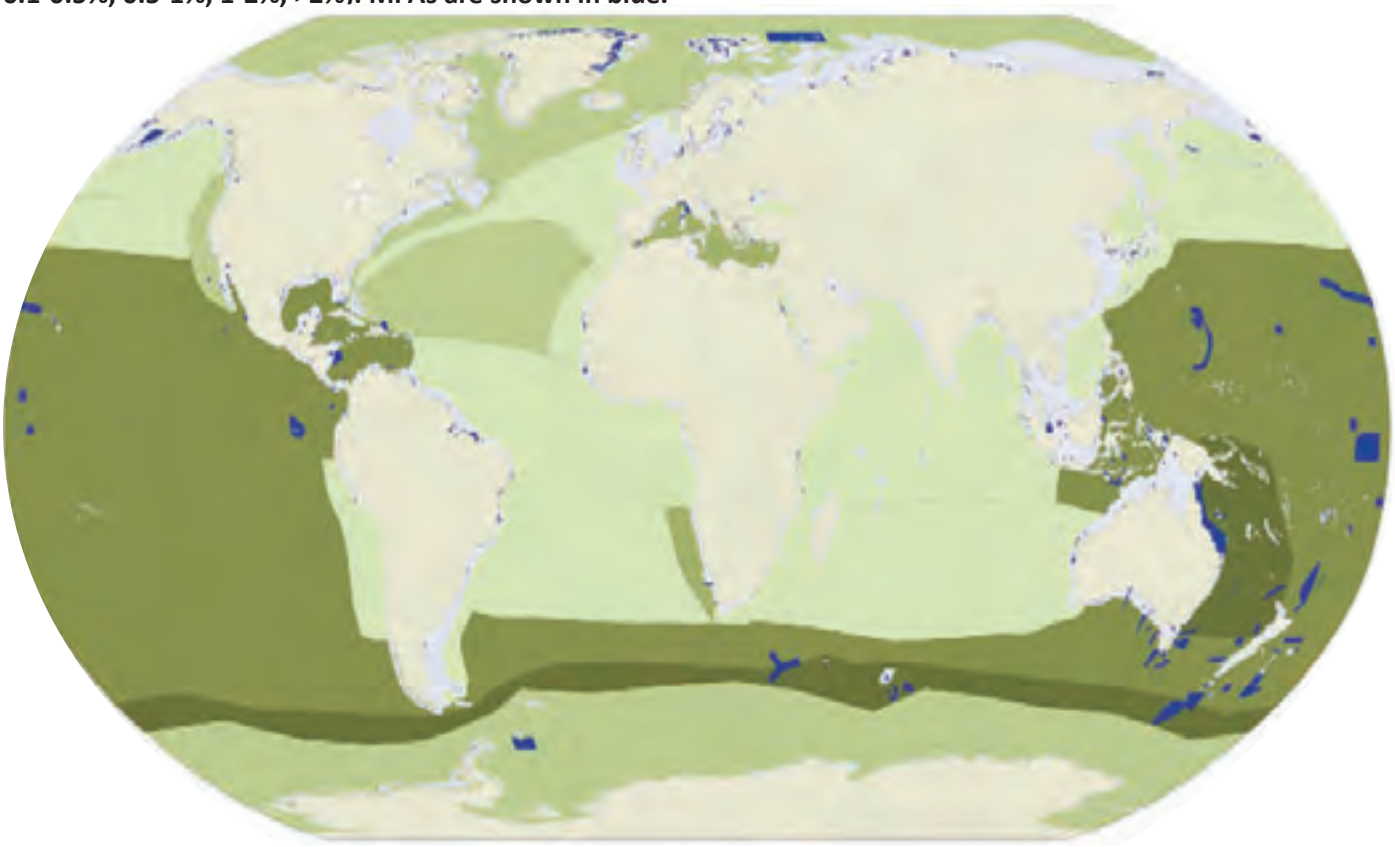
10% target: Dominican Republic, Ecuador, Estonia, Germany, Guam, Heard and McDonald Islands, Jordan, Kiribati, New Zealand, Northern Mariana Islands, South Africa, and the United States Minor Outlying Islands. Clearly these include some jurisdictions with relatively small EEZ areas, as well as two remote territories with few inhabitants, but nonetheless such achievements are important, and provide critical examples for others to follow.

By contrast, some 75% of the 190 states and territories with a marine component that are considered in this chapter (143 in total) have less than 1% of their EEZs (or equivalent) within MPAs, including 63% with less than 0.5% protected. At a global scale, there are some very large gaps, most notably around the Indian Ocean Basin, Central and West Africa (but see Chapter 4), and around the western and southern coasts of South America. In most of these cases, new MPAs are currently being developed, some within the context of regional networks (e.g. West Africa). In addition to these geographic trends, two further socio-political trends can be observed:

1) Most MPAs are largely restricted to territorial waters (Territorial Seas claims extend from the legal baseline on the shore to three, or more typically up to twelve, nautical miles offshore). Only a few countries have designated extensive MPAs right across their EEZs or equivalent areas. Most notably these include Australia, New Zealand, Germany and the USA, while single large sites beyond the territorial sea have also been declared by Colombia, Ecuador, South Africa and the Dominican Republic. These countries and their associated territories are all listed as having high levels of MPA coverage.

2) In terms of overall spatial extent, there is a clear trend for the most extensive MPA coverage, even in coastal and shelf areas, to be located far from populated areas. This is reflected in both overlay analyses performed here (EEZs and biogeographic areas, see below). Many of the areas that exhibit higher levels of protection are either remote territories with administrative connections to large nations, e.g. Commonwealth of the Northern Mariana Islands and the USA, or are nation states with extensive EEZs, e.g. the Republic of Kiribati. The considerable growth of MPA coverage in areas far from human populations presents an interesting observation. Such areas are not immune from impacts such as overfishing (Friedlander and DeMartini 2002; Sadovy et al. 2003; Graham et al. 2010), pollution, ocean acidification or climate change (Harley et al. 2006; Fabry et al. 2008; Veron et al. 2009), however they are less likely to be suffering the sustained impacts of multiple intense pressures that characterise

Map 3.3: Pelagic provinces of the world, shaded by the proportion protected, (lighter to darker equalling <0.1%, 0.1-0.5%, 0.5-1%, 1-2%, >2%). MPAs are shown in blue.



many coastal areas (Bryant et al. 1998; Halpern 2003; Diaz and Rosenberg 2008; Selman et al. 2008). Establishing MPAs in remote areas that are likely to be less degraded than areas closer to human population can be expected to help facilitate broader-scale ecosystem resilience and recovery capacity by acting as refugia and possible source areas to support ecosystem recovery elsewhere. They can also act as scientific baselines, which is critical for monitoring purposes. Managing for broad-scale ecosystem resilience through these MPAs may be particularly important in the context of the largely unknown and unpredictable impacts of rising temperatures, ocean acidification, stratification, and diminished oxygen zones in the open ocean. The cost of monitoring, control and surveillance (MSC) can be much higher in such remote locations and hence illegal activities could occur undetected. New and emerging technologies could help offset this issue, however (Brooke et al 2010).

However, it is also important to consider the patterns of MPA coverage closer to areas of more heavy and/or direct human use. It is in these areas where the impacts of degradation are having the most direct social and economic costs (Brander et al. 2006; Donner and Potere 2007; Martínez et al. 2007; Costanza et al. 2008; Cinner et al. 2009; Ling et al. 2009; Waycott et al. 2009), but also where MPAs could support dramatic and rapid improvements. Such areas have much lower levels of protection than the remote ecoregions already discussed. Even so, there are important examples of progress, most notably the growth of community-led or community-supported initiatives. Typically such sites are small, and make up only a very small fraction of ocean space, even in a local context, but for some benthic and coastal ecosystems, they can make a considerable difference: to biodiversity conservation, to resilience in the face of multiple pressures, to food security, and to local economics (Gell and Roberts 2003; Alcala et al. 2005; Claudet et al. 2008). The locally managed marine areas (LMMAs, see Chapter 4) recognised across the Pacific islands are an excellent example of this (Bartlett et al. 2009; Govan 2009; Lowry et al. 2009). Placed in a wider context (whether that context be geographic, thematic or socio-economic), many of these small-scale interventions can be seen to build up into a bigger picture of protection and local resource management.

The two observations made here may be related. Specifically, the timeframe available for countries to achieve the 10% target was especially short given the complex socio-economic, political, legislative, and consultative processes that must be undergone in a transparent and equitable MPA network planning and designation process (for example Fernandes et al. 2005). As such, one of the most likely ways for countries to achieve this target (especially those with large EEZ areas) would be to designate a small number of very large MPAs that are distant from human population and therefore subject to fewer potential human use conflicts that would need to be resolved prior to designation. While there may be some challenges to establishing MPAs in offshore areas (Sand 2007), the rapid growth and successful implementation of such sites in several countries indicates a new and important trend. However, taking this approach alone may not ultimately prove effective in the context of the second MPA target for ecologically representative national and regional systems of protected areas, or, more importantly, achieving broader resource management, conservation, or development goals.

Although conservation efforts in the high seas are increasing in many areas (see box), the only MPAs beyond national jurisdiction considered in this study are 38 sites around Antarctica. All but one of these are small, nearshore sites declared under the Antarctic Treaty, whose “high seas” nature is determined by the international agreements to suspend marine jurisdictional claims in the Antarctic (Ardron et al. 2008). Only one site extends across large areas of open ocean – the South Orkneys Marine Protected Area (see Box on High Seas Protection).

Map 3.4: Benthic provinces of the world, shaded by proportion protected: bathyal (greens) and abyssal (blues). MPAs are shown in red.

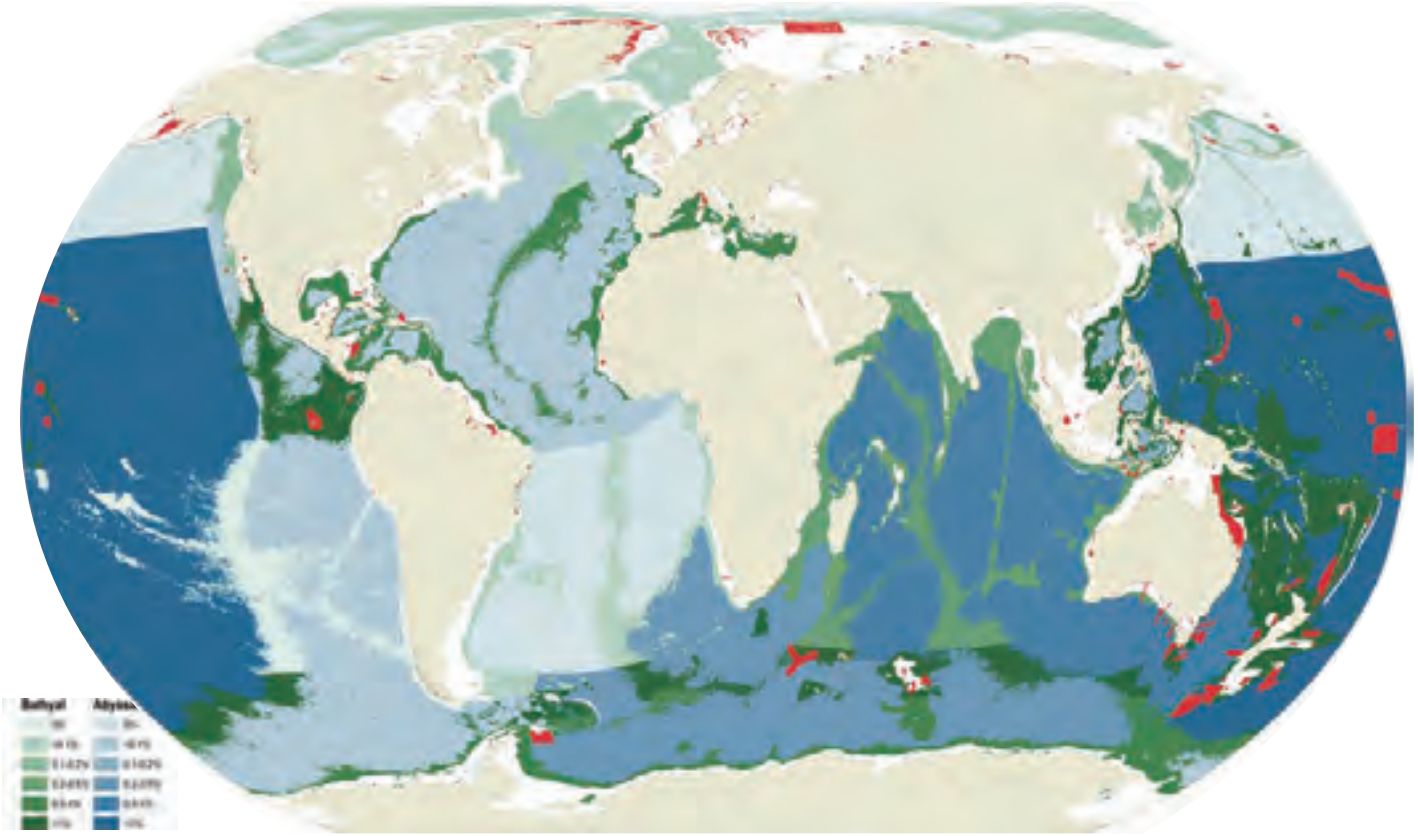


Table 3.4: The world's largest MPAs: all known sites with marine areas calculated in GIS as being greater than 30,000km².

Name of MPA	Jurisdiction	Marine Area (calculated in GIS) (km²)
Phoenix Islands Protected Area	Kiribati	408,342
Great Barrier Reef Marine Park	Australia	343,480
Papahanaumokuakea Marine National Monument	United States	334,154
Mariana Trench Marine National Monument	United States	247,179
Pacific Remote Islands Marine National Monument	United States	212,788
Prince Edward Islands Marine Protected Area	South Africa	180,633
Kermadec Benthic Protection Area	New Zealand	164,840
Macquarie Island Commonwealth Marine Reserve	Australia	161,895
Galapagos Marine Reserve	Ecuador	137,975
Franz Josef Land Zakaznik	Russia	123,877
Antipodes Transect Benthic Protection Area	New Zealand	110,565
Sub-Antarctic Deep Benthic Protection Area	New Zealand	99,734
North-East Greenland National Park	Greenland	96,598
South Orkneys Marine Protected Area	High Seas	93,787
Nearshore Bristol Bay Trawl Closure	United States	65,030
Heard Island and McDonald Islands Marine Reserve	Australia	64,267
Seaflower Marine Protected Area	Colombia	61,099
Freycinet Commonwealth Marine Reserve	Australia	57,942
Hikurangi Deep Benthic Protection Area	New Zealand	54,025
Norfolk Deep Benthic Protection Area	New Zealand	44,231
Tasman Fracture Commonwealth Marine Reserve	Australia	42,501
Fiordland Transect Benthic Protection Area	New Zealand	40,695
Rose Atoll Marine National Monument	American Samoa	34,784
Challenger South Benthic Protection Area	New Zealand	30,553

Biogeographic patterns

From a biogeographic perspective the coast and shelf patterns are similar to those observed in Spalding et al (2008). Overall, coverage remains highest for tropical realms, with 6.15% incorporated into MPAs. Temperate areas, in both northern and southern hemisphere remain poorly covered, with 1.95% and 2.31% covered respectively. An apparent decrease in protection in the figure for the Temperate Northern Pacific Realm, (5.49% MPA coverage was cited in Spalding et al. 2008) reflects an improvement in the analysis rather than a true reduction. The earlier study included a large number of sites where fisheries regulations apply, but only provide partial protection to single taxa. Such sites cannot be considered to conform to IUCN's definition of an MPA and their inclusion in the earlier study was an error. In polar regions protection is more widespread, and includes a number of very large MPAs both in the Arctic and around the Subantarctic Islands. The realms showing the most rapid increases in protection include Temperate Southern Africa and Temperate Australasia (71% and 47% increase, respectively, since January, 2008).

Within this overall picture, biogeographic coverage at finer resolution (Table 3.2 and Map 3.2) remains highly variable across shelf areas. Some 44 ecoregions have greater than 10% MPA coverage (19% of the total), including 31 (13%) with greater than 20% coverage, and 14 (6%) with over 50% coverage. By contrast 102 ecoregions (44%) have less than 1% MPA coverage. By and large the greatest progress has been made in ecoregions far from major populations – of the 31 ecoregions with greater than 20% protection, 25 are oceanic island ecoregions and only 4 are in areas with substantial human populations[6].

Off-shelf protection is much lower, totalling only 0.91% of off-shelf waters, and apart from the Antarctic cases already mentioned, it is entirely restricted to the EEZs of individual nations. Only 307 sites (about 5% of the total number of MPAs) extend off-shelf, but these include most of the world's largest MPAs. Many of these sites are linked to oceanic islands and in the pelagic overlays coverage is greatest in the Pacific and Southern Ocean areas where such sites have been most widely declared: both the Southwest Pacific and the Antarctic Polar Front pelagic provinces have just over 2% of their area within MPAs. As more countries begin to designate MPAs whose boundaries extend beyond territorial seas, the spatial patterns of pelagic ocean protection might be expected to change. Relatively rapid increases in MPA coverage could be achieved in some pelagic provinces simply through national-level MPA designations, because approximately 40% of the global ocean surface falls within potential national marine jurisdictions, and around half of the pelagic provinces have a majority of their total area within such jurisdictions. Beyond these areas however, international regulation will be needed to ensure effective and representative coverage for the remaining pelagic provinces. As already mentioned, RFMOs may have a critical part to play in such high seas conservation efforts. It should also be noted that parties to regional agreements which extend to areas beyond national jurisdiction in the Antarctic, the Mediterranean and the North East Atlantic have committed to establishing representative networks of MPAs and are in the process of identifying areas.

From a benthic perspective, the linkage of almost all MPAs to terrestrial margins or shallow water area is clearly reflected in the decline in MPA coverage with depth: bathyal areas, which make up 23% of the ocean have 1.32% coverage, while the vast abyssal provinces, which make up 66% of the ocean (and 44% of the entire planet) have only 0.67% of their area within MPAs. Most of these provinces are very large indeed and it is only through concerted international co-operation that representative protection will be developed at scale for these provinces and the biodiversity they represent.

Ile de la Passe © J Tamelander / IUCN

6 In their earlier analysis Spalding et al. (2008) looked at MPA coverage of a narrow 2km belt (1km inland and offshore from the coast). This study provided an insight into the very concentrated conservation effort going on this area. It also provided a more accurate overview of coastal coverage (simple marine overlays can miss the large parts of the intertidal zone which fall on the landwards margin of the coastline). Unfortunately we were unable to re-run this analysis in the available time for this chapter, however it is undoubtedly the case that MPA coverage in the coastal belt will have risen (from 12%) since that analysis, although perhaps not so steeply given the large increased in large oceanic MPAs.

Conclusions

Comprehensiveness and Representativeness

Overall our findings are not surprising: MPA coverage remains remarkably low and far below the current CBD targets. Existing MPAs are still largely "anchored" to terrestrial areas, with few wholly offshore sites. Even in coast and shelf areas biogeographic representation is patchy and is still largely inadequate, with only a small number of shelf ecoregions having MPA coverage reaching or exceeding the 10% target. These successes are mostly in areas remote from human populations. Beyond the 200m depth contour, the recent rapid increase in MPA coverage is a positive trend but remains insufficient to adequately protect the truly vast expanse of the open oceans.

Overall, the observed rapid increase in rate of growth of MPA coverage is cause for guarded optimism (Figure 3.2). It now seems possible that the projections made in Wood et al (2008) – a date of 2047 for 10% protection in EEZs, and of 2067 for 10% coverage of global oceans – can be brought forward. Some caution is needed of course and it is worth noting that previous dramatic increases in MPA coverage (illustrated in Figure 3.2), have been the result of the designation of single very large sites such as the Northeast Greenland National Park (1974), the Great Barrier Reef Marine Park (1979, 1984), the Galapagos Marine Reserve (1986) and the Northwest Hawaiian Islands (designated in 2000 as a Coral Reef Ecosystem Reserve and redesignated in 2006 as the Papahanaumokuakea National Monument). The recent increases have been driven by multiple new designations, rather than single sites, and we are aware of others such as the Chagos Marine Protected Area (see Footnote 5) and the Sala y Gomez MPA near Easter Island (WCPA, 2010), which may continue this trend, but they are still being driven by a few jurisdictions and a small number of designations in a process that can still appear more random than systematic.

A further concern regarding the disproportionate influence of a few very large MPAs is that large marine areas may be left unprotected even

as progress towards targets appears to improving. Large MPAs in remote locations are extremely valuable, and in off-shelf and pelagic systems they are necessary to achieve meaningful impacts on biodiversity. However in coastal waters, even small MPAs can make a dramatic difference not only to biodiversity, but also the valuable marine ecosystem services on which millions depend for their livelihoods and well-being. It may therefore be necessary to provide further encouragement to ensure that MPA designation continues to target areas where human use is intense and threats are high.

The challenges of establishing off-shelf MPAs remain considerable, but are not insurmountable. It seems likely that two important trends will be critical. Firstly, the extension of MPAs beyond the limits of territorial waters and across EEZs in a few nations provide valuable examples for other nations to follow, both in terms of developing legal frameworks and in building models for implementation elsewhere. Secondly, the legal challenges of establishing MPAs in the high seas, whilst complex, can be resolved (Scovazzi 2004; Corrigan and Kershaw 2008). Both the Pelagos Sanctuary and the MPAs designated through CCAMLR and Antarctic Treaty in the Southern Ocean provide valuable case studies, highlighting the importance of strengthened cooperation at the regional level between regional seas organizations and RFMOs, and the potential need for new mechanisms where regional organizations are lacking.

Although we have focused our review of "representative" marine protection on biogeographic coverage, the same patterns of patchiness appear to be repeated from a habitat-centred viewpoint. Wood et al. (2008) pointed to the relatively high coverage of mangrove, seagrass and coral reef habitats compared to seamounts, and global marine coverage overall. Since that publication, the proportion of these habitats under protection has continued to rise, with some 25% of all (remaining) mangrove areas (Spalding et al. 2010) now protected and likely an even higher proportion of tropical coral reefs (Burke et al. in prep). Concentration on these coastal habitats is certainly not without justification – they are high diversity, high-value systems, but they are also are well-known and well-mapped. The apparent failure to adequately protect other systems – seamounts, upwellings, shellfish or vermitid reefs, kelp forests, deep sea coral communities and many others – may be illustrative of another challenge facing MPA designation: our lack of knowledge, and subsequent inability to appropriately prioritise many marine ecosystems.

Effectiveness

The concept of "effective" protection is central to CBD targets, but remains very hard to assess or to quantify. Across our database of MPAs it is impossible to generalise about governance and management effectiveness: these sites range from poorly managed "paper parks" to actively patrolled strict reserves, closed to all extractive use. While good protocols have been established for assessing effectiveness and many individual sites have been assessed (Pomeroy et al. 2004; Leverington et al. 2008b), there are no global datasets that have been developed using consistent methodologies. In a review of recent assessments of some 2322 terrestrial and marine sites, 14% were found to be clearly inadequate and only 21% were described as "sound" (Leverington et al. 2008a). Rapid regional assessments of effectiveness for coral reef MPAs (considering both management application and ecological efficacy) showed for Southeast Asia that 38% of 332 sites assessed were "inadequate" and for the Caribbean that 72% of 192 sites assessed were "inadequate" (only 14% and 9% of sites, respectively were rated as "adequate") (Burke et al. 2002; Burke and Maidens 2004). Such studies provide a valuable warning regarding our statistics: 1.17% of the world's ocean may fall within MPAs but a much smaller proportion is effectively conserved.

It seems likely that management challenges may be greater for MPAs than for many terrestrial sites, with physical challenges and high management costs of access and monitoring; with the pressures arising from activities beyond site boundaries, which are much enhanced in aquatic environments (Jameson et al. 2002); and with the often inadequate legal frameworks to deal even with *in situ* pressures. At the same time, it is worth nothing that even those MPAs that are not yet completely effective may still provide valuable contributions to overall resource management and conservation objectives. They still enable at least a partial reduction of human pressures occurring within (and perhaps outside) them, and they also provide the legal basis for future development of more effective legislation and management frameworks.

The degree of protection offered by MPAs is not solely dependent on the effectiveness of management of course and a considerable range of management aims are encompassed within the MPAs reviewed here. Most sites allow some ongoing use, including fisheries, recreational use and boat access. In zoned sites such as the Great Barrier Reef these differences of use have tangible influences on the ecology – with greater abundance of sharks and coral trout are recorded from no-take zones, while higher frequencies of crown of thorns starfish outbreaks are recorded from multiple use areas (Australian Government 2009). Wood et al (2008) estimated that no-take areas represented only 12.8% of the total MPA network, but clearly such sites are of considerable importance. In considering targets for MPA coverage it is important to stress this importance and to encourage widespread use of different management strategies, zoned sites and especially of no-take areas.

Networks / Systems Characteristics

Currently the global set of MPAs cannot be viewed as an effective network or system of MPAs (see also, Wood et al. 2008), and it would be overambitious to expect a fully hierarchical network of networks across scales (e.g. national to regional to global) to be realised for some time. In the shorter term, progress is more likely to be made at national and regional scales. Indeed there are growing efforts to integrate the theory of MPA network design into real-world applications, such as in Australia and South Africa (Day and Roff 2000; Sala et al. 2002; Leslie 2005; Green et al. 2007; Lombard et al. 2007; Harris et al. 2008; Game et al. 2009 and see Chapter 2).

While such regional approaches are important first steps towards more effective networking of MPAs across scales, it is notable that in most areas, and particularly in off-shelf systems, no provinces currently have sufficient MPA coverage to indicate any semblance of a network or comprehensive coverage. Furthermore, for pelagic systems, there is growing evidence that for MPAs to be effective they will need to be either very large, or dynamic in space and time, in order to track the movement of oceanographic features or migratory species (Stefansson and Rosenberg 2005; Stefansson and Rosenberg 2006; Game et al. 2009). The current off-shelf coverage is not only too small, but it is also largely linked to the edges of provinces with closer links to landforms and to political landscapes than to the environmental factors which drive patterns of biodiversity in the ocean.

Moving Beyond the CBD Targets

Beyond 2010 it is clear that the growth of MPA coverage will continue, but there are also trends that may signal broader changes in the geography of MPA establishment. There is also an urgent need to build our understanding of how MPAs sit within a broader management regime of ocean space, and to consider how that wider framework of use and regulation can be best taken forward for conservation and for concomitant human benefits.

Future trends

It seems clear that the parallel trends towards the designation of very large MPAs in remote ocean space and the continued expansion of local MPAs, with varying but increasing levels of local involvement will continue. In off-shelf areas the move towards protection right out to EEZ boundaries is still relatively new – if adopted by other countries this could lead to a rapid increase in protection. Furthermore it could lead to levels of MPA coverage that are ecologically meaningful even at the scale of benthic and pelagic provinces in many areas. Trends in the High Seas are even more tentative, but patterns here appear to be more towards a gradual strengthening of existing fisheries regulations, with increasing use of spatial closures, increasing size of such closures, stronger support and more effective monitoring and policing. Such measures will likely fit within a wider regime of fisheries management measures. The challenges of monitoring and policing in these areas are diminishing with current and emerging technologies (Brooke et al. 2010).

Building a global system

In most areas the growth of marine protection has been *ad hoc* with individual designations gradually building up to form very loose networks. This is not always the case and there are good models of the larger-scale planning needed to build networks of MPAs (Sala et al. 2002; Ballantine and Langlois 2008; IUCN-WCPA 2008) with growing numbers of examples at national (Harris et al. 2008) and even regional scales (Ardron 2008, and see Chapter 4).

Extending efforts towards a truly global approach will require a re-focussing of effort notably, but not solely, to ensure coverage in off-shelf waters. Larger international agreements, such as the Ramsar and World Heritage Conventions may also play a part: both have already actively encouraged the designation of MPAs (Wood et al. 2008), as well as the development of representative systems. The recent development of the biogeographic classifications used in this chapter has been targeted at supporting the development of global representative systems and the adoption of the MEOW classification by the Ramsar Convention (COP10, Resolution X.20, Changwon, Republic of Korea) as a means to encourage global representative systems provides a valuable insight into one potential mechanism for adoption. More targeted approaches at global prioritisation have come from the adoption by COP9 in 2008 of criteria for the identification of areas of ecological or biological significance (EBSAs) in need of protection in the open ocean and deep sea in need of protection, and guidance for the design of representative networks of MPAs to protect these (Convention on Biological Diversity 2008). A further, overlapping mandate for protection comes from the UN General Assembly decisions regarding Vulnerable Marine Ecosystems (VMEs), which specifically mention certain key habitats ("seamounts, hydrothermal vents and cold water corals") and call upon states and RFMOs to sustainably manage and protect these (UN General Assembly 2006). FAO has further developed guidelines for the management of deep sea fisheries in the high seas that pays particular attention to the VMEs (FAO 2009).

Protected areas are only one means of sustainably managing marine space, and in many areas the wider use of ocean space is already highly regulated through coastal planning; restrictions on discharge;

Wandering Albatross in Kaikoura, Southern island, New Zealand © Imèn Meliane

Lagoons of New Caledonia © Dan Laffoley

shipping lanes and a vast range of fishing regulations. Even in the High Seas there are numerous regulations established under international law (ocean dumping, drift net moratoria, whaling controls) and a body of organisations exists with increasing strength and capacity to manage ocean space, such as the RFMOs. There is therefore a growing need to bring such approaches into a more holistic approach to ocean management of which MPAs are an integral part, as advocated through marine spatial planning and ocean zoning approaches (see Chapter 6). From the perspective of this study, a critical role in future assessments will be to try and understand this more complex framework of ocean use and management extending beyond the boundaries of MPAs. From a global perspective it will further be important to extend considerations of marine space from a narrow 10% and to set targets for the remaining 90%.

In conclusion, while the CBD targets for marine protection will not be met in time in most areas and jurisdictions, it seems highly likely that these targets have still played an important part to accelerate the policy and management response efforts to expand MPA coverage, which are a key component of biodiversity conservation (Chape et al. 2008). Furthermore, it is important to recognise that the timeframe for implementation of this target was quite short, yet there are timelags inherent in both the policy-level implementation of the targets, as well as their impacts on biodiversity. As such it may take more time before the full benefits of recent efforts, in response to the current CBD targets, can be observed and measured.

Beyond 2010, it seems clear that the growth of MPA coverage will continue, although the extent to which new designations will be developed as part of national, regional, and global networks, remains less apparent. The present work shows the urgent need to increase protection in off-shelf areas, building on the dramatic recent growth in areas under national jurisdiction, but also with the rapid expansion of protection in the high seas. Gaps in coastal and shelf areas cannot be ignored, and nor should gaps be filled solely by very large designations remote from population centres. Although the challenges of MPA establishment and management are far greater where there are other, ongoing uses of marine space, the benefits of protection in such areas, both to nature and to people will also be commensurately greater. Indeed factoring in ecosystem services or other socio-economic considerations into MPA design may be a critical part of MPA priority setting and network design. In this context, the formulation of post-2010 targets will be critical to support the most effective allocation of resources by countries to the implementation of spatial management and conservation measures. Targets may continue to be valuable in raising awareness, encouraging action, maintaining accountability and momentum, and facilitating information flow to support effective conservation and management of marine biodiversity and build on successes achieved to date. However, they must be both realistic and challenging, and may require some refinement beyond relatively simple benchmarks (see, e.g. Mace et al. 2010).

The need to monitor progress at all levels is important and there is a need to broaden our assessments to more comprehensively include issues such as MPA effectiveness, habitat coverage, and network characteristics. Such understanding can only be built through considerable investment in data gathering and management. There is also an urgent need to build our understanding of how MPAs sit within a broader management regime of ocean space, and to consider how that wider framework of use and regulation can be best taken forward for conservation and for concomitant human benefits (see Chapter 6 for more detail). MPAs, though necessary, are not a panacea and cannot be expected to deal with sheer volume and diversity of pressures facing the marine environment. Numerous measures other than MPAs are already in place and, although many only provide limited protection to elements of biodiversity, their inclusion in the assessment of conservation progress will not only help to complete the picture, but may provide critical encouragement that is needed to develop co-ordinated and integrated planning for the sustainable use of all ocean space.

Derelict Fishing Gear and Nets - Marine debris, like these discarded fishing nets, pose a major threat to marine life and the fragile coral reef ecosystems of the Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands ©Claire Fackler

Chapter 4
Meeting Global Goals at Regional Scales and in the High Seas

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Key Messages:

- Collaborative marine management partnerships among multiple sectors and stakeholders (e.g. Regional) can be cost-effective means for sharing scarce resources, personnel and skills.
- Both legislative (top-down) and community driven (bottom-up) approaches can be used to implement successful ocean protection measures.
- Aligning data, messaging and stakeholders is essential to successful MPAs.

Introduction

The establishment of MPAs is, in essence, a political process and to this end the great majority of MPAs have been established by national authorities, or by state authorities in some larger nations. Of course oceanographic patterns and processes have no cognizance of political boundaries. Over the last decade, many regional organizations have been dedicating efforts to improve larger-scale MPA planning and management.

There are many advantages to working on regional and even sub-regional scales. First, is the need to protect entire ecosystems that usually span across political boundaries. Next, is the need for legal instruments that allow for nations to work across boundaries of which many exist that allow countries to implement transboundary MPAs (e.g. Barcelona Convention). Finally, there are some cases is which scaling up appropriate local endeavors to regional ones can reduce costs, personnel, and governmental processes when compared to managing many small areas. However, increased efforts must be made to ensure the highest levels of communication and coordination, in order to avoid potential conflicts that could ensue due to increased number of partners and complexity.

As many nations increase their efforts to improve ocean management and achieve WSSD and CBD targets, regional approaches can provide a useful mechanism to share successful practices, lessons learned on how to overcome obstacles and accelerate progress on a scale commensurate with the issue of global ocean protection.

In this chapter, seven case studies (from the Caribbean, the Mediterranean, East Asia, West Africa, the United States of America, the South Pacific Islands and a general section on the High Seas) illustrate regional or sub-regional approaches on policy, data, and management effectiveness that are being pursued to help meet global conservation goals. Other examples exist throughout the world and these case studies are intended to be an illustration of regional successes, not a comprehensive review.

Table 4.1: Regional Protection Comparisons of Terrestrial and Marine Regions

MEOW Realms and Provinces	Shelf Area (km^2)	Marine Area under some form of protection (km^2)	% Marine Area Protected (within the coastal belt)*	WCPA Terrestrial Region	Total land area (km^2)	Land Area under protection (km^2)	% Land area protected**
Southern Ocean	792,253	28,330	3.58	**Antarctic**	14,024,832	3,470	0
Tropical Eastern Pacific	254,137	27,558	10.84	**Central America**	521,600	133,731	25.6
Temperate Australasia	1,025,333	56,288	5.49	**Australia / New Zealand**	8,011,930	831,420	10.4
Temperate Northern Pacific	3,029,022	74,156	2.45	**East Asia**	11,799,212	1,904,342	16.1
Temperate Southern Africa	284,261	7,225	2.54	**Eastern & Southern Africa**	11,487,920	1,825,918	15.9
				Europe	5,119,172	634,248	12.4
Western Indo-Pacific	2,233,848	39,119	1.75	**North Africa & Middle East**	12,954,170	1,226,928	9.5
Temperate Northern Atlantic	4,178,449	66,113	1.58	**North America**	23,724,226	4,231,839	17.8
Arctic	7,636,248	372,132	4.87	**North Eurasia**	22,110,050	1,789,006	8.1
Eastern Indo-Pacific	150,287	29,448	19.59	**Pacific**	553,058	54,949	9.9
Temperate South America	1,704,401	6,052	0.36	**South America**	9,306,560	2,056,559	22.1
				South America (Brazil)	8,547,400	1,305,864	15.3
				South Asia	4,487,510	339,058	7.6
Central Indo-Pacific	5,881,372	421,679	7.17	**South East Asia**	4,480,990	715,218	16
				Western & Central Africa	12,804,860	1,293,206	10.1
Tropical Atlantic	2,162,800	138,764	6.42	**Caribbean**	234,840	36,469	15.5
Totals	29,332,411	1,266,864			150,168,330	18,382,225	
Global Average			5.55				13.30

*Source PPO/WDPA 2008; Note some MPA #s are disputed. Regardless, there is clearly much less than the 10-30% CBD goals protected.
**Source Chape et al 2005, Measuring the extent and effectiveness of protected areas as an indicator for meeting global diversity targets.

Wider Caribbean: Building Networks Through Regional Agreements

Coral Reefs in Dry Tortugas Ecological Reserve. © Jiangang Luo

The Wider Caribbean region extends from South Florida south to French Guyana, including The Bahamas, Mexico, Central America, the Greater and Lesser Antilles, and Colombia, Venezuela, Trinidad and Tobago, Suriname and Guyana. It comprises 38 continental and island countries and territories and is occupied by one Coastal Biogeographic Province, the Tropical Northwestern Atlantic.

The harvest of fisheries resources in the region has exceeded the capacity of many fish stocks to replenish naturally. As a result, the abundance of fishes, lobster, and other species have declined to a point where some resources, such as Nassau grouper and queen conch, have become "commercially extinct" or very depleted in most countries. In addition to excessive fishing, major impacts to ecosystems include poorly managed coastal development and land-based and marine pollution, leading to the loss of critical marine habitats such as coral reefs, seagrasses and mangroves. Global changes associated with climate change may add to the effects of locally induced impacts. It is recognized that MPAs alone or in combination with other measures may not be adequate to keep corals from bleaching, for example, as it happening currently (as of Summer 2010). However, when there are problems that can be ameliorated through existing management options (such as functional MPAs), it is clear that they must be implemented to give the area the best chance at surviving catastrophic events.

In the Caribbean, with a long history of exploitation of coastal resources, creating incentives for having functional MPAs in the vicinity of local communities and tourist resorts is essential. For MPAs to be effective and accepted by the local community they should include a combination of no-take areas and areas of responsible fishing or other regulated uses. Recent studies of the economic value of coral reef areas in Belize, Tobago, St. Lucia and Dominican Republic have contributed to better understanding of the cost effectiveness of maintaining marine ecosystem health. The awareness of the economic benefits of healthy marine environments among governments and coastal businesses has prompted several initiatives and partnerships between marine resources management authorities and non-governmental conservation organizations with both big companies (developers, hotel chains, etc.) and local communities. Marine protected areas owned by government but managed jointly with private institutions (environmental organizations, academic centers, tourist operators) seem to have the highest likelihood to be effective in the long term.

During the last 15 years, some coastal communities adjacent to MPAs have seen reduced user conflicts, and fishers have shifted to less extractive economic activities which provide economic and social

Map 4.1: Map of the Wider Caribbean and its tentative units of biological connectivity of marine populations (dotted ovals depict less documented divisions). These divisions, based on larval dispersal modeling[1] suggest a more compartmented ecoregional scenario than previously thought, and can serve as a road map to establish transboundary coordination of marine managed areas.

1 Bustamante, G. and C. Paris. 2008. Marine population connectivity and its potential use for the nomination of new World Heritage Sites in the Wider Caribbean. Marine Sanctuaries Conservation Series, NOAA. ONMS-08-07, pp 97-112. (Proceedings of a Special Symposium, November 9-11, 2006, 59th Annual Meeting of the Gulf and Caribbean Fisheries Institute, Belize City, Belize) (http://sanctuaries.noaa.gov/science/conservation/pdfs/carib.pdf)

incentives to have environmentally healthy and well managed MPAs. That is the case of coastal towns next to Hol Chan and Port of Honduras Marine Reserves in Belize; the Soufriere Marine Management Area in St. Lucia; and within the Sian Ka'an Biosphere Reserve in Mexico, among others.

Most Caribbean countries are in different phases of development of national MPA systems. However, scientific evidence of the large-scale connection of fish and invertebrate populations suggest that a national system might not be enough for areas where marine populations are ecologically connected across countries. Transboundary or sub-regional coordination of marine and coastal managed areas with shared marine populations (fish, conch, corals, lobsters, etc.) might increase the effectiveness of their management and the resilience to climate change impacts, both in individual sites and within national systems. For example, countries that have endorsed the Caribbean Challenge (The Bahamas, Dominican Republic, Jamaica, Saint Vincent and the Grenadines, St. Lucia, Antigua and Barbuda and St. Kitts and Nevis) intend to set aside under protection 20% of their coastal areas by the year 2020 (see Chapter 6). But even with such impressive efforts, it may take a broader, transboundary/subregional ecosystem-based approach to accelerate progress to the desired levels. Strengthening communication among MPA sites and systems management authorities may contribute to scaling up conservation efforts from site to system to ecoregional levels.

Attributes that Make the Wider Caribbean a Potential Model for Transboundary Marine Management

There are many characteristics in the Caribbean that may facilitate scaling up to a subregional/regional approach to managing marine resources:

- *Similar climate and oceanographic conditions:* Tropical marine currents from the Atlantic Ocean that enter the Caribbean Sea, a semi-enclosed sea, from the Atlantic Ocean flow to exit mainly along the Gulf of Mexico and Florida coast as the Gulf Stream, and The Bahamas.
- *One marine biogeographic province with several ecoregions:* Although the region shares most marine populations (fishes, invertebrates, turtles, plants, mammals) the province is divided into distinct eco-regions or units of connectivity due to the existence of gyres and meandering currents that retain oceanic larvae. This ecoregional scenario may serve as a road map to develop subregional management of marine resources.
- *Tourism and fisheries are major industries:* In most countries coastal tourism is the dominant industry, and commercial fishing is common to all of them. Coastal development and overfishing have negative impacts throughout the region. Restoring and maintaining the ecological services of coastal habitats and populations is essential to the economic prosperity of most nations.
- *Few languages:* English and Spanish are the dominant languages, although French, Dutch, Creole and Papiamento are also spoken in some islands. Communication is easier than in many other regions of the world.
- *Similar historical and cultural heritage:* Similar patterns of colonialism and impacts of the slave trade shaped the formation of the Caribbean culture in the 16th-18th centuries.
- *Geographic closeness:* 38 Countries and Territories with approximately 5.8 million km^2 of combined Economic Exclusive Zones.
- *A regional intergovernmental agreement for coastal and marine resources:* The Cartagena Convention and its Protocols provide a legal framework to address issues for the protection and sustainable development of the marine environment, facilitate funding acquisition and foster regional cooperation.

CASE STUDY

Fishermen become allies in protection efforts in the caribbean

At the 62nd Annual Conference of the Gulf and Caribbean Fisheries Institute (GCFI) held in Venezuela in November, 2009, a Caribbean Fisher Forum cosponsored by UNEP, CaMPAM, GCFI and others, was attended by 25 fishers, and more than 150 marine scientists, college students and professors, as well as staff of governmental and nongovernmental agencies. This forum is part of a larger initiative (http://www.gcfi.org/Initiatives/FisheriesForFishers/FisheriesForFishersEng.html) aimed at incorporating fishers into the regional conservation dialogue and dissemination of best management practices. This dialogue showed that the problems are similar and require quick solutions to generate radical changes in the ways coastal resources are used in the 21st century. Among the measures and changes suggested are:

1. Grant exclusive fishing rights to traditional local fishermen in certain "areas of responsible fishing." This would generate a climate conducive to self-monitoring and control of resources, and create community management schemes that combine sustainable fisheries and tourism.
2. Increase the number and size of no-take areas (sanctuaries and reserves) within multiple-use managed areas (for conservation, fisheries, tourism, etc.).
3. Train fishermen and coastal communities to better understand the ecological functioning and value of their marine ecosystems and the promotion of alternative (non-extractive) livelihoods.
4. Increase the added value of fishery products for boosting competitiveness in domestic and international markets, and increase income with less catches.

These recommendations show that fishermen and marine managers in the Caribbean understand the need of spatial planning, and the development of new policies are essential if the marine resources are to be there to be available for present and future generations.

In order to expedite the process of ecologically-based MPA networks and coordination of transboundary national systems, human communication is critical. Social and professional networks of marine resource management practitioners are essential to facilitate learning and disseminate best practices for promoting the transition of coastal communities to sustainable livelihoods. In this context, the Caribbean Program of the United Nations Environment Programme (UNEP-CEP) created in 1997 the Caribbean Marine Protected Area Management Network and Forum (CaMPAM) to "enhance of marine and coastal area management in the Wider Caribbean Region through sharing and collaboration to strengthen our national and regional systems of existing and future marine and coastal protected areas". Its capacity building program comprises communication and training to facilitate the dissemination of best management practices and foster collaboration among MPA stakeholders.

Research data and management experiences in the Wider Caribbean suggest that scaling up coastal conservation from site to national to

ecoregional levels requires a recipe with some or all of the following ingredients: local socioeconomic incentives for MPAs; raising awareness that MPAs are not solely closed, no-take zones but are "marine managed area with multiple use" (strict preservation, regulated fisheries, etc.); fishers, tour operators and other stakeholders involved in management; granting fishers exclusive rights to operate inside and around MPAs; assisting local communities to transit to less extractive livelihoods; educating site and national stakeholders in the economic value of healthy marine ecosystems; and strengthening managers capacity using state-of-the-art training and communication tools. The biophysical scenario and socioeconomic conditions of the Caribbean provides this region with exemplary conditions to achieve the goal of developing effective systems of MPAs over the next 10-15 years. Implementing such measures will move the region closer to the goal of having "integrated coastal managed zones", a dream of the 20th century that is still waiting to come true.

East Asia: How Groups are Working Together Across a Vast Ocean Area

Fishing community near the Ang Thong National Park, Thailand © Imèn Meliane

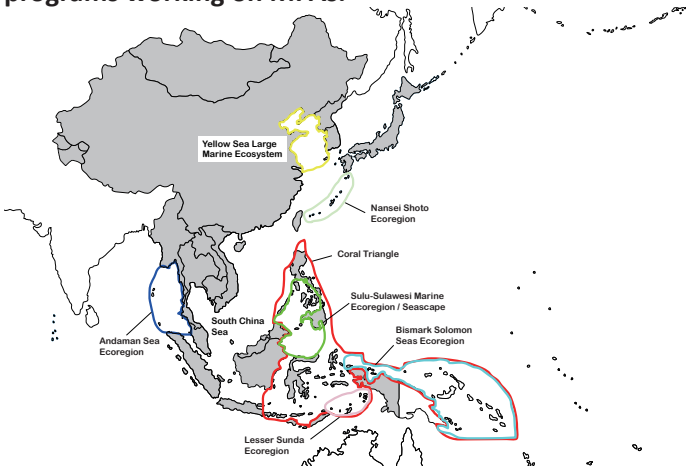
East Asia generally comprises of two WCPA-Marine Regions, the North-West Pacific and the East Asian Seas. The area includes a wide range of climate from sub-arctic in the north to tropical in the south, and part of the southern area is recognized as the global center of marine biodiversity, known as the Coral Triangle area (see Ch. 6 for more details). The region also supports the greatest human population in the world, and the majority of people live near the coast. There is a long history of people using and depending on the ocean through trade, food consumption and various cultural activities. The consequence of the increasing human pressure is not just resulting in the degradation of valuable marine and coastal resources, but more severely affecting the socioeconomic conditions of local communities that depend on these resources.

There are several ongoing MPA related initiatives and programs in the region but most of them are at sub-regional or national levels. One of the most recent initiatives that attempts to cover the entire region and focuses on MPA networks was conducted from 2008 to 2010 by the East Asian countries and partners using the International Coral Reef Initiative (ICRI) regional framework.

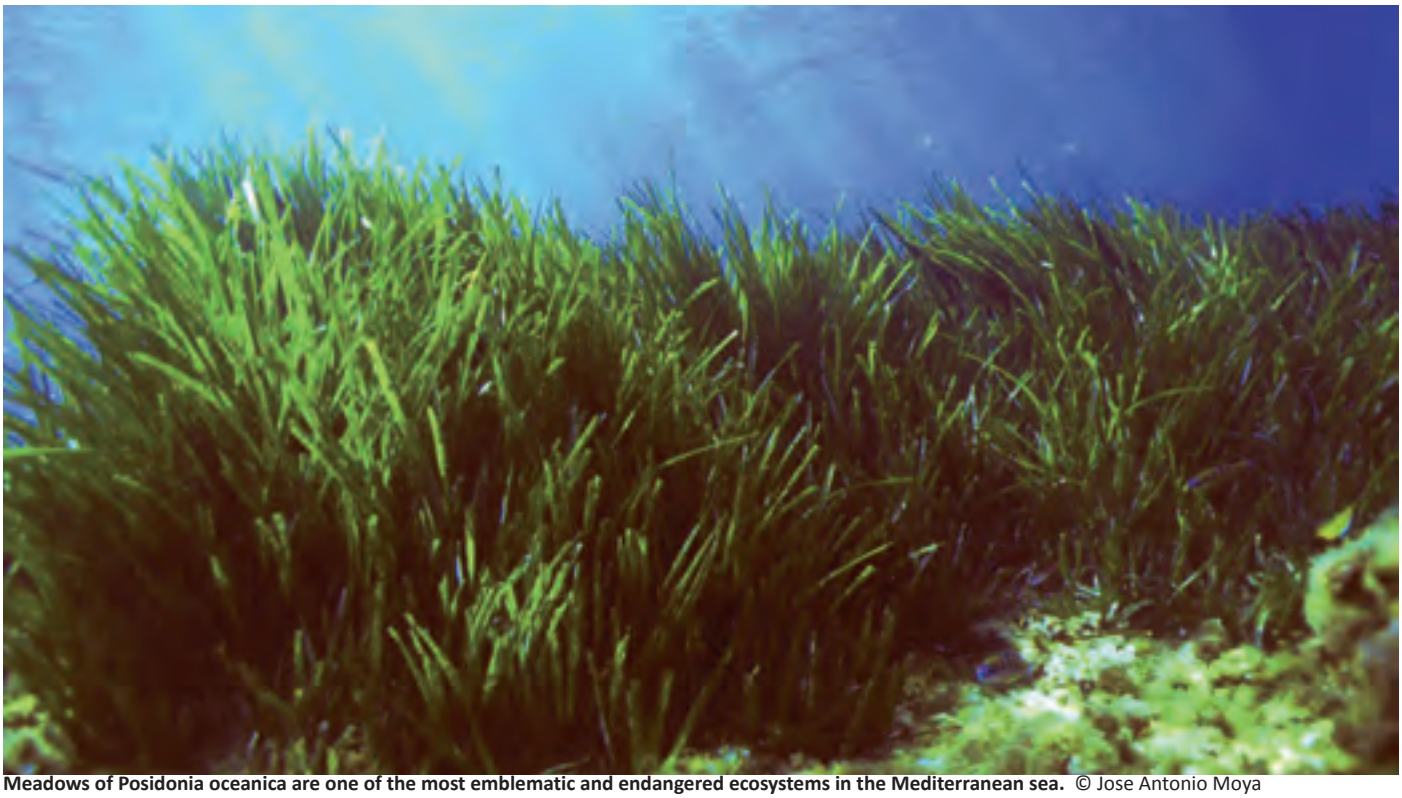
The activities supported by this initiative included: An upgrade the regional MPA database; implementation of a regional MPA gap analysis; identification of an appropriate MPA management effectiveness system; identification of appropriate MPA network guidelines; and a coral reef habitat mapping exercise done by remote sensing. One of the most successful achievements was the upgrade of the regional MPA database "Coral Reef MPAs of East Asia and Micronesia" (http://mpa.reefbase.org/). The database aimed to strengthen the usability for MPA planning and management by updating the data, improving the GIS system with multi-biophysical layers, adding analytical functions, and providing an online/offline updating system for countries to have their own virtual MPA database on their website.

These activities were collaboratively implemented by a voluntary working group and discussed in the three consecutive ICRI East Asia Regional Workshops during 2008 to 2010. The results of the discussions and feedback gained throughout the process were reflected in the *ICRI East Asia Regional Strategy on MPA Networks 2010*. The document focused on the development of a sustainable regional support mechanism, tangible follow-ups of the activities during 2008 to 2010, and a series of socioeconomic guidance on MPA network development in East Asia (http://earw.icriforum.org/home.html).

Map 4.2: Map of East Asian countries and biogeographical area of relevant initiatives and programs working on MPAs.



The Mediterranean[1]: Building a Regional Picture Combining Knowledge from Disparate Sources

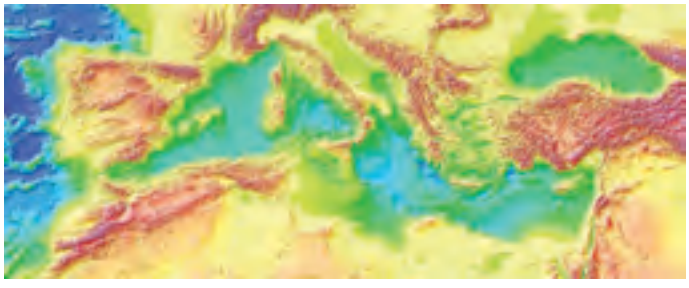


Meadows of Posidonia oceanica are one of the most emblematic and endangered ecosystems in the Mediterranean sea. © Jose Antonio Moya

Considering its small dimension (less than 1% of the world's ocean area), the Mediterranean is one of the world's conservation priority areas; The Mediterranean Sea includes 6% of the world's species in less than 1% of the world's ocean area, and while much of the fauna is of Atlantic or Red Sea origin, the levels of endemism are also high, including some emblematic species of global conservation concern. It contains 46,000 km of coastline and about 2.5 million km^2 of sea. Within its waters live 20 species of marine mammals (including the critically endangered monk seal), 5 species of sea turtles, 750 species of fish (including sharks and rays) and the main spawning grounds of the Atlantic bluefin tuna. Due to its small size and high population, the regional threats to this region are intensive and unrelenting, including overfishing, unsustainable tourism, land and sea based pollution and vessel traffic.

Fishing in the Mediterranean is a major economic activity in terms of jobs, revenue and food supply and is an important component of the Mediterranean diet – having been one of the pillars of the Mediterranean civilization and culture. However, the increase in demand along with the increase in population has led to a generalized over-fishing trend in the region. In addition to over-fishing, the industry faces other problems such as poor knowledge of the biology of juvenile stages and fish migration patterns; insufficient quality of Mediterranean fish statistics; and lack of integration between fishery biologists and fishery managers. Overall vessel activity within the Mediterranean has been rising steadily over the past 10 years and is projected to increase by a further 18% over the next 10 years. The maritime traffic sector is known to cause many threats to marine biodiversity. This sector is growing rapidly and is expected to become three times larger in the next twenty years due to the intensification of transportation needs and global commercial exchanges. Pollution, dumping, oil spills and negative interactions with species are all increasing throughout the Region. The Mediterranean also remains a key world tourism destination. Of the 220 million tourists who visit the region every year, over 100 million visit Mediterranean beaches. Mass tourism has led to degraded landscapes, soil erosion, increased waste discharges into the sea, loss of natural habitats, higher pressure on endangered species and heightened vulnerability to forest fires. It puts a strain on water resources and often leads to cultural disruption. Other threats to the marine environment are invasive marine species and climate change. Many of these threats can be addressed, at least in part, with the implementation and effective management of marine protected areas.

Map 4.3: An Interactive Global Map of Sea Floor Topography Based on Satellite Altimetry & Ship Depth Soundings. Meghan Miller, Walter H.F. Smith, John Kuhn, & David T. Sandwell. NOAA Laboratory for Satellite Altimetry. http://ibis.grdl.noaa.gov.



1 More information can be found in The Mediterranean and Black Sea Region: Celebrating successes and addressing challenges in marine protected areas. Vol. 1 in Protect Planet Ocean Review Series. 2009. IUCN, and in Abdulla, A., Gomei, M., Maison, E. and Catherine Piante (2008). Status of Marine Protected Areas in the Mediterranean Sea. IUCN, Malaga and WWF, France.

The Mediterranean Region is on par with other regions of the world with ~1% of their marine area protected (Table 4.1); however that number jumps to ~4% if the Pelagos Sanctuary[2], the world's first high seas MPA, is included. Though this is far less than the 10% target set by the CBD, certain nations of the Region are proudly accelerating their pace in attempt to reach their goals (e.g. France). All MPAs are located in coastal waters under national jurisdiction, with the exception of Pelagos, and are mainly located in the northern shores of the Region (with the exception of a few Southern sites). Unfortunately, even with such protection progress there are still disparities in MPA distribution resulting in many habitats and biomes without protection and spacing between protected sites too wide to ensure larval exchange. Management is still not adequate in approximately half of the MPAs of the region, often due to a lack management plans, limited information on natural resources, low or no enforcement and surveillance, limited human and financial resources, facilities and equipments such as boats, visitor centres, and diving equipment. In addition, ecological and socioeconomic monitoring is not common practice in the Mediterranean.

The Region is committed to ocean protection primarily through various means, including the CBD commitments and the Barcelona Convention. According to the findings in this report and through the recommendations of MedPan, the MPA Managers Network of the Mediterranean (find more information at www.medpan.org), all nations throughout the Mediterranean Region need to:

- Increase and accelerate MPA development,
- Develop a coherent, viable network of MPAs through regional networks,
- Improve management effectiveness of existing MPAs including increasing communication between social networks,
- Work across political boundaries at a Regional scale to abate the most destructive fishing efforts, pollution and development issues, and
- Create national and multi-national management frameworks that include an ecosystem based approach.

The first step in addressing these goals was to create a common, regional data platform from which to work. To come together as a region and work towards protection goals, the difficult yet necessary task of aligning data needed to be managed. To that end, IUCN embarked on a regional MPA analysis of this region (IUCN, 2009; Abdulla et al 2008), and the first step was to assess what MPAs and MPA Networks currently exist. What was found was a multitude of data sources, availability and detail, even between databases that were thought to be similar (i.e. WDPA and MPA Global). To address the diversity in available data, IUCN took on a reconciliation process of the multiple databases available (i.e. ProtectPlanetOcean, MedPan, WDPA, and MPA Global). The findings from this reconciliation will feed (concerning core data of MPA : GIS layer and general characteristics of the MPA) into a single platform, Protected Planet (www.protectedplanet.net), the most up to date platform for the WDPA, and the only one globally reported to by Countries on a regular basis.

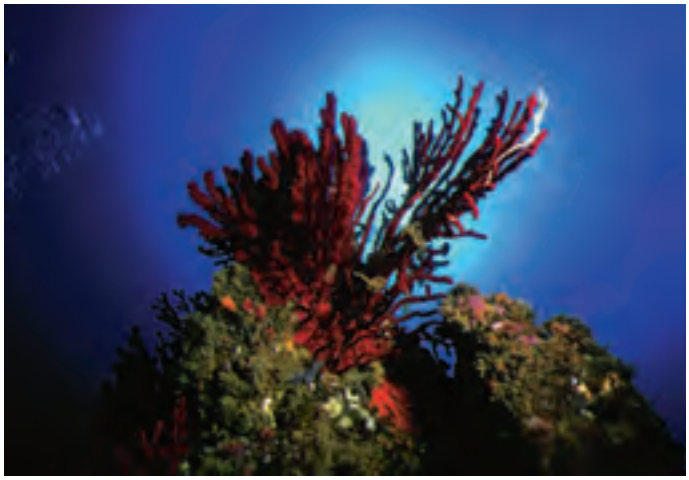
2 The Pelagos Sanctuary for Mediterranean Marine Mammals is a vast marine protected area extending over 87,500 km2 of sea surface in a portion of the north-western Mediterranean Sea between south-eastern France, Monaco, north-western Italy and northern Sardinia, and encompassing Corsica and the Tuscan Archipelago. The Sanctuary waters include the Ligurian Sea and parts of the Corsican and Tyrrhenian Seas, and contain territorial waters of France, Monaco and Italy, as well as the adjacent high seas.

The importance of data reconciliation/working from a common database cannot be overstated. In a region with 23 countries, more than 20 languages, and nearly 300 million people dependent on a comparatively small area (46 000 km of coastline) , coordination and communication are essential. If those working on ocean protection are working from various definitions of what their region is, what an MPA is, or where boundaries lie, it can become even more difficult to work together. Reconciling those data at the same scale is often time and money intensive but the benefits of a shared platform outweigh the upfront costs.

To initiate this process, four databases (WDPA, 2009; Protect PlanetOcean, 2010; MedPan 2010; MPA Global 2009) were compared and contrasted. A hierarchy was created with the most current and up-to-date database used as a base (MedPan) and compared to the world standard (WDPA). Gaps were filled in the WDPA database with MedPan data when available; if no data was available in MedPan files, gaps were filled in using Protect Planet Ocean and MPA Global, respectively. Once this initial reconciliation process was completed, new entries to the WDPA were notes as were still conflicting entries (e.g. multiple entries for the same location, conflicting dates of implementation, conflicting sizes). The conflicting entries were then sent to individual MPA managers for review. Their corrections were added to the database and the final batch of gaps that were filled and new entries were sent to WDPA to upload.

This was a time consuming and challenging approach to data management, however it became clear that there were so many inconsistencies between data sources that only a line by line comparison, as was done here, would suffice in correcting the data. The cost (aside from staff time) was low and will serve the region and world with the most up to date and accurate MPA data yet. Currently, an additional process is underway in the region to explore each entry even further and involve additional sub-regional databases, more experts and additional methodology. The next steps in this initiative, which was launched at the regional level between regional partners (RAC/SPA, IUCN, WWF, MedPAN, Conservatoire du Littoral), are to build a common database of MPAs which will be linked with ProtectedPlanet (the newest version of the WDPA).

With one globally approved database for protected areas (WDPA), it is essential it is updated with the most up to date data available and is corrected by experts. Approaching this daunting task at a regional level involves the key stakeholders, allowing for a wide range of input and, in the end, creating the best data all parties can work from.



Red gorgon in Cap de Creus, Spain. © Jose Antonio Moya

West Africa: High Level Government Collaboration

Fishing boats along the coast between Nouakchott and the Banc d'Arguin National Park in Mauritania. © Hellio - Van Ingen

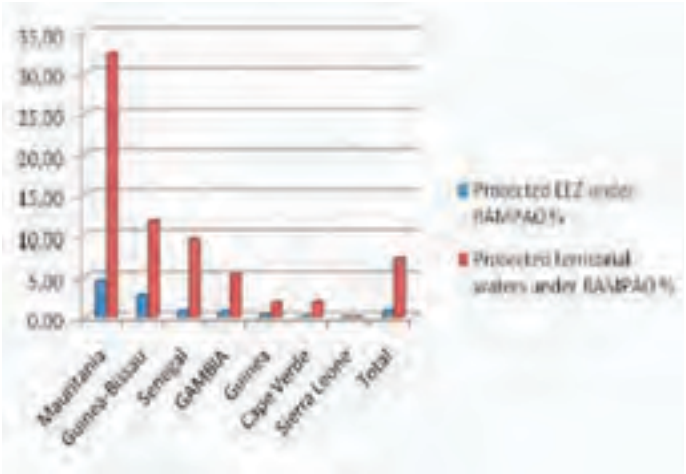
The West African marine region extends southwards from Morocco to South Africa; it spans 14 000km of coast and includes 24 countries. This region presents a wide variety of ecosystems, from rocky cliffs and broad sandy beaches to extensive sea grass beds, island systems, dense mangrove forests and well-developed and productive estuaries, wetlands and coastal lagoons (Figure 4.1).

For several years, seven countries (Mauritania, Senegal, Guinea Bissau, The Gambia, Cape Verde, Guinea and Sierra Leone) have been implementing activities for better coordination of the fisheries management - the subregional fisheries commission. Those countries are included in the West African transition and the Cape Verde ecoregion, but are also partially covered by the western Gulf of Guinea. Overfishing, both from artisanal and industrial fisheries, represents the major concern in the region and has led to important declines in fish stocks. In addition, marine resources are threatened by habitat modification and destruction, uncontrolled urbanization, erosion and pollution, with increasing risks from emerging activities associated with the oil and gas and mining industries.

Most striking biodiversity features in the region are: the largest breeding colony of monk seals on Earth, one of the 10 top global hot spots for coral communities, the most important breeding sites for green and loggerhead turtles on the Atlantic coast, high concentrations of migrating birds and several species of cetaceans, including dolphins and whales. Due to the cold water upwelling zones, this region is characterized by a very high productivity, ranking second in the world in terms of primary productivity and featuring the highest level of fisheries production in Africa.

Increasing pressure on coastal and marine resources has led to the accelerated depletion of critical habitats, key species and strategic resources for local communities and national economies in the West Africa region. The objectives for the establishment of marine protected areas (MPAs) are thus diverse and include the conservation of biodiversity, the contribution to sustainable fisheries management, the promotion of local socioeconomic development and the conservation of cultural heritage.

Figure 4.1: Country profiles of protection in the region



Map 4.4: Location of West Africa project

The challenges arising from strong ecological, social and economic interactions between the sites and the countries led the core actors to implement a concerted approach in order to tackle the identified common issues related with the sustainable management of coastal and marine resources (FIBA/WWF/UICN 2000).

The establishment and strengthening of a representative and coherent network of marine protected areas at the regional level is considered the highest priority in the joint strategy (PRCM 2003). This strategy was elaborated by representatives of governmental and non-governmental institutions, and research institutes which led to the creation of a regional, multi-actor conservation program (PRCM[3]) which is being implemented with the joint support of international conservation organizations[4], in close collaboration with an intergovernmental body, the subregional fisheries commission.

The West African regional MPA network (RAMPAO) was officially created in 2007 as the result of an extensive consultation process, with the objective of maintaining at the marine ecoregion a coherent set of critical habitats in order to ensure the ecological processes that are essential to the regeneration of natural resources and to preservation of biodiversity on behalf of the communities. To achieve this goal, the RAMPAO seeks to enhance cohesion within a group of ecologically representative MPAs, increase exchanges and mutual learning between the members, improve MPAs management effectiveness, and increase mutual capacity building and advocacy on common issues in the region at international level (RAMPAO 2007a, RAMPAO 2007b).

One of the key success factors for RAMPAO network is the high level of political commitment from the involved countries' decision makers. A general policy declaration in support of the regional strategy that recognizes the need to establish a regional network of MPAs in West Africa was signed by 10 ministries in charge of protected areas, environment and fisheries in 6 countries. Following the official creation of the network, this was formally recognized through a ministerial declaration involving the same ministries. In that declaration the governments have committed themselves to support the strengthening of the RAMPAO and to reinforce its subregional representativeness, coherence and functionality, to enhance cooperation among institutions and across countries, to promote the integration of the regional priorities of the Network's action plan into national programs and to facilitate the co-ordinated and efficient access to funding in support to the network's functioning, priority projects and activities.

Today the RAMPAO includes 22 MPAs from 5 countries (Mauritania, Senegal, The Gambia, Guinea Bissau and Guinea), including a wide range of management categories and governance types. The network covers 18,867 km^2, which represents more than 92% of the total area under protection.

More than 70% of the total RAMPAO area is marine, however this represents only about 7% of the total territorial waters and only about 0.7% of the total EEZ. In fact some countries have already achieved considerable results in protecting the marine environment; this is the case for Mauritania where more than 32% of the territorial waters are within the MPA network or Guinea Bissau with around 12% and Senegal with almost 10% (Fig. 4.1).

Coastal habitats such as mangrove forests constitute the most represented ecosystem in the network, followed by humid forests, sea grass and salt marsh. Some critical areas are however not yet included. Any new MPA nominated to the network must have official recognition, along with geographic boundaries and management objectives. For community-based MPAs, that recognition can be in the form of a decision taken by the decentralized local or customary authorities. Furthermore, new MPAs must be prioritized using the CBD criteria for identifying Ecologically and Biologically Significant Areas (EBSA) (COP 9 Decision IX/20 Annex 1) and guidance for designing representative networks of marine protected areas (COP 9 Decision IX/20 Annex 2).

Planned next steps for the RAMPAO include the analysis of the network's level of representativeness, connectivity, replication and viability and the identification of new priority sites to be included. The main priorities and challenges for the RAMPAO include:

- The better integration of MPAs and the network in the sectoral policies;
- Improving the ecological representativeness and the coherence of the network according to its objectives;
- Enhancing the effective and equitable management of the member MPAs;
- Identifying and implementing sustainable funding mechanisms or the MPAs and the MPAs network; and
- Strengthening the functioning and institutional capacities of the network.

3 Regional program for the conservation of the coastal and marine zone in West Africa (French acronym PRCM)

4 IUCN, International foundation for the Banc d'Arguin FIBA, WWF and Wetlands International

The United States: Building a Systematic Network With a Scientific Base

A Marina and Golf Course sit along the San Francisco Bay. The Coyote Point Marina, the Poplar Creek Golf Course and a power substation are just some of the uses for the heavily developed shore along the San Francisco Bay near San Mateo, California.© Gerick Bergsma

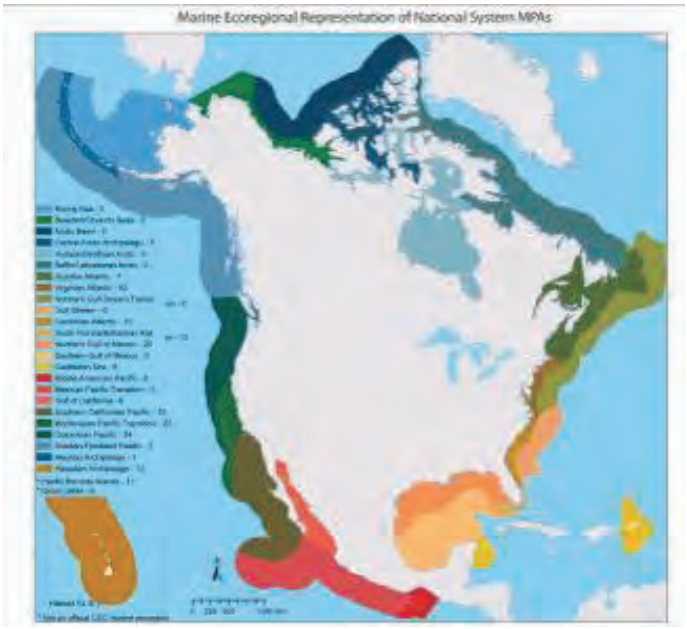
Although the United States is a single country, its EEZ is the largest in the world, spanning over 12 million km^2, including all of its overseas territories, and can therefore be an example of scaling up to a large-scale MPA effort. As noted in the Framework for the *National System of Marine Protected Areas of the United States of America* (http://mpa.gov/nationalsystem/framework), these marine areas are threatened by "coastal and offshore development, overfishing, a changing climate, natural events, and other sources straining the health of marine ecosystems and the Great Lakes. Impacts to these intricately balanced environments include declining fish populations, degradation of coral reefs and other vital habitats, threats to rare or endangered species, and loss of artifacts and resources that represent the diverse cultural heritage of the United States. The effects of these losses are significant and jeopardize the social and economic fabric of the nation."

With such a large area, a system was needed coordinate the diverse marine areas under protection by federal, state, territorial, tribal and local authorities. To that end, in 2009, the United States established the National System of Marine Protected Areas to support the effective stewardship, conservation, restoration, sustainable use, understanding and appreciation of the nation's marine resources. Currently, there are over 1,600 federal, state and territorial MPAs in U.S. waters. The national system is a subset of MPAs that meet entry criteria (meet the definition of "MPA"; have a management plan; support at least one goal and objective of the national system) and nominate themselves because they want to work collaboratively on conservation issues of common concern. Currently, the national system includes 254 federal, state and territorial MPAs, and will expand over time through an annual nomination process. In all, the system includes sites in 31 states and territories, plus additional offshore areas under federal jurisdiction. The national system has three goals: conserving and managing

National System Sites At A Glance

- The national system contains 254 sites and covers an area of 175,000 square miles
- 4% of U.S. waters (0-200 nautical miles, including estuarine areas and the Great Lakes) is covered by the national system sites
- About 27% of the total area of all national system sites is considered no-take, and this is primarily located in the large, highly protected Papahanaumokuakea Marine National Monument in Hawaii
- All 21 of the national system's priority conservation objectives are addressed by national system members
- Every major marine ecoregion in the U.S. is represented in the national system

Map 4.5: Map of North America highlighting the United States by Ecoregion



natural heritage, conserving and managing cultural heritage, and the sustainable production of marine resources. Of the 254 national system sites, the U.S. Fish and Wildlife Service manage 106 sites (42%). The National Park Service manages 29 national system sites, or 11%. All of the 13 (5%) National Marine Sanctuaries are included in the system, as well as five (2%) National Estuarine Research Reserves. Altogether, 58% of the national system sites are managed by Federal agencies, while 37% are managed by state agencies. The remainder is managed by federal/state partnerships or territories.

The national system coordinates MPAs managed by diverse agencies across all levels of government to work toward national conservation objectives described in detail in the *Framework for the National System of Marine Protected Areas of the United States of America*). The national system helps the U.S. address international commitments, such as those made at the 2002 World Summit on Sustainable Development and the G8 Group of Nations to establish MPAs consistent with international law and based on scientific information. The national system is also an integral part of the North American MPA Network (NAMPAN), a cooperative effort with Canada and Mexico, coordinated by the Commission for Environmental Cooperation. NAMPAN is implementing a shared approach across the three countries toward MPA condition reports, a cooperative education initiative, and developing guidelines for identifying priority conservation areas in light of climate change impacts in the ocean. The national system also helps support U.S. commitments under the Protocol Concerning Specially Protected Areas and Wildlife (SPAW Protocol) of the Cartagena Convention to protect, preserve and sustainably manage areas under U.S. jurisdiction, including areas that require protection to safeguard their special value, and threatened or endangered species of flora and fauna. By establishing the national system as a framework for coordination for the SPAW Protocol, the U.S. will be better positioned to address capacity building and collaboration both domestically and internationally within the region.

The majority (65%) of the total area of the national system is in either uniform or zoned multiple use sites that allow a variety of human activities, including fishing and other extractive uses. In contrast, about 27% of the area of the national system is considered no-take and prohibits the extraction or significant destruction of natural or cultural resources. Papahanaumokuakea Marine National Monument in Hawaii, a zoned site that has eleven no-take zones covering approximately 44,000 square miles, makes up nearly all of the no-take area in the national system. Less than 1% of U.S. waters overall are no-take.

The National Marine Protected Areas Center also launched a new interactive online mapping tool that allows users to view boundaries and access data for more than 1,000 marine protected areas (MPAs) in the United States (www.mpa.gov). The tool provides an interface to explore MPA information that was previously limited to expert geographic information system users. The site has easy-to-use functions to visualize MPA boundaries, review MPA classification information (e.g., level of protection, managing agency, fishing restrictions), and explore all MPAs in a given location.

The National System of MPAs was established to both strengthen and expand protection of marine resources through MPAs. The system is working to support existing federal, state, and territorial MPA programs through technical assistance, training, and a new partnership with the National Fish and Wildlife Foundation to provide MPA Partnership Grants to national system members to work together on common conservation priorities. The national system will also support the protection of marine resources by informing decisions about the establishment of new MPAs by providing data, information and tools on ecologically important areas and human uses of the ocean. These efforts will be coordinated with the U.S. Ocean Policy, including the Coastal and Marine Spatial Planning Initiative.

Oyster reefs in the Virginia coastal reserve. © Robert Brumbaugh

The South Pacific: Local Uptake at a Regional Scale

Namena Reserve Fiji - Namenalala Island, at the heart of the Namena Marine Reserve, Kubulau, Fiji © Stacy Jupiter

The Pacific islands region encompasses an ocean expanse that stretches some 10,000 kilometres from east to west and 5,000 kilometres from north to south, with a combined EEZ close to 38.5 million km². The region represents one of the most biologically and culturally diverse areas on the planet. The small island nations of the region are surrounded by rich coastal and marine ecosystems including mangroves, seagrass beds, coral reefs and estuaries, as well as extensive deep waters in their exclusive economic zones and beyond. The Pacific Islands are home to a great number of indigenous populations who have retained robust cultures, over a thousand distinct languages, and strong traditional attachments to the land, sea and natural resources. There is a high cultural and economic dependence on marine and terrestrial resources for daily needs such as food, water, shelter and medicine, and much of the use and management of resources is arranged through customary tenure systems that cover over 81-98% of land areas in independent Melanesia and Polynesia (with the exception of Tonga). Customary marine tenure is also common, with seaward boundaries ranging from coastal and outer reefs to offshore fishing areas (Govan, 2009). The conservation and sustainable use of biodiversity is therefore critical not only for social and economic development, but is also supported in many areas by cultural and spiritual tradition. The latter has given rise to strong community-based initiatives towards the management and conservation of marine and coastal biodiversity.

Pacific Island Countries and Territories are experiencing high population growth (the population of 9.3 million is projected to double in the next 30 years), which combined with poor economic performance and poverty in some areas increases pressures on natural resources. In many countries, the rapidly expanding population is reliant on fish as a major source of protein, further increasing the demand for this resource. In general, both subsistence and commercial activities are impacting forests, agricultural land and fisheries resources (Govan, 2009).

Many current conservation and management approaches, including the ecosystem approach and marine protected areas, have been traditionally applied in a number of Pacific Island communities. For example, traditional watershed management "units" reaching from the mountaintops to the reef (such as the ahupua'a in Hawaii, vanua in Fiji and tapere in the Cook Islands) are an application of the ecosystem approach (Ruddle and Hickey, 2008). Many Pacific Island communities have traditional systems of "setting aside" areas and using time-based restrictions to facilitate the recovery of marine resources. The methods used include seasonal bans on harvesting, temporary closed (no-take) areas, and restrictions on time, places and species or taking by certain classes of persons. Closed areas include the tabu areas of Fiji, Vanuatu and Kiribati, the ra'ui in Cook Islands, the tambu in Papua New Guinea, the bul in Palau, the mo in the Marshall Islands, the kapu in Hawaii and the fono in Niue (Govan et al. 2008a, Parks & Salafsky 2001, Vierros et al. 2010).

Traditional systems were generally not applied with biodiversity conservation in mind, but were instead aimed to benefit communities. For example, in Hawaii, kapu areas, or fishery closures, were often put in place to ensure catches for special events or as a cache for when resources on the regular fishing grounds ran low. Thus, while

Map 4.6: Map of Pacific Islands Region (Benzaken et al. 2007).

the primary aim of these traditional management practices was to benefit communities, they have in most cases been successful in also delivering fisheries and biodiversity outcomes (Vierros et al. 2010).

During the last decade, there has been a revitalization of traditional management systems and traditional tenure (Govan et al. 2009; Ruddle & Hickey, 2008; Vierrros et al. in press). These revitalized customary practices have changed through the years in response to societal and economic changes (Johannes & Hickey, 2004). One aspect of this has been the proliferation of community-based marine managed areas., An example is provided by Locally Managed Marine Areas (LMMAs) which constitute areas of nearshore waters actively being managed by local communities or resource-owning groups, or being collaboratively managed by resident communities with local government and/or partner organizations. An LMMA differs from what is commonly known as a Marine Protected Area (MPA) in that LMMAs are characterized by local ownership and/or control, whereas MPAs are typically designated by local or national governments, often via a top-down approach. Marine managed areas in the Pacific Islands region mainly correspond to IUCN management categories V ("The preservation of longterm and sustainable local fishing practices or sustainable coral reef harvesting) and VI ("predominantly natural habitats but allow the sustainable collection of particular elements, such as particular food species or small amounts of coral or shells"). One or more MPAs or other management techniques or "tools", including commonly a variety of fisheries management tools (such as no-take areas, seasonal harvest and rotational harvest areas, species-specific harvest refugia, and restriction of fishing or harvesting effort) may be employed within an LMMA. In using an LMMA approach, some coastal communities are reviving methods that have been used traditionally as part of their culture for many generations. Others are using a combination of local knowledge and western science (LMMA network, 2010).

According to a recent study (Govan et al. 2009), marine managed areas are now implemented by over 500 communities, spanning 15 independent countries and territories, and they are virtually the only type of marine protected area pursued in the independent countries of the North/South Pacific WCPA Region. The dependent states and territories are using more western-style protected area approaches.

Recently, many community-based resource management practices haves been strengthened by their incorporation into national law, and into national strategies for biodiversity conservation and natural resources management. For example, Papua New Guinea, Vanuatu, Fiji and Samoa acknowledge the value of community law in their national legislation and have recently made progress in forming partnerships between communities and national agencies for conservation. However, the integration of traditional practice and national law are not always without challenges, as demonstrated by a recent study on the synergies and discord between national laws and community management rules in Kubulau District, Fiji (Clarke & Jupiter, 2010).

Community-based marine management initiatives have a central role to play in reaching national, regional and international biodiversity and MPA targets in Pacific Island countries, and their role is explicitly recognized in the Micronesia Challenge, as well as in many national biodiversity strategies. Because they are built on customary tenure systems and traditional sustainable management methods, LMMAs and similar approaches are likely to be more successful in providing biodiversity outcomes in the Pacific Islands than western-style MPAs (Ruddle & Hickey, 2008). It also appears that the IUCN definition of MPAs (particularly categories V and VI) is broad enough to encompass

Quick Facts About LMMAs

Linking Conservation and Culture: The main driver leading to the establishment of LMMAs is a community desire to maintain or improve livelihoods, often related to perceived threats to food security or local economic revenue. In the Pacific Island countries, conservation and sustainable use are often seen as inseparable, and are part of the surviving concept of traditional environmental stewardship, in which caring for resources is a duty towards future generations. In general, LMMAs have succeeded in creating economic benefits for communities while providing for sustainable use of marine resources.

In Fiji, monitoring has demonstrated the real impact of the approach in economic terms, including increased harvests and sustainability of marine resources. Results since 1997 have included a 20-fold increase in clam density in the *tabu* areas; average of 200-300% increase in harvest in adjacent areas; tripling of fish catches; and 35-45% increase in household income (Aalbersberg et al. 2005).

LMMA Size: varies widely from small to relatively large (the largest LMMAs, Macuata and Yadua Taba in Fiji, cover an area of more than 1000 km^2 each).

No-take Areas: Generally small (less than 1.0 km^2). Not permanent, opened to harvest occasionally (for example on special occasions, such as major feasts) or regularly, (for example as part of annual rotation). The smaller reserves may be well suited for meeting fisheries, livelihoods and community engagement goals, as evidenced by the documented increases in resources within closed areas.

Biodiversity benefits: Localized recovery or protection of vulnerable species (large food fish or marine turtles).

Future management: Attainment of broader biodiversity and resilience-building goals would likely require the integration of LMMA approaches into wider ecosystem-based management that incorporates entire watersheds and operates in the context of adaptive management (Govan et al. 2009).

traditional marine managed areas. Similarly, the CBD definition of marine and coastal protected area (MCPA) encompasses LMMAs and other traditional marine managed areas, and thus provides for their application to meet countries' obligations under the CBD, including in contribution towards international MPA targets.

While it is becoming clear that Pacific Island Countries are using LMMAs and other traditional marine resources management methods to contribute to the attainment of international protected areas and conservation targets, their role in this regard is often not recognized internationally. Accurate information about their numbers, size and coverage is lacking, as many countries do not maintain up-to-date national lists. Lists maintained in global databases (such as the World Database on Marine Protected Areas) do not always include smaller, locally-managed areas, and traditional closures that are temporary in nature are difficult to accurately report (sometimes resulting in over-reporting) (Govan et al. 2009). Information about LMMAs and other traditional marine managed areas is often not included in national reports to various conventions, such as the CBD, particularly in countries where such areas have no legal recognition (Vierros et al. 2010).

Protection Progress In The Region

On average, between 3 and 4% of territorial seas are protected in the region, with Fiji and New Caledonia reaching 10% and 24% protection respectively. Marine managed area coverage represents under 0.2% of the combined national EEZs, and only Fiji (0.8%) and New Caledonia (0.9%) are within reach of the global average of 1.5% of EEZ protected (Govan et al. 2009).

While most LMMA sites are located in clusters, networks or groupings, the sites have been mainly selected with social, logistical or political factors in mind, rather than according to ecological criteria. Although some ecologically-based LMMA networks exist, they are a minority. This is due to the fact that bottom-up approaches do not lend themselves very easily to external planning guidance, and selecting sites based on geospatial data can be costly particularly if the established sites have to rely on incentives or investments of external resources to survive (Govan et al. 2009, Ruddle & Hickey, 2008).

The strength of community-based approaches in the Pacific Islands is their sustainability, adaptive nature, and ability to enhance community resilience and self-sufficiency in a time of change. While these approaches alone are likely not enough to develop ecologically representative regional networks, particularly in the deeper ocean, they provide building blocks that can be integrated into wider national and regional strategies, as has already been done in the context of national marine protection efforts in at least Palau, the Federated States of Micronesia, Fiji and Samoa. Strengthening LMMAs and other traditional marine management systems in the context of national strategies relating to biodiversity conservation, fisheries management, climate change adaptation and poverty alleviation are particularly important at a time when many MPAs established through top-down processes have failed to reach their management objectives, and are in danger of becoming paper parks.

Advancing Conservation of the Open Oceans and Deep Seas Within and Beyond National Jurisdiction

Introduction to deep and open oceans

The open oceans and deep seas cover more than half of the planet and account for the largest part of the ocean. Of that vast area, the majority lies beyond national jurisdictions of coastal States. These areas contain not only the majority of ocean by volume, but also provide critical oases (feeding, breeding or nursery areas) for highly migratory species such as cetaceans, turtles, tuna and seabirds, and house benthic communities of breathtaking beauty and scientific significance. In addition to their unique and often highly specialized biodiversity, they contribute to the provision of important ecosystem services, such as production of oxygen, food and the regulation of the Earth's climate.

As illustrated in chapter 3, efforts to establish MPAs have often concentrated in coastal and shelf areas where both knowledge of and pressures on the environment and resources are highest. Offshore, the open ocean and deep sea remain largely unprotected, particularly in areas beyond national jurisdiction.

With advances in technology, human capacity to reach offshore and deeper areas has increased manifold, leading to growing threats from many sources, including irresponsible fishing and shipping activities, pollution, ocean dumping and oil, gas and mineral exploration. Climate change and ocean acidification also threaten these areas. At the same time, technological advances have helped improve the scientific knowledge about the deep sea, unveiling an important array of unique and often endemic biodiversity.

Rising concerns about risks to biodiversity in marine areas beyond national jurisdiction have been expressed in international fora, such as the CBD, the United Nations General Assembly (UNGA) and other international gatherings. The international attention has focused on the need to conserve and sustainably manage these remote ocean areas. However, our ability to undertake strategic action towards the conservation and sustainable use of biodiversity in deep and open ocean areas has been limited by our incomplete knowledge about how and where species and their habitats are distributed geographically, though this knowledge will likely be greatly enhanced by studies currently in progress. In addition, deficiencies in the current legal framework, including both implementation and regulatory gaps, have hampered action to manage multiple human impacts through modern conservation tools.

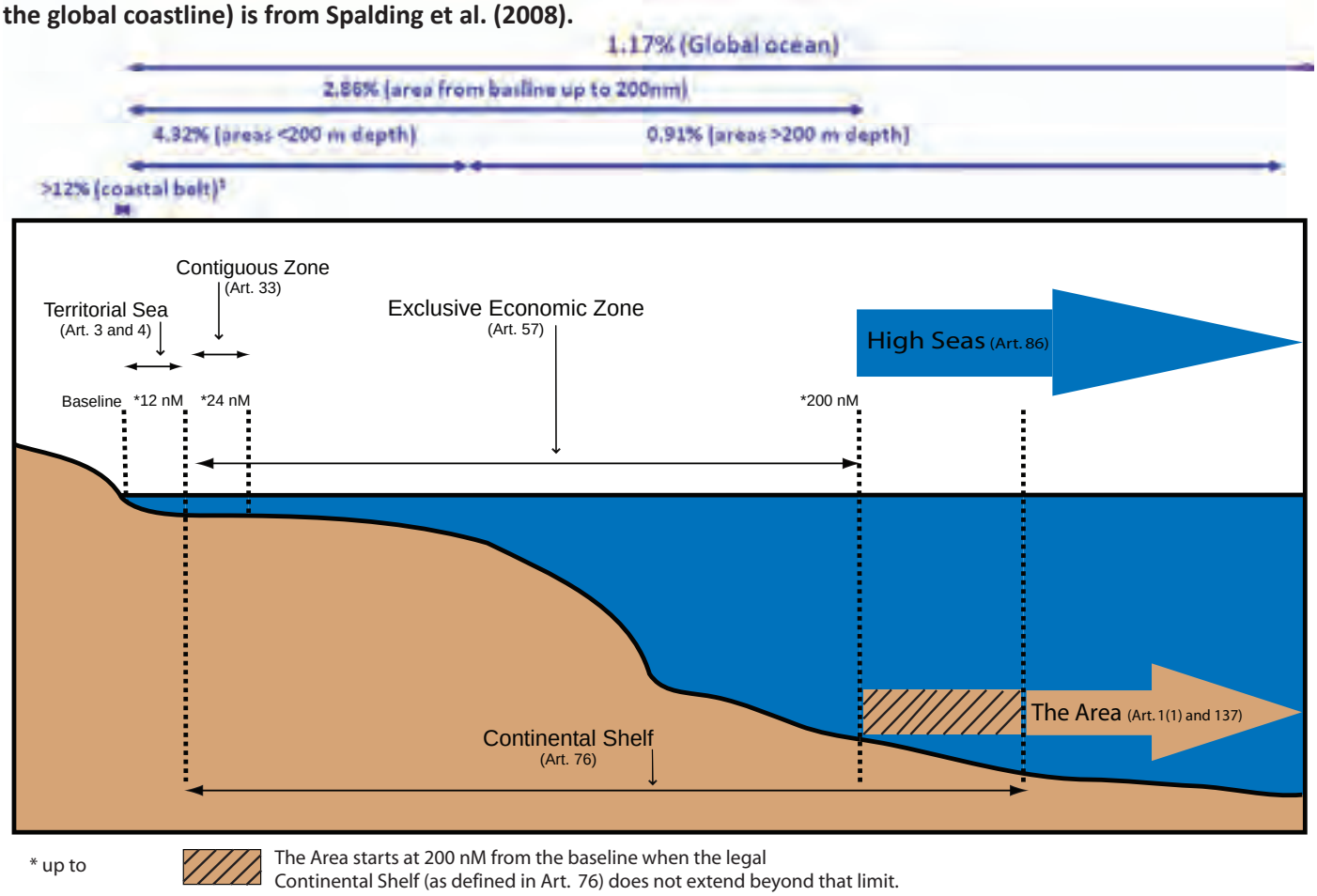
Recent scientific activities for improved management

Realising the need to move forward on the conservation and sustainable use of underrepresented deep and open ocean areas, several international policy fora requested further work aimed at developing criteria for selecting priority areas for protection and biogeographic classification systems.

The UNGA ad hoc open-ended informal working group to study issues relating to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction (UN Working Group) noted that further cooperation was necessary to advance in the development of criteria for the identification of ecologically and biologically significant areas, the development of systems of MPAs and biogeographic classification systems (A/61/65, paras 59-60).

The eighth meeting of the CBD Conference of the Parties (COP-8) recognized that the Convention has a key role in supporting the

Figure 4.2: Global Protection by distance from Coast. Coverage of the coastal belt (a buffered 1 km either side of the global coastline) is from Spalding et al. (2008).



work of the General Assembly with regard to MPAs beyond national jurisdiction, by providing scientific and technical information and advice relating to marine biological diversity. The CBD would also advise on the application of the ecosystem approach and the precautionary approach, and in delivering the 2010 target.

In 2008, COP-9 adopted a set of seven scientific criteria to identify ecologically and biologically significant areas (EBSAs) in the deep and open ocean, and urged Parties and invited other Governments and relevant organizations to apply them, as appropriate. In the same decision, the COP also adopted guidance for the establishment of representative networks of MPAs. The criteria were originally compiled at a CBD expert workshop in the Azores in 2007, and are as follows:

1. Uniqueness or rarity
2. Special importance for life history of species
3. Importance for threatened, endangered or declining species and/or habitats
4. Vulnerability, fragility, sensitivity, slow recovery
5. Biological productivity
6. Biological diversity
7. Naturalness

Advice on the use of the criteria has been further developed by an expert workshop, which met in Ottawa in September 2009 under the aegis of the CBD Secretariat. The objective of the workshop was to review and synthesize progress on the identification of areas beyond national jurisdiction which meet the scientific criteria and experience with the use of biogeographic classification systems.

The Global Ocean Biodiversity Initiative (GOBI) is assisting CBD Parties in applying the criteria, as described in the box below.

The EBSA criteria of the CBD could also be applied in deep waters within national jurisdiction and be used as a reference model. As well, an EBSA marine area could overlap and cover both marine areas within and beyond jurisdiction.

A biogeographic classification system for deep and open oceans

As mentioned in the previous section, recent discussions amongst international policy and management bodies have underscored the need to improve the scientific and technical basis for managing human activities in marine areas beyond the limits of national jurisdiction. Biogeographic classification is a method that uses biological and physical data to partition ecological units at a chosen scale, and identifies broad patterns of co-occurrence of species, habitats and ecosystem processes. A biogeographic classification system provides a basis for ecosystem-based management of human activities, including representative networks of marine protected areas, as well as assessment and monitoring activities. Until recently, there has been no comprehensive biogeographic classification system for the deep and open oceans globally.

The box below describes the Global Open Oceans and Deep Seabed (GOODS) biogeographic classification, which is the first classification system covering the entire oceans beyond national jurisdiction.

Global Ocean Biodiversity Initiative (GOBI)

The Global Ocean Biodiversity Initiative (GOBI) is an international partnership advancing the scientific basis for conserving biological diversity in the deep seas and open oceans. It aims to help countries, as well as regional and global organizations, to use and develop data, tools, and methodologies to identify ecologically and biologically significant areas with an initial focus on the high seas and the deep seabed beyond national jurisdiction.

This initiative began in late 2008 as a collaboration between the German Federal Agency for Nature Conservation (BfN), IUCN, UNEP World Conservation Monitoring Centre, Marine Conservation Biology Institute, Census of Marine Life, Ocean Biogeographic Information System and the Marine Geospatial Laboratory of Duke University. The Initiative now numbers 17 partners and continues to seek additional collaborators to help bring the best science and data to bear on the identification of EBSAs beyond national jurisdiction. GOBI is facilitated by IUCN with core support from BfN.

The work under this initiative aims to help countries meet the goals and targets adopted under the CBD and the 2002 World Summit on Sustainable Development.

The objectives of GOBI are to:

- Establish and support international scientific collaboration and assist States and relevant regional organizations to identify EBSAs using the best available scientific data, tools, and methods.
- Provide guidance on how the CBD's scientific criteria can be interpreted and applied towards management, including representative networks of MPAs.
- Assist in developing regional analyses with relevant organizations and stakeholders.

Thus far, GOBI has developed practical illustrations on how to apply the CBD EBSA criteria. These illustrations relate to species, habitats and oceanographic features, and are available in the GOBI report titled: Defining ecologically and biologically significant areas in the open oceans and deep seas: Analysis, tools, resources and illustrations. The report was presented at the CBD Scientific Expert Workshop on ecological criteria in October 2009 in Ottawa, Canada. In addition, GOBI continues to advance scientific information available relating to the application of tools and analysis for selecting EBSAs, and is planning capacity building activities (www.GOBI.org).

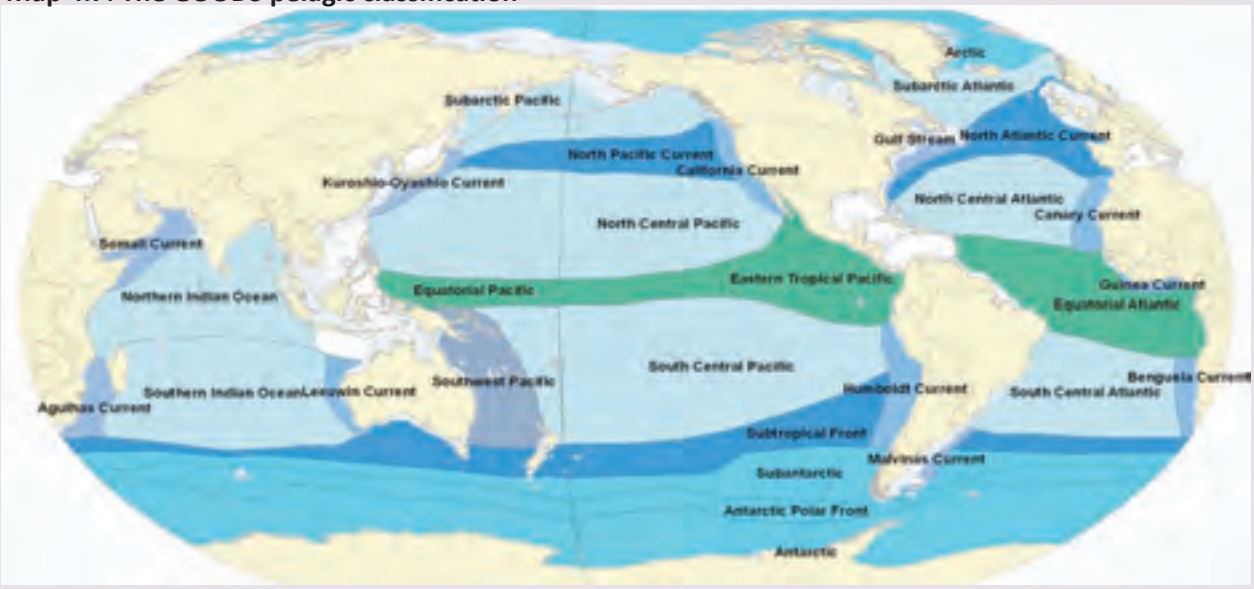
Global Open Oceans and Deep Seabed (GOODS) biogeographic classification

The recently published Global Open Ocean and Deep Seabed (GOODS) biogeographic classification (UNESCO 2009) divides the ocean beyond the continental shelf into biogeographic provinces based on both environmental variables and biological information. The ocean is first stratified into benthic and pelagic zones. The pelagic zone is divided into 30 biogeographic provinces, largely on the basis of properties of water masses and currents. The benthic zone is divided into 37 biogeographic provinces in three large depth zones: 14 bathyal (between 300-3500m in depth), 13 abyssal (3500-6500m) and 10 hadal (> 6500m). In addition, 10 hydrothermal vent provinces have been delineated, for a total of 77 large-scale biogeographic provinces (UNESCO 2009).

The GOODS biogeographic classification was initiated at an expert workshop held in Mexico City, Mexico, in January 2007. It has subsequently evolved with input from many experts in science, policy, and management, including meetings of the Convention on Biological Diversity (CBD) and the UN Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction.

At the present time, the GOODS biogeographic classification is the only comprehensive global biogeographic classification system. The classification includes simplifications, particularly in presenting a static "snapshot" that does not address inter-annual or intra-annual variation, and in not resolving the biologically important coupling of benthic and pelagic systems. Nonetheless, it provides a reasonable basis for advancing management based on best available science.

Map 4.7: The GOODS pelagic classification



Important efforts at the regional level

Exciting first steps are already underway within a number of regions to address the management of marine areas beyond the limits of national jurisdiction. These regions include the North Atlantic, the Mediterranean and the Southern Ocean, and they demonstrate what can be achieved within the existing legal regime as States partner to protect significant areas beyond their national jurisdictions. But these early efforts need to be vastly scaled up to provide the level of protection required to sustain vital ecological goods and services and species.

Only a few Regional Seas programmes have direct competence in areas beyond national jurisdiction. Those that do have large maritime areas that include the high seas have moved forward by taking collaborative action to conserve biodiversity in these areas. One of the first MPAs beyond national jurisdiction was the Pelagos Sanctuary for Mediterranean Marine Mammals. The Pelagos Sanctuary is part of the network of Specially Protected Areas of Mediterranean Interest under the Barcelona Convention. The parties have developed a bioregionalisation framework for the high seas including the deep sea. From this exercise, they identified 12 priority conservation areas covering roughly 20% of the Mediterranean Sea for further consideration for designation as SPAMIs.

The OSPAR Convention in the North East Atlantic area has also made substantial progress in identifying marine protected areas beyond national jurisdiction. The parties have similarly developed a bioregionalisation framework and in September 2010 agreed to designate six high seas MPAs, including areas that overlie the outer continental shelf of a coastal State.

Mediterranean Submarine Canyons

In the Mediterranean, many submarine canyons are extensions to rivers confirming that their formation is linked with the low sea level phases of the late Miocene. Nowadays, submarine canyons funnel large volumes of sediment and organic matter from shallow regions to the deep ocean, thus reshaping the seabed and having a significant impact on the food supply to deep-sea ecosystems. Submarine canyon morphology generates various processes resulting in an accelerated and concentrated transport of nutrient rich waters from deep sea layers to the surface through currents, upwelling and eddies. Consequently, many top predators such as birds, sharks, tuna, sword fish, dolphins and whales (mainly sperm whale) are attracted by the enhanced concentration and abundance of their preferred prey (mid-water shrimp, fish and squid). Submarine canyons are a biodiversity hotspot that is fundamental to the functioning of the Mediterranean ecosystem.

In the Mediterranean, an important set of submarine canyons is located in the north of the western basin, between the coast of Catalonia (Spain), the south of France, and the coast of Corsica Island. The north-west part of this area is the Gulf of Lion. Several canyons are located in this area; they extend from 100 to 2000 metres deep through the continental self and continental slope. Though they are of diverse nature, most are made of very thick layers of mud and therefore very instable. They harbour a very rich and diverse biodiversity: fish and sharks, including Chimaeras, cephalopods such as squid and octopuses, a variety of crustaceans (shrimp, galateid crabs, etc.), cold water corals (including *Lophelia sp.*), sponges, and worms. They are a key ecosystem for fisheries resources, being the habitat for reproduction of important commercial species such as red shrimps (*Aristeus antennatus*). The level of endemism between each canyon is relatively high. Unfortunately, the canyons also harbour a high volume of litter of various nature, such as fishing gears (lines and nets), tiles and construction materials, plastic bags, bicycles, shoes, etc., which are brought by the currents coming from the rivers.

The IUCN and WWF report “The Mediterranean deep-sea: highly valuable ecosystems in need of protection” published in 2005 has brought the issue of conservation of deep sea ecosystems on the agenda of the General Fisheries Commission for the Mediterranean (GFCM) leading to the adoption of 2 important decisions:

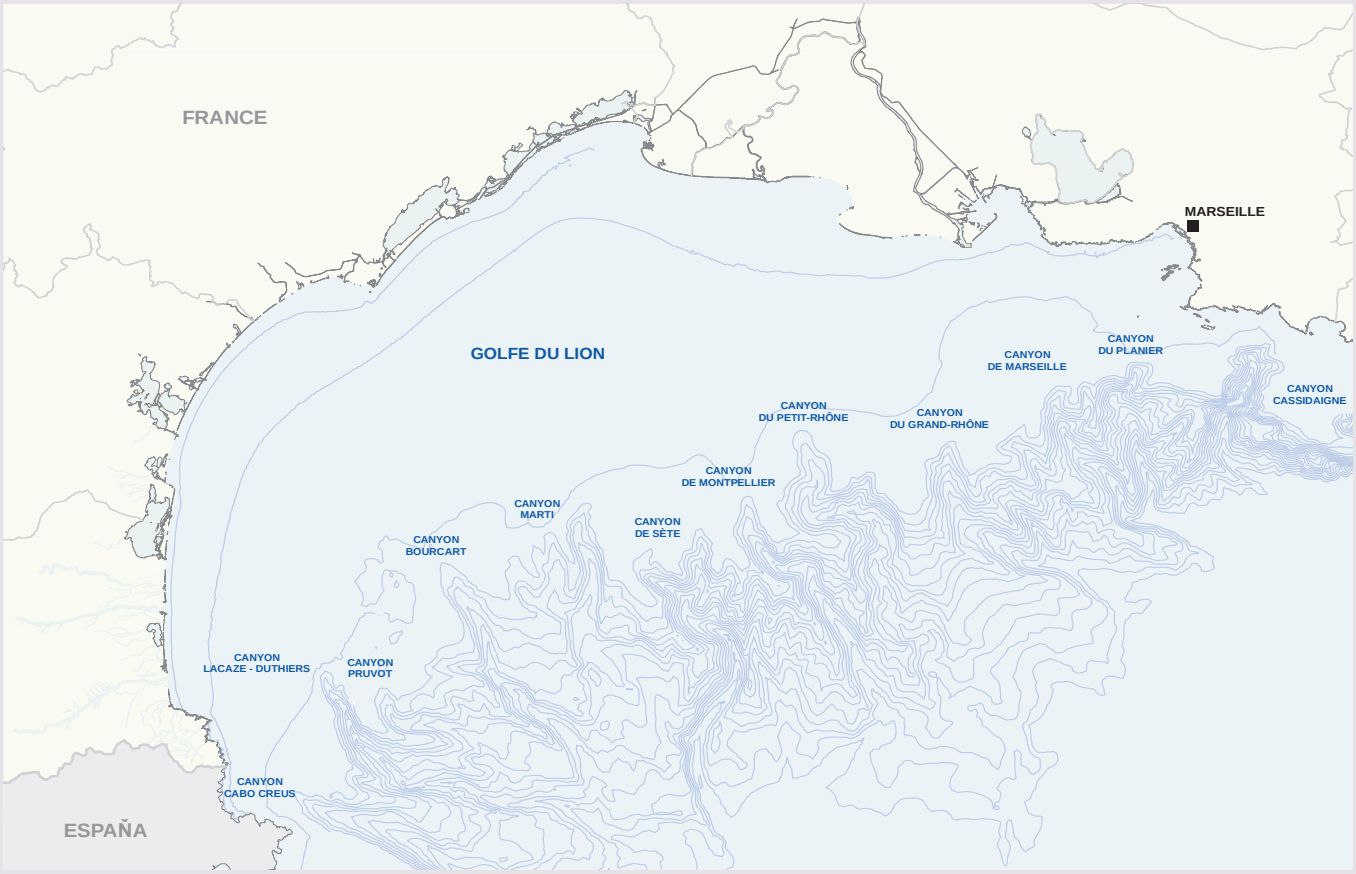
- The Members of the GFCM shall prohibit the use of towed dredges and trawl nets fisheries at depths beyond 1000 m of depth.
- Fishing with towed dredges and bottom trawl nets shall be prohibited in the areas bounded by lines joining the following coordinates: a) Deep Sea fisheries restricted area “Lophelia reef off Capo Santa Maria di Leuca”; b) Deep Sea fisheries restricted area “The Nile delta area cold hydrocarbon seeps”; c) Deep Sea fisheries restricted area “The Eratosthemes Seamount” (South of Cyprus). For the same areas, Members shall call the attention of the appropriate authorities in order to protect these areas from the impact of any other activity jeopardizing the conservation of the features that characterize these particular habitats.

In 2009, the GFCM added another fisheries restriction zone (FRA) to this list: the submarine canyons of the Gulf of Lions south off Marseille, France. IUCN, WWF, GFCM and the UNEP Mediterranean Action Plan are currently working together to further strengthen these conservation measures and improve the conservation status of Mediterranean deep sea ecosystems. In particular, the UNEP Regional Activity Centre for Specially Protected Areas (RAC-SPA) is conducting a large-scale project for identification of important areas in the open-ocean and deep seas. This project should lead to the designation of Specially Protected Areas of Mediterranean Interest in several areas in the Mediterranean.

Although there is a common agreement on the importance of conservation of canyons amongst international organisations, the governance of the area is complex: the canyons extension covers waters and seabed under French and Spanish jurisdictions (territorial waters, Spanish Fisheries Protection Zone, French Ecological Protection Zone, including a delimitation issue).

Progress in conservation of deep sea features such as the canyon, including the establishment of MPAs requires improving our understanding of the biological and ecological features of these ecosystems. With the intention of meeting this need, the French Agency for Marine Protected Areas is conducting an important study (MEDSEASCAN) of all French canyons between 150 and 600 metres deep using ROV, submarines and sampling tools, aiming to develop a baseline survey of the macrofauna and draft an atlas of these species. Results showed that two canyons, dug into a rocky substrate, are extremely rich in biodiversity with a particular high number of threatened and vulnerable species. Both canyons harbour large patches of Lophelia sp. and Madrepora sp. Other canyons, in very muddy areas, are less populated by macrofauna but play a crucial role in the trophic chain and support numerous species of sea birds and marine mammals. The Spanish Superior Council for Scientific Research (CSIC - Consejo Superior de Investigaciones Científicas) is also conduction research on canyons ecology.

Map 4.8: The Gulf of Lion, located in the north of the Western Mediterranean, is characterised by a large continental shelf and continental slope cut by numerous canyons from 100 to 2000 meters deep.



In order to progress toward the conservation of these important submarine features in the whole Mediterranean Sea, the next steps are to:

- Improve the knowledge and recognize the importance of submarine canyons for the functioning of the Mediterranean ecosystem;
- Recommend to the Mediterranean States to adopt a precautionary approach in the management of these areas which are threatened by some fishing activities and the flow of trashes from the land;
- Integrate canyon protection and management in national, regional and international priorities;
- Recommend an inter-sectorial approach to take into consideration the socioeconomic aspects;
- Include submarine canyons in discussions of the GFCM, which already adopted some fisheries closure for seabed feature protection; and
- Use all available tools for the identification and creation of MPAs, such as the World Natural Heritage, the CBD EBSA criteria, the European Habitat Directive, the SPAMI system of the Barcelona Convention, as well as the tools used by fishery bodies (Fisheries Restriction Zones and Vulnerable Marine Areas) and Maritime organisations (PSSA).

With four of the six new OSPAR "high seas" MPAs also abutting the outer continental shelf of a coastal State party, the OSPAR experience highlights a complexity in managing high seas MPAs—responsibility for managing certain seabed activities can vary. Coastal states have sovereign rights over the sedentary and non-living resources of their outer continental shelf. Beyond the outer continental shelf, the International Seabed Authority has management authority related to seabed minerals of the seafloor beyond national jurisdiction. So while the water column beyond the territorial sea or EEZ is high seas, it is necessary to ascertain and work with the State or organization that has management responsibility for the seabed below.

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has now adopted broad-scale bioregional classifications for both the pelagic and benthic environments of the Southern Ocean. The pelagic bioregionalisation maps have been used to define eleven priority areas in which further work to identify systems of marine protected areas will now be focused. CCAMLR established a high seas MPA below the South Orkney Islands in 2009 where fishing and the discharge of fish wastes are prohibited.

Sectoral advances

Most regional fisheries management organizations (RFMOs) have the capacity to adopt binding measures to protect biodiversity including through spatial or temporal closures, effort or gear restrictions, catch or bycatch quota, reporting, or observer coverage. This authority could be applied to protect species, habitats and ecosystems in the high seas water column as well as the deep sea and seabed beyond national jurisdiction.

In 2006, responding to global concern over the impacts of unregulated high seas bottom fishing on fragile deep sea ecosystems, the UNGA called for three important new requirements for "vulnerable marine ecosystems" (VMEs) in the context of high seas bottom fisheries. It called for flag States and RFMOs: 1) to conduct environmental assessments prior to authorizing bottom-contact fishing activities (including the identification of known or likely VMEs); 2) to manage such fisheries so as to prevent significant adverse impacts to VMEs; and 3) to not allow the activities to proceed until steps one and two had been taken (UNGA Res. 61/105 (paragraphs 80-93)).

Internationally agreed guidelines have been adopted to assist RFMOs take measures to implement these requirements, including criteria for identifying "VMEs" that are comparable to the CBD EBSA criteria. Various RFMOs have as a result closed areas where VMEs are known or likely to occur. While the extent of VMEs closed to bottom fishing to date is far from comprehensive, the actions taken by these RFMOs demonstrate an effort in a positive direction.

The International Seabed Authority (ISA) is responsible for the regulation of mineral exploration and exploitation in the deep seabed Area and for protecting the environment in that process. As a potential prototype, it is now developing an environmental management plan for a region in the Pacific abyssal plain to provide enhanced protection to nine "areas of environmental interest" from the impacts of mining activities. The ISA also has strict requirements for environmental impact assessments.

The International Maritime Organization (the IMO) is the responsible UN agency for regulating international shipping. The IMO has adopted a number of protective measures for environmentally sensitive areas that could be applied to the high seas. These include discharge restrictions, reporting requirements, voyage planning and voluntary routeing measures. The IMO already has adopted criteria similar to EBSAs for identifying "Particularly Sensitive Sea Areas" (PSSAs) to help IMO Member States to assess the need for specific measures to protect sensitive marine environments at risk from shipping activities.

Future needs

These efforts, though commendable, are not enough to afford biodiversity beyond national jurisdiction the protection it needs. Improved implementation of existing instruments, as well as new regional and global cooperative mechanisms, are needed.

At the present time, relatively few activities which have the potential to adversely impact marine areas beyond national jurisdiction are subject to environmental impact assessment (EIA) processes, and it is possible for a State or non-State actor to proceed with activities which may have significant impacts on marine areas beyond national jurisdiction to the detriment of current and future generations. In addition, the existing EIAs and strategic environmental assessments (SEAs) have often been applied at an activity or sector level, and have rarely considered synergistic or cumulative impacts.

EIA commitments are now contained in a wide array of hard and soft international instruments (including UNCLOS, the Madrid Protocol of the Antarctic Treaty System, the International Seabed Authority regulations, the UN Fish Stocks Agreement for highly migratory and straddling fish stocks and the UNGA resolutions regarding high seas bottom fishing) addressing a broad range of environmental issues and geographic contexts. A requirement for States to perform environmental impact assessments before all activities that might have a deleterious effect on the marine environment could enable prevention of significant impacts to the ocean beyond national jurisdiction in a more comprehensive, participatory and transparent manner, while advancing cross-sectoral cooperation. An EIA requirement could also incorporate examination of alternatives which take into account the shared interests of the international community in the long term sustainability of marine resources, continuing marine scientific research and the stability of global climate.

The need for existing EIA processes to incorporate biodiversity concerns and to address unregulated activities and cumulative impacts in marine areas beyond the limits of national jurisdiction has gained international attention in fora such as the CBD (which held an expert group meeting on the topic) and the UN Working Group on marine biodiversity beyond national jurisdiction.

In order for the international community to implement tools and approaches such as ecosystem-based management, marine protected area networks and EIAs/SEAs, there is a need for institutional improvements and cooperative mechanisms at national, regional and global levels. In particular, the extension of marine spatial planning into areas beyond national jurisdiction could help establish a framework for inter-sectoral cooperation regionally and globally. High level agreement on common principles and goals for spatial management, accompanied by guidance on implementation would help facilitate more coherent policies and practices across the numerous relevant agencies as well as States. Facilitating an exchange of information about biodiversity, its uses and management measures in areas beyond national jurisdiction is a first practical step towards improved management.

Towards implementation of MPAs in the high-seas

The implementation and the control of MPAs in high-sea keep being the weak point of all the international systems. Proposing the development of MPAs in high-sea without settling the issue of the management and control capacities in a new international system could really quickly cast doubt on the interest to continue the designation of new MPAs. The effectiveness of MPAs in high-sea will become real when they will be developed in consistent networks certifying the marine ecological connectivity and the biological resilience among the large deep ecosystems; when they will have both research and knowledge capacities for an ecosystem-based management; when they will have appropriate regulatory measures, monitoring and control capacities, intensive communication and education policy. Good governance is also supposed to get the support of and to integrate the sea users and professionals in the management system.

Advancing conservation in the high seas have sparked a global debate on the governance of ocean resources and the need to jointly tackling, principles, mechanisms and tools of protection and management of ocean, decision-making processes. There's a broad recognition for the need to advance ecosystem-based principles across board and resolve some gaps and mismatches in the various instruments for ocean managements.

We are witnessing an important movement in that direction, at national and regional levels, which are important to advance at a global level. The new integrated maritime policy of the European Union and the new US national marine policy provide good examples. Both initiatives identify marine spatial planning as an important tool to help the implementation of an integrated strategy with improved coordination between stakeholders.

Deep Sea Coral Community © Alberto Lindner

Artisanal Fishermen, Patagonia, Chile ©Tom Crowley

Chapter 5
Climate Change – a Challenge and an Opportunity

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Key Messages:

- Climate change is already affecting the ocean in many different ways and the scale and extent will continue to increase as effects take hold.
- By protecting important habitats and ecosystem functions, MPAs can provide the foundation for ecosystem-based mitigation and adaptation strategies.
- The role of coastal marine habitats as effective carbon sinks provides a new reason why greater action should be taken to increase management coverage of MPA networks in these areas as part of an effective strategy to tackle climate change.
- Important changes in the way that MPAs are designed, managed, and governed are needed to assure they are resilient in the face of climate change impacts and effective in playing this role.

Introduction

Since the industrial revolution, human activities have caused a significant increase in atmospheric concentrations of greenhouse gases, in particular through the burning of fossil fuels associated with energy production and transportation, as well as through deforestation, cement production and land use change. The buildup of greenhouse gases leads to increasing average temperature of both the lower atmosphere and the surface ocean, which in turn changes Earth's climate system and disrupts ecological processes and the provision of ecosystem services.

The challenge is how to secure the diversity of wildlife and habitats in the ocean, and the values they provide humanity, in the face of such changes. MPAs face a significant challenge as one of the key management tools (see chapter 6). At their full potential, MPAs can best provide benefits through the development and implementation of effective climate change mitigation and adaptation strategies. On the one hand this calls for reducing and eventually stabilizing atmospheric greenhouse gases at a safe level. On the other hand it means changing how MPAs and MPA Networks are viewed, created and managed. This is to ensure they can meet the threats associated with climate change, while also serving as a tool to facilitating ecosystem mitigation and, more broadly, adaptation. The design and management of MPAs therefore need to take climate change impacts into account to effectively implement resilience-building principles and increase MPA network connectivity and ecological representation (Dudley et al. 2010).

Climate Change Impacts, Ocean Acidification, and MPAs

The main effects of climate change and ocean acidification on MPAs and the ocean are many, varied and complex (Reid et al. 2009), often depending on local circumstances and conditions, and include:

Changing climatic conditions: A warming ocean impacts marine species in numerous ways, such as changes in geographical range, behavior and life-history (e.g. reproduction, growth, and dispersal). Changes in species composition and biomass (Gitay et al. 2002; Hays et al. 2005; Bjork et al. 2008) will have implications for all levels of marine food webs. Changes to any part of the web can cause cascading effects that alter entire systems (Edwards & Richardson 2004; Frank et al. 2005).

Evidence shows that some species are already migrating and occurring at higher latitudes than before, though not always at predictable rates (Perry et al. 2005; 2009). This can cause species to shift within, into or fall out of an existing MPA. Populations that move outside of an MPA will lose valuable protection. This will be especially menacing for the distribution and survival of endangered and threatened species. Where there are no higher latitudes to reach or where changes are taking place too quickly for species and ecosystems to adapt, local losses or global extinctions will take place.

Shallow coral reefs are especially susceptible to warming waters given that they are adapted to live near the upper physiological limit of their temperature range (Gitay et al. 2002). Even slight, temporary warming events can lead to coral bleaching, disease and even widespread

Antarctica © Dorothée Herr

mortality (Hoegh-Guldberg 1999; 2005; Wilkinson 2008; Muller et al. 2008; Marshall & Schuttenberg 2006a).

Habitat loss: Coastal areas will increasingly experience habitat loss due to sea-level rise and severe storms events. Due to rising sea water temperature the intensity of extreme weather events such as hurricanes, typhoons or cyclones is expected to augment (IPCC 2007; Webster et al. 2005; Hoyos et al. 2006). This will erode sandy beaches and other soft shorelines, including critical nesting habitat for seabirds and sea turtles. Other impacts include increased risk of seawater intrusions into estuaries and freshwater habitats, adversely affecting those habitats, species, and agricultural practices sensitive to salinity shifts, as well as the availability of safe drinking water to coastal inhabitants. Changes in salinity will hamper natural regeneration processes in mangroves, thus threatening the role of mangroves in stabilizing shorelines (Khalil 1992) and carbon sequestration, as well as a source of food and livelihoods for dependent communities.

New invaders: The spread of invasive alien species (IAS), already recognized as one of the most significant threats to biodiversity worldwide (CBD 2009a), is likely to increase as a result of climate change. The lowering of physiological barriers, e.g. as a result of warming, will open migration pathways, and reduce differences between donor and recipient areas. Further, the risks of successful IAS establishment increases in systems that are weak or altered (Lotze et al. 2006), including those damaged by climate change. IAS can severely disrupt ecosystems, out-competing and replacing native biota and often reducing the ability of the ecosystem to provide services (IUCN 2009; McNeely et al. 2001).

Ocean Acidification: The Ocean has absorbed approximately one third of all anthropogenic CO_2 emissions since the Industrial Revolution (Sabine et al. 2004). While this buffers and slows the atmospheric greenhouse effect (Fung et al. 2005, Le Quéré et al. 2007), it puts marine life at risk. Dissolved CO_2 lowers the ocean's pH, which may significantly reduce the ability of some reef-building corals and other calcium carbonate-dependent organisms, including some phytoplankton species and commercially important shellfish, to produce their skeletons, with reefs becoming more vulnerable to erosion (Laffoley & Baxter 2009). It is likely to therefore affect growth and wellbeing of many keystone species, with impacts possibly cascading through marine ecosystems.

Other human-induced stressors: The impacts of climate change and ocean acidification are exacerbating other, already existing pressures on marine and coastal ecosystems (Keller et al. 2009; Hughes et al. 2005; Breitburg and Riedel 2005). The degradation caused by overfishing, pollution, coastal destruction and declining water quality for already limiting coastal and marine ecosystems in performing their functions and services, on which so many people rely on for food and income. Coral reef communities which are subject to stress from local factors are more likely to succumb to the impacts of rising water temperatures and acidities (Hoegh-Guldberg 2009). These and other observations suggest an opportunity for coastal resource managers to increase the resilience of coral reefs and other ecosystems to the impacts of climate change while the global community struggles to bring greenhouse gas emissions under control (Hoegh-Guldberg et al. 2007; Hughes et al. 2007; Marshall & Schuttenberg 2006a).

We are now building a clear picture of the nature of changes climate is having on the ocean globally, and regional examples, such as the UK Marine Climate Change Impacts Partnership's latest Annual Report Card (Baxter et al. 2010), give a clear comprehensive insight to the scale and extent of changes now occurring in temperate waters around the British Isles.

CASE STUDY

Providing a clear perspective on climate change impacts on the ocean: the UK's Marine Climate Change Impacts Partnership Annual Report Card for 2010 - 2011.

The Marine Climate Change Impacts Partnership (MCCIP) is a UK partnership between scientists, government, its agencies, non-governmental organizations (NGOs) and industry. The principal aim is to provide a coordinating framework for the UK, so as to be able to transfer high quality evidence on marine climate change impacts, and guidance on adaptation and related advice to policy advisors and decision makers.

The 2010 – 2011 Annual Report Card (Baxter et al. 2010) provides the very latest updates on how climate change is affecting the seas. Almost 100 scientists from 40 leading UK science organisations contributed. Key messages include that: sea temperatures are generally increasing but variability between years is high; some fish distributions have moved northwards over the past 30 years by distances ranging from around 50 to 400km; climate change has contributed to a decrease by approximately 9% in the total number of seabirds breeding in the UK between 2000 and 2008; and the increasing seawater temperatures may have the potential to increase the geographical range of some harmful algal bloom species associated with Paralytic Seafood Poisoning (PSP) events.

MPAs and MPA Networks as a Tool for Ecosystem-Based Adaptation to Climate Change

Most existing and proposed adaptive responses to climate change in coastal areas have focused on using "hard" engineering solutions. These solutions, while sometimes necessary, are expensive and can exacerbate the impacts of climate change by further destroying fragile ecosystems. Ecosystem-based adaptation (EbA) secured through MPAs and coastal management —approaches that use the protective and regenerative capacity of healthy natural ecosystems to help human communities adapt to the impacts of a changing climate—is an alternative that is especially appropriate and readily available for coastal communities.

Protecting natural ecosystems provides proven and cost-effective protection against some of the threats that result from climate change. For example, wetlands, mangroves, oyster reefs, barrier beaches and sand dunes all provide coastal protection from storms and flooding. Such ecosystem-based approaches can complement, or substitute for, more expensive infrastructure investments to protect coastal settlements (World Bank 2009). MPAs offer 'natural solutions' as natural buffers that are often cheaper to manage and maintain, and provide additional goods and ecosystem services, including natural resources such as water and fisheries on which human livelihoods depend.

Ecosystem-based adaptation aims to preserve and restore natural ecosystems to provide cost-effective protection against some of the threats that result from climate change and make ecosystems more resistant and resilient in the face of climate change so that they can continue to provide ecological services. This is particularly important for sustaining natural resources (e.g., fish stocks, fuel, biodiversity to attract tourists) on which vulnerable communities depend for their subsistence and livelihoods. (Hale et al. 2009)

MPAs and MPA networks nested within broader coastal and ocean management frameworks are a key tool to help ecosystems remain healthy and perform these functions as part of climate change adaptation strategies (see Chapter 6). If well designed and managed, they can do this by protecting critical habitats, such as wetlands, mangroves, reefs and barrier beaches, and helping enhance and restore the productive potential of fisheries, and thereby contributing to greater food security of coastal communities and others that depend on these resources.

Creating Climate Resilient MPA Networks

In order for MPAs to contribute to ecosystem-based adaptation strategies, they must themselves adapt to the impacts of climate change. If an MPA is resilient it can rebound from or withstand environmental fluctuations or unexpected catastrophes. Their ability to reduce the adverse impacts of climate change, are greatly enhanced through the design and management of connected networks rather than individual protected areas (IUCN-WCPA 2008; Keller et al. 2009). Networks are more effective at protecting and sustaining the full range of habitats and species on which ecosystem services depend, particularly when complemented with better management outside the MPAs.

Existing research and management practices have demonstrated that connectivity among sites within a network helps insure against the risk of losing an important habitat or community type following a disturbance such as a bleaching episode or intense storm. The widespread replication of these experiences for increasing the resilience of MPA networks in the face of climate change impacts provides a solid foundation for rapid expansion of these important management approaches as a key strategy for protecting ocean and coastal ecosystem services and the wide range of benefits they provide us.

Components of a Resilient MPA Network are:

- ***Effective management***, including integrated management of coastal and marine ecosystems. This is essential to keep ecosystems healthy. Reducing threats is the foundation for successful conservation and the core of resilience-based strategies.
- ***Full protection of critical areas*** that can serve as reliable sources of seed for replenishment and representation of ecological functions is essential. These areas include spawning grounds, nursery habitats, areas of high species diversity, areas that contain a variety of habitat types in close proximity, and potential climate refugia.
- ***Connectivity*** (both biological and ecological) should be maintained among and between habitats to ensure larval exchange and replenishment of affected populations and fish stocks. This can enhance recovery following disturbance events.
- ***Risk-spreading*** through inclusion of replicates of representative species and habitats ensures that some habitat areas and species will be protected and remain viable given the uncertainty of exactly where and how strong impacts of climate change will be.

The successful use of MPA networks as a tool to help reduce the impacts of climate change will require multiple actions. Among the most critical are to engage with and address the needs and concerns of key stakeholders, including the communities who depend most on coastal and ocean ecosystem services. The traditional knowledge of indigenous and local communities and other stakeholders of their environment should be incorporated into governance systems that involve them in the planning, managing, decision-making, and monitoring. Efforts should be made to build the capacity of local communities to understand climate change impacts and how they affect their use of resources and ecosystem services. It is particularly important to engage community members in monitoring and management activities, as these raise their awareness of the impacts of climate change on their surrounding ecosystems, and help them understand and support the need to manage resource use in appropriate ways, and to devise ways to do this most effectively.

There is a growing body of research and experience on managing for resilience. This experience has been summarized in a number of useful tools that are now available to help managers and decision makers them address climate impacts. Some examples of existing guidelines to manage in the face of change are presented at the end of this chapter (see Box pg. 68).

Lagoons of New Caledonia © Dan Laffoley

Table 5.1: Comparison of carbon stocks and longterm accumulation of carbon in soils in key terrestrial and coastal marine ecosystems. (From The Management of Natural Coastal Carbon Sinks, IUCN, 2009)

Ecosystem type	Standing carbon stock (gC m^{-2})		Total global area (*10^{12} m^2)	Global carbon stocks (*10^{15} gC)		Longterm rate of carbon accumulation in sediment (gC m^{-2} y^{-1})
	Plants	Soil		Plants	Soil	
Tropical forests	12045	12273	17.6	212	216	2.3-2.5
Temperate forests	5673	9615	10.4	59	100	1.4 – 12.0
Boreal forests	6423	34380	13.7	88	471	0.8 – 2.2
Tropical savannas and grasslands	2933	11733	22.5	66	264	
Temperate grasslands and shrublands	720	23600	12.5	9	295	2.2
Deserts and semi-deserts	176	4198	45.5	8	191	0.8
Tundra	632	12737	9.5	6	121	0.2 – 5.7
Croplands	188	8000	16	3	128	
Wetlands	4286	72857	3.5	15	225	20
Tidal Salt Marshes			Unknown (0.22 reported)			210
Mangroves	7990		0.152	1.2		139
Seagrass meadows	184	7000	0.3	0.06	2.1	83
Kelp Forests	120-720	Na	0.02- 0.4	0.009-0.02	na	na

The Additional Value of MPAs for Carbon Sequestration

In recent decades there has been a significant focus, quite rightly, on major carbon sinks on land such as forests, particular soil types and peatlands. These ecosystems inherently hold vast reservoirs of carbon, and some areas of protection have been put in place to attempt to retain such reserves. The challenge is recognizing that other carbon sinks that could contribute and ensure that they too are subject to protection.

Marine ecosystems – particularly coastal ecosystems such as mangroves, seagrasses and salt marshes – alongside their widely acknowledged values to local communities and for biodiversity have demonstrated capacity for carbon storage. This is in both the biomass of the dominant plants and the sediment below them that is similar to carbon storage in terrestrial systems. Research shows that these coastal systems sequester carbon in the sediment at rates up to 50 times values observed in terrestrial systems (see table 5.1). This high efficiency of carbon sequestration into the sediment by coastal systems can be maintained for centuries or more: terrestrial forest systems more typically reach a steady-state equilibrium level of carbon in the soil within a few decades.

Coastal wetlands sequester globally significant quantities carbon from the atmosphere by supporting vegetation and through soil burial of organics (Chmura et al. 2003; Duarte et al. 2005; Laffoley & Grimsditch 2009) (See Table 5.1). Ongoing sequestration is dependent upon maintaining or restoring natural processes and environmental conditions. Coastal wetlands also offer substantial and well recognized environmental 'co-benefits' that are critical to supporting a wide range of ecosystem services and human benefits.

The high carbon sequestration capacity and storage rates strongly suggest that conservation of keycoastal marine systems is a very cost-effective tool in mitigating climate change, potentially one of the very few low-cost options for removing CO_2 already in the atmosphere. Destruction and degradation of marine ecosystems, however, is rapidly eroding this highly efficient carbon sequestration and causing emissions from sediments/soil (see Table 5.2) Recent estimates suggest that ongoing degradation of tidal wetlands in the Sacramento-San Joaquin Delta region of California leads to emissions of 10 to 15 million tCO_2/year which represents 2.5% of California's total annual emissions. Currently we have a very poor understanding of the geographic extend of these wetlands types, and their vulnerability to pressure of global environmental change.

The carbon storage capacity of terrestrial systems has been widely recognized for its importance in addressing climate change and mechanisms are now being developed to reduce greenhouse gas emissions from habitat loss and degradation, such as Reduced Emissions from Deforestation and Forest Degradation (REDD) financing schemes. Currently no such carbon accounting systems specifically value the role of coastal marine systems in sequestering greenhouse gases, and hence there are no incentives to maintain these systems for their role in climate change mitigation. Actualizing the carbon value of certain coastal marine systems has the potential to be a transformational tool in helping support the future sustainable funding of marine management and conservation.

There is, therefore, a strong and immediate need to understand the viability of using the climate mitigation value of coastal systems in supporting sustainable management and conservation along the world's coasts through accounting for the carbon sequestered in these systems and developing coastal carbon offsets or other payment mechanisms to create appropriate economic incentives where feasible.

Climate-Smart Marine Protected Areas: Helping MPAs Plan, Adapt, Manage, and Mitigate for Climate Change

Facing a Challenging Issue

Climate change has been acknowledged as the greatest natural threat facing the planet today. However, many protected area managers have not been able to do as much as they would like to due to uncertainty about climate change impacts and the appropriate response measures lack of resources, or both. To help meet this challenge for its own sites, the U.S. National Marine Sanctuary System (NMSS), part of the National Oceanic and Atmospheric Administration (NOAA), developed a Climate-Smart Sanctuary Initiative This initiative is based on a number of proven processes and tools already in use by the NMSS, including the management plan review process, condition reports, sanctuary advisory councils, and performance assessment methodology. These tools have been in use for over ten years and have produced real and extensive results in NMSS sites.

Recognizing that other MPAs outside the NMSS might also find value in such a process, the NMSS has developed a more generic version called Climate-Smart MPAs.

Taking Action

This process was developed on the premise of certifying MPAs as "Climate-Smart" when they have taken action to meet a set of identified standards:

- Climate Change Site Scenario completed
- MPA Manager, staff, and/or partners as appropriate have completed training
- Advisory groups and/or stakeholders have been briefed
- Climate Action Plan completed
- Minimal green operating standard reached

Adapting to Different Needs

Most of this process can be adapted to the specific needs of an MPA, MPA network, agency, or nation. Ways to adapt the process include changing or replacing the standards, and removing or altering the certification process.

MPA managers and agencies are encouraged to adapt the procedures and standards of this process, or any other, to their specific situations, keeping it as rigorous and scientifically sound as possible. The most important thing is to begin taking action.

Mangroves in the lagoon of Aldabra Atoll World Heritage Site © Jerker Tamelander / IUCN

Table 5.2: Annual and total loss of mangrove and Seagrass habitat and the equivalent areas of tropical and temperate terrestrial forest needed for longterm carbon sequestration in sediments (From The Management of Natural Coastal Carbon Sinks, IUCN, 2009)

	Mangroves	Seagrasses
Annual average global loss (km^2/ year)	118	110
Equivalent tropical forest loss (km^2/ year)	6600	3600
Equivalent temperate forest loss (km^2/year)	1400	770

Implications for MPA Network Design and Management[1]

The range of climate change and ocean acidification impacts requires multiple MPA network design and management responses. In order for MPAs to be reasonably effective their size, numbers and networks need to be scaled up drastically (see Chapter 3). In addition to current common practices, MPA design, designation and management should focus on ecological representation and resilience strategies.

MPA managers can enhance ecosystem resilience, for example, by protecting functional groups (McLeod et al. 2009). The conservation of multiple replicates of coastal and marine ecosystems will help prevent biodiversity from being lost as a result of isolated disturbances. By protecting ecological corridors, buffer zones and stepping stones MPA networks support ecosystem function and connective synergies between different coastal and marine ecosystems (Salm et al. 2006; McLeod et al. 2009). Fragmented or degraded ecosystems will require some restoration strategies to reestablish critical processes and strengthen resilience.

MPA managers should thus consider stronger protective measures for native species (Keller et al. 2009) and establish baseline biodiversity information and monitor the performance of protection over time.

Climate change will exacerbate other already existing stressors on marine and coastal ecosystems and resources, thus additionally challenging MPA strategies and management plans. Minimizing other human-induced impacts can strengthen the resilience of ecosystems to climate change. MPA management responses and MPA network design should be developed and implemented in an integrated manner with other management strategies, such as fisheries regulations, sustainable coastal development and reductions of nutrients and other forms of land-based pollution (Keller et al. 2009).

MPAs should also be managed in a dynamic and adaptive manner to an ever changing environment Therefore it is extremely valuable for MPA managers to understand the possible changes on MPAs and their resources provoked by climate change, ocean acidification and other pressures. Especially due to a degree of uncertainty about climate change impacts it is extremely important to provide managers with updated information on the latest scientific findings and ensure investment in quality research programme and information sharing platforms (Dudley et al. 2010).

Dynamic MPA boundaries are recommended for the protection of breeding and foraging habits of highly migratory and pelagic species (Keller et al. 2009). Where possible, terrestrial components should allow for landward migration of coastal ecosystems such as mangroves and wetlands. There is also a need to establish 'Predictive Protected Areas' which will provide some level of forecast protection for areas expected to be future refugia (Herr & Galland 2009) and areas that have demonstrated some resilience to the effects of climate change (Done 2001; see also Marshall & Schuttenberg 2006b).

There may be some trade-offs between designing and managing MPAs for climate change mitigation and adaptation versus biodiversity conservation and sustainable use goals. It is therefore important that decisions to implement ecosystem-based mitigation or adaptation strategies include risk assessment, scenario planning and adaptive management approaches that specifically consider and integrate these potential trade-offs (CBD 2009).

CASE STUDY

Climate change range extensions.

In eastern Tasmania, warming coastal waters due to climate change have driven range extension of the long-spined sea urchin (*Centrostephanus rodgersii*), which has begun catastrophic overgrazing of productive kelp beds, leading to loss of biodiversity and important rocky reef ecosystem services. Coincident with the overgrazing is heavy fishing of reef-based predators including the spiny lobster *Jasus edwardsii*, shifting the distribution of lobsters toward smaller size classes and dramatically reducing the abundance of large lobsters capable of preying on the sea urchin. Experiments conducted inside and outside MPAs clearly showed that, by protecting large lobsters, MPAs were able to considerably reduce survival of sea urchins and the overgrazing resulting from their range extension (Ling et al. 2009).

1 Additional and more explicit information on the design and effective management of representative and resilient protected area networks see Dudley et al. 2008, IUCN-WCPA 2008, Marshall & Schuttenberg 2006a

Conclusions

MPAs have a critical role to play in helping address climate change impacts and building adaptation actions. This is both in terms of safeguarding biodiversity but also securing livelihoods, securing continued benefits we derive from the ocean, and securing coastal communities in the future.

MPA coverage, networks and effective management also offer the opportunity to maximize additional benefits in terms of climate change mitigation and adaptation. Marine and coastal protected areas can help to reduce the vulnerability of coastal population to climate change and are an essential tool for Ecosystem-based Adaptation (EbA) (see chapter 6). In terms of climate change mitigation, the avoided loss and degradation as well as the sustainable use and management of coastal carbon sinks can contribute to reducing global GHG emissions.

The effect of such endeavors can only be optimized if immediate and significant reduction in greenhouse gas emissions also occurs to reduce the impacts of climate change on ocean and coastal systems and the human economies and cultures they sustain. Impacts from climate change are likely to increase over the short to medium term, making adaptation urgent for many, particularly vulnerable coastal communities.

Resilience Management Resources

There is a growing body of research and experience on managing for resilience. This experience has been summarized in a number of useful tools that are now available in the literature to help managers and decision makers.

Some leading examples of include:

- Establishing Resilient Marine Protected Area Networks - Making it Happen. IUCN World Commission on Protected Areas (IUCN-WCPA) (2008). Washington, D.C.: IUCN-WCPA, National Oceanic and Atmospheric Administration and The Nature Conservancy. 118 p.

- Managing Coral Reefs for Resilience to Climate Change. Grimsditch, Gabriel and Salm, Rodney (2006). Coral Reef Resilience and Resistance to Bleaching. IUCN, Gland, Switzerland. 52 pp.

- A Reef Manager's Guide to Coral Bleaching. Marshall P.A. and Schuttenberg, H.Z. (2006). Great Barrier Reef Marine Park Authority, Australia

- Reef Resilience Toolkit: http://www.reefresilience.org

- Managing Mangroves for Resilience to Climate Change. McLeod, Elizabeth and Salm, Rodney V. (2006). Managing Mangroves for Resilience to Climate Change. IUCN, Gland, Switzerland. 64pp.

- Managing Seagrasses for Resilience to Climate Change. Björk M., Short F., Mcleod, E. and Beer, S. (2008). Managing Seagrasses for Resilience to Climate Change. IUCN, Gland, Switzerland. 56pp.

- Honolulu Declaration on Ocean Acidification and Reef Management. McLeod, E., R.V. Salm, , K. Anthony, B. Causey, E. Conklin, A. Cros, R. Feely, J. Guinotte, G. Hofmann, J. Hoffman, P. Jokiel, J. Kleypas, P. Marshall, and C. Veron. 2008. The Nature Conservancy, U.S.A., and IUCN, Gland, Switzerland.

Coral Reef, Papua New Guinea, Kimbe Bay © Mark Godfrey - TNC

Chapter 6
Moving Forward Towards Networks and Broader Spatial Management

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Key Messages:

- Individual MPAs are vital but not sufficient in either scale or effectiveness to achieve sustainable ocean management.
- Sustainable financing mechanisms and involvement of stakeholders are needed to improve management effectiveness of MPAs.
- The effectiveness of MPAs and the broader benefits they provide are greatly increased when MPAs are networked together.
- The design of MPAs and MPA networks should not only consider biological and ecological criteria but also integrate the social and economic considerations.
- Regional "Challenges" are proving successful in providing enabling conditions for increasing the scale, effectiveness and financing of MPA networks.
- To be truly effective, MPAs must be part of a broader ecosystem-based management approach.
- Marine spatial planning provides a concrete step towards the development of ecosystem-based management because it focuses on developing area-based management plans to jointly meet multiple objectives such as conservation, fishery production, transportation, and energy extraction, and allows for addressing multiple human uses and their cumulative impacts on the ecosystem.

Introduction

As previous chapters have shown, many countries and regions have made remarkable progress in establishing MPAs and MPA networks. Chapter 3 also highlights that efforts towards achieving the global goals of establishing ecologically representative and effectively managed MPAs have clearly accelerated over the last several years and the number of MPAs has increased significantly. Important progress has been made in several key areas to support ocean conservation both at national and international levels.

However, despite these efforts and progress, the coverage of marine protected areas remains very low, just over 1%, compared to over 12% already achieved on land (Chapter 3; Butchart et al. 2010). The existing coverage and connectivity of marine protected areas remain in several ways insufficient to meaningfully contribute to reversing the trends of overexploitation and degradation in coastal and marine environments. The current coverage of MPAs does not adequately represent all ecosystems, habitats and species important for conservation, and the MPAs that are established often lack human capacity and financial resources to ensure effective management that includes adequate enforcement and evaluation processes in place (Spalding et al. 2008b).

When we look beyond MPAs with a broader perspective, we see that efforts to manage the impacts of human activities on marine and coastal ecosystems has had limited results so far (Sale et al. 2008; UNGA 2009). The various reports on the health of the planet and oceans continue to be alarming (Millennium Ecosystem Assessment 2005; Halpern et al. 2008; Secretariat of the CBD 2010). The global biodiversity outlook concludes that no country claims success in meeting the target of reducing biodiversity loss by 2010. Worse, the report warns that the principal pressures leading to biodiversity loss (e.g. overfishing, habitat destruction, etc.) are not just constant but are, in some cases, intensifying (Secretariat of the CBD 2010).

Marine and coastal ecosystems are amongst the most threatened in the world (Millennium Ecosystem Assessment 2005). Fisheries continue to be on a downward trajectory, the pressure on coastal ecosystems continues to increase, and climate change is adding new stress to an already weakened marine environment. There is a recognition that the various drivers of environmental degradation act synergistically, and are resulting in a serious decline in the capacity of coastal ocean environments to provide the goods and services on which humans depend.

Looking ahead over the next decade, the world will be facing extraordinary challenges. The world population is expected to grow to an estimated 9 billion people by 2050, with an increased concentration in coastal areas adding significant pressure on and competition for space and resources. Climate change impacts are expected to increase, with potential tipping points being crossed (Allison et al. 2009). Given the reliance of a large portion of the human population on the services provided by oceans and coasts, the global community needs to build on and accelerate success and progress towards achieving the goals of effective ocean protection and effective management of the multiple human uses and activities that affect coasts and oceans.

Marine protected areas remain a strong foundation to address these challenges. When adequately designed and effectively managed, they contribute significantly to the sustained conservation of ecosystems and, can support the enhancement or restoration of coastal and marine fisheries (IUCN-WCPA 2008).

Though global data are lacking to provide a comprehensive picture on management effectiveness of MPAs, there is a widespread recognition that most of them suffer from lack of management. Moving forward, national and global efforts need to ensure that all MPAs are not only a line on a map but that they become effectively managed. We equally need to ensure that the coverage of well-designed and effectively managed MPAs continues to expand rapidly, moving from single, often small scale MPAs to resilient MPA networks that cover large(r) areas and provide the needed connectivity in the vast ocean realm. Policies, planning and management also need to be expanded to look beyond MPAs, to consider biodiversity conservation and management needs across the entire ocean space, within and beyond national jurisdictions. MPAs cannot be a panacea to the heavy pressures on the coastal and oceans. For them to achieve their objectives, they need to be part of a broader framework that addresses effective management across all sectors.

Sustained political will, increased human and financial capacity and improved governance and engagement with ocean stakeholders are all key ingredients for success and need to be secured moving forward. Perhaps even more critical still is to ensure that conservation efforts are not undermined by conflicting policies. To tackle the root causes of ocean degradation, national and international policies must integrate sustainable management of the coastal and marine environment and resources in all areas of decision-making and in all economic sectors. Conserving biodiversity and maintaining ecosystem services can no longer be a postscript once development objectives are addressed. Rather, it should be the underpinning to ensure that the natural capital is sustainably managed to continue to provide for the needs of the present and future generations.

This chapter outlines the efforts needed to increase the effectiveness of marine protected areas and to make them more resilient to change. It highlights how three promising regional initiatives are addressing some of the impediments in order to dramatically strengthen and scale up ocean conservation. The final section of the chapter highlights new efforts to embed MPAs and other conservation tools within the larger seascapes and mainstream them in development planning.

Sea fans on the outer reef slope, Aldabra Atoll WH site © Jerker Tamelander

Improving MPA Effectiveness

A key step in moving the MPA agenda forwards involves addressing the widespread concern that many MPAs around the world are mostly legislative exercises and do not provide the protection that is needed. For that reason, they are often referred to as "paper parks" (Parks et al. 2006, The World Bank 2006).

A global review of the management effectiveness of protected areas highlighted six areas that were most often assessed as unsatisfactory. These include financial aspects (funding budget and funding security), community assistance programs, communication, infrastructure and maintenance (Leverington et al. 2008c). Many MPAs simply lack staffing and basic infrastructure and resources, which makes it hard to even consider monitoring programs that provides necessary data to evaluate whether or not the MPA is achieving its objectives. Addressing financial sustainability and exploring alternative management options should be an important consideration starting from the design phase. Amongst the recommendations of the study are the need to dedicate greater efforts to involving communities in the design and management of the protected areas as well as programmes to communicate the benefits of the protected areas to the neighbouring communities.

Globally, little hard data exists to truly quantify and categorize the level of management effectiveness and the benefits derived from MPAs at local or larger scales (see Chapter 3). Most management effectiveness evaluations have been undertaken in terrestrial protected areas, but there is growing international recognition of the need to evaluate and understand the degree to which MPA management efforts are effective and meeting their objectives and how best to improve their effectiveness (Hockings et al. 2000, 2006; Parks et al. 2006).

An evaluation of management effectiveness is needed to facilitate the development of adaptive strategies to specific challenges that influence whether the goals and objectives of the MPA are being reached. It should incorporate an assessment of the three factors (biophysical, socioeconomic, and governance) influencing the management of the area. Specifically, an evaluation of management effectiveness can assist managers to document and monitor the performance of management efforts at achieving MPA goals and objectives and to provide a report on progress to decision-makers and stakeholders (Pomeroy et al. 2004; Staub & Hatziolos 2004; Wells & Mangubhai 2007; White et al. 2006). Furthermore, when community members are involved in the evaluation, public support and trust can be strengthened. In addition, when the results of the evaluation of the MPA are shared with the public, this can raise the visibility and credibility of an MPA team, also leading to increased public support of the MPA, and increased financial support.

Engaging communities and stakeholders

For an MPA to be effective, securing the support of a broad constituency is of central importance. MPAs, and no-take reserves in particular, often raise concerns with the fishing communities: the notion of permanently closing off major sections of fishing grounds can be the focus of major disputes. In turn, a lack of support for, and compliance with, the MPA regulations ultimately results in reduced effectiveness of the protected area.

Certain management processes and conditions - including strong participation, local awareness, equitable distribution of benefits, and consistent implementation of regulations- are emerging in various countries as important useful processes that help reduce conflicts with stakeholders and ensure a broader support for the MPA (McClanahan et al. 2006; Pollnac et al. 2004; The World Bank 2006). Many studies (Agardy et al. 2003; Christie & White 2007; Pinto da Silva 2004) show that centralized management regimes run by government institutions, are not generally effective, and that community-based processes have proven more useful in ensuring management effectiveness.

When establishing a marine protected area, participatory processes that incorporate stakeholders and in particular fishermen's input and knowledge, can alleviate their scepticism toward scientists, increase the likelihood they will respond positively to marine reserves, and can be one of the most important criteria for successful fisheries management (Martin et al. 2007, Guidetti & Claudet 2010).

Throughout the world, experiences of community involvement in the design, planning and management of MPAs through co-management approaches have proven fundamental to improving their effectiveness and sustainability. Such co-management approaches have often been improved in many regions by integrating catch-share practices and exclusive territorial use rights over defined areas (Costello et al. 2008; Gelcich et al. 2008) to further alleviate overfishing. The Chilean network of areas for management and exploitation of benthic resources (*Áreas de Manejo y Explotación de Recursos Bentónicos*) and the Sian Ka'an Biosphere Reserve in Mexico illustrate good examples of governance arrangements designed with the fishing community to provide incentive for their engagement with the management and enforcement of the protected areas by allocating fishing rights. Marine

CASE STUDY

Marine Conservation Agreements and the example of the Gili Eco Trust's fishermen project at Gili Trawangan in Indonesia

Marine conservation agreements (MCAs) are increasingly being recognized and used by NGOs, governments, and conservation-minded businesses as adaptive mechanisms to meet ocean and coastal protection needs. They can serve to formally recognize and potentially shift governance arrangements over ocean and coastal resources.

MCAs include any formal or informal contract in which one or more parties commit to delivering explicit economic incentives in exchange for one or more other parties committing to take certain actions, refrain from certain actions, or transfer certain rights and responsibilities to achieve agreed-upon ocean or coastal conservation goals.

In 2002, the Gili Eco Trust (GET) was established to support efforts of SATGAS (a local security effort) in protecting the reefs around Gili Trawangan, one of three islands located within the Gili Marine Recreation Area off the coast of Lombok in Indonesia. Seven SCUBA dive centers at Gili Trawangan (through GET) reached an agreement with SATGAS and began collecting a small fee from each diver visiting the area. This money was initially used to help ban dynamite and cyanide fishing. In 2008, a formal agreement was signed between GET, SATGAS, the government MPA manager, and groups of local fisherman to control destructive net fishing in approximately 103 hectares of nearshore reef areas around Gili Trawangan (1.5% of the total 6,140-hectare MPA). The agreement allows net fishing in only two small areas around the island. There is a first-come, first-serve policy implemented around the island for fishermen and SCUBA divers (if fishermen are at a site first, divers must go elsewhere; if divers are at a site first, fishermen must go elsewhere). Explicit incentives in the agreement include monthly direct cash payments to seven fisher families. Explicit monetary sanctions are available to both parties for noncompliance. The project is sustainably financed via daily diver "donations" that go directly to GET for fishermen payments, guard salaries, community outreach and development, and reef restoration. GET employs local staff to patrol the area and works with MPA enforcement personnel.

Extract from Dudley, 2008

Conservation Agreements are also providing a vehicle to strengthening traditional management systems as well as support new forms of engagement of stakeholders in marine conservation including private leasing and ownership and new roles for civil society, NGOs, tourism and other sectors (Beck et al. 2004)(see also www.mcatoolkit.org)

Ensuring linkages to livelihood and other human benefits

The problems that MPAs and MPA networks are intended to solve are well known. However, one of largest issues surrounding the effective implementation of even the best designs and plans is the link to the human community that is affected by the ultimate change in resource use patterns inevitably required by well-designed MPAs/networks. In this regard, the planning and implementation of MPAs/networks must, from the outset, consider the impacts on the human communities and identify and measure the tangible benefits that will accrue directly to these same communities. The impacts that may be caused from changes in resource use rules can include reduced fishing in restricted areas, controls on level of tourism and development in an area, changes in waste disposal among many others. These potential impacts should be determined and transparently discussed with stakeholders.

While negative impacts on a community should be made known and discussed, they do not need to be inhibitors of a good project if the human benefits in terms of livelihoods or others are known, measured and communicated (Leisher et al. 2007). Such potential benefits can include:

- Improved fish catches, spill over effects to adjacent areas.
- New job opportunities, mostly in tourism and MPA management.
- Empowerment through stronger local governance and community decision-making.

Papua New Guinean villagers in a dugout canoe at Tarobi village in Kimbe Bay, Papua New Guinea. Mark Godfrey © 2008 The Nature Conservancy

Figure 6.1: Basic considerations in the development of MPA networks

- Benefits to women through economic returns and social rewards.
- Improved health through increased protein intake.
- Strengthened social cohesion and cultural tradition.

The strongest convincing factor in the eyes of involved stakeholders is usually what they stand to gain. Thus, being able to identify and quantify benefits is essential to the long-term success of most MPAs and/or networks. In addition, to the extent that successful MPAs provide more benefits, an educated and motivated community that wants to derive such benefits, will be more likely to ensure effective management of the MPA that may be at least partially under their control and watchful eye.

Moving from Isolated MPAs to MPA Systems or Networks

Once individual MPA effectiveness is addressed, there is a critical need to scale up to "networks" of MPAs or to develop MPA systems whereby connectivity of MPAs is considered in planning and implementation (IUCN-WCPA 2008; UNEP-WCMC 2008). As science and experience continue to provide more evidence of the importance of ecological conditions and of biological connectivity, which may confer resilience in the face of climate change, natural disasters, and economic, political and social fluxes, the development of linked systems or networks of MPAs is being seen increasingly important. Sale et al. (2010) provides a summary of what is currently known about the science of connectivity and provides MPA managers and others with useful guidance in understanding and applying the concept of connectivity in their work.

As discussed in chapter 2, depending on the governance, the term MPA may be applied narrowly to strict protection of small areas; to larger areas of habitat protection with consistent limited use; or more broadly to a zoned management regime for integration of conservation and sustainable multiple use of large ecosystems. Whatever is the case, networks of representative strictly protected areas is a critical component of marine ecosystem-based management because they can provide refuges or sanctuaries with the highest level of protection and maintenance of biological diversity and ecosystem processes. They also provide control or reference areas against which the management of the larger ecosystem can be evaluated.

Groups of MPAs, or multiple more strictly protected zones within a very large MPA, may form part of a more integrated system of ocean

and coastal management, but specifically such "networks" can confer benefits in three broad areas:

- Ecological: Whereby the basic tenets of functional marine ecosystems are maintained through the consideration of temporal and spatial needs of these ecosystems
- Social and learning: Whereby the human communities and primary stakeholders within and surrounding the areas of concern are connected to resolve and manage conflicts in the use of the natural resources and to contribute to the effective management of the MPAs at a network scale
- Governance: Whereby the legal and social jurisdictions within and surrounding the areas of concern are linked into an efficient and cooperative management system at a network scale

The development of effective MPA networks can be planned from the outset, but in many cases involves a progression from individually well designed and protected MPAs to network scale of management. This development can take time and cannot be forced or rushed beyond the capacity and foundation that exists in a given country or local area. Several basic considerations in the development of MPA networks are shown in Figure 6.2 (IUCN-WCPA 2008):

In many cases opportunism is used as a strategy to establish MPAs (Kelleher 1999), however opportunistic support of certain protected areas needs to be balanced and informed by confidence that these areas can deliver conservation or socio-economic outcomes for the targeted habitats or communities (Game et al. 2010).

Scaling Up – Regional Approaches to Fostering Political Will, Sustainable Finance, Capacity and Accountability

We have a vision. We have agreed goals. We have great knowledge and ever greener technologies. What we need is high-level political commitment for marine conservation and protection areas.

Kofi Annan, UN Secretary General, Port Louis, 13 January 2005

It is encouraging to note that over the last few years, an increasing number of political leaders are recognizing the connection between marine protected areas and the well-being of their people and nations, and are taking action for the protection of their marine environment. Just in the last several years, a growing number of coastal countries have articulated bold commitments to significantly increase their MPA coverage. France – which has the second largest maritime territory in the world- has committed to increase the MPA coverage to 10% of the areas under its jurisdiction by 2012, and to 20% by 2020 as part of a blueprint for sustainable development for coastal and marine areas – Le grenelle de la mer (http://www.legrenelle-mer.fr). A growing number of other nations, including Mexico, most coastal countries of Western Europe, Australia and New Zealand, Thailand, Belize, Costa Rica, Canada, have also taken important efforts to establish new MPAs (which are often part of their National systems of Protected Areas) as well as improve the design and management of existing MPAs.

CASE STUDY

The Japanese Concept of Satoumi in Ecosystem-Based Management of Coastal Areas

The Japanese concept of "satoumi" is centred on providing benefits to both people and biodiversity through culturally specific methods of implementing the ecosystem approach in a coastal context. As recognized in the CBD ecosystem approach, humans with their cultural diversity are an integral component of many ecosystems, and thus management activities will need to benefit both biodiversity and human communities. In Japanese, "Sato" means the area where people live, while "Umi" means the sea. When "satoumi" is restored in coastal waters, marine productivity and biodiversity are enhanced through the involvement of, and in harmony with, people. Achievement of satoumi relies on a long cultural heritage of fisheries knowledge and management, and an understanding of the interactions within and between ecosystems and human communities in the coastal zone.

Satoumi is an extension of the concept of "satoyama", which is a traditional a rural practice of resource management in hilly or mountainous areas. Satoyama has long been practiced in Japan and has not only been the subject of numerous academic publications, but is also a key element of government policies and civil society activities in the last twenty years. Satoumi is a more recent concept based on traditional management methods, and is an attempt to apply the essence of satoyama to coastal areas and communities.

The concept of satoumi was originally introduced as an attempt to restore coastal seas that have been affected by marine pollution and associated impacts, such as eutrophication and red tides, particularly in an area called the Seto Inland Sea. This area, renowned for its biodiversity and scenic beauty, and celebrated in some of the earliest Japanese poetry, has experienced rapid environmental deterioration since the 1950s. Concerned citizens and fishermen in the area organized protests to fight against pollution and large-scale development, which accounted for one of the very first citizens' environmental movements in Japan. This resulted in a partnership of local government bodies and experts to revive the ocean under the slogan "let's transform Seto Inland Sea into Satoumi". The partnership has produced a number of concrete measures aimed at achieving positive environmental outcomes.

Satoumi is unique in addressing highly populated coastal areas, such as the Tokyo Bay area. In the Tokyo Bay, large human populations cause a significant pollution load into the sea, while water purification is limited due to the lack of natural coast. Satoumi-based efforts have been undertaken by local residents and communities to improve water quality through various means, including through the use of oyster cultivation for water purification. By increasing the number of living and filter-feeding organisms ingesting nutrients from the land, the project aims to restore water quality in the Tokyo Bay. As the population densities in coastal areas increase, these types of efforts are transferable to many highly populated areas in Asia and globally.

Unlike many management practices based on traditional cultural heritage, satoumi has been incorporated into Japanese national policies, including the Strategy for an Environmental Nation in the 21st Century (2007), the Third National Biodiversity Strategy of Japan (2007), and the Basic Plan on Ocean Policy (2008). The concept is being put into practice through a programme of the Japanese Ministry of Environment, which supports the efforts of local governments, residents, non-profit organizations and universities to undertake diverse activities that include planting eelgrass to restore coastal ecosystems, public education, and working with fishing communities to revive traditional fishing methods. There are also plans underway to develop a satoumi restoration manual and promote public awareness and education, both in Japan and abroad.

The global MPA targets have also stimulated action by various regional conventions and arrangements, in particular by the regional seas programmes and the regional conventions and protocols on the protection of the marine environment (e.g. Barcelona Convention and Specially Protected Areas Protocol in the Mediterranean, and the Cartagena Convention and Specially Protected Areas and Wildlife Protocol in the Caribbean), which have increased efforts towards establishing and strengthening regional MPA networks (see Chapter 4).

In a similar fashion, the last few years have seen the rise of various initiatives where national leaders have joined forces to make bold commitments, launching substantial efforts to accelerate the creation of marine protected areas and effective management of their ocean and coastal resources in response to the CBD target. The Micronesia Challenge, the Caribbean Challenge and the Coral Triangle Initiative are among the most notable examples where leaders in all three regions were motivated by connections between effective natural resource management and economic and social benefits (fisheries/ food security, sustainable tourism, maintenance of natural capital and ecosystem services, livelihoods, and cultural heritage). These three regional challenges have also looked at creative ways to address one of the most significant impediments facing developing countries in establishing and maintaining their MPA networks – sustainable financing. They illustrate how regional grassroots approaches can be successful in maximizing the capacity and ability of the countries and the regions to access and leverage technical and funding assistance from various sources.

The "Micronesia Challenge" – a precedent setting initiative

In 2005, President Tommy E. Remengesau, Jr. of Palau committed his nation to preserving at least 30 percent of their near-shore marine resources and 20 percent of their terrestrial resources by 2020 and urged his neighbouring jurisdictions to match Palau's daring conservation commitment. This was the birth of the Micronesia Challenge that was launched in 2006 at CBD COP-8 by the Republic of Palau, the Federated States of Micronesia (FSM), the Republic of the Marshall Islands (RMI), the U.S. Territory of Guam, and the U.S. Commonwealth of the Northern Mariana Islands (CNMI). Each jurisdiction committed to effectively conserve at least 30% of the near-shore marine and 20% of the terrestrial resources across Micronesia by 2020, an ambitious commitment that aims to strike a critical balance between the need to use their natural resources today and the need to sustain those resources for future generations.

This region-wide initiative evolved from local, on-the-ground conservation projects across the region. The Challenge brings together more than 2,000 isolated islands, separated into five political jurisdictions, inhabited by nearly 500,000 people speaking 12 different languages — all working towards the same set of goals.

The Micronesia Challenge looked for creative ways to enhance skills and organizational capacity needed to achieve conservation in the region by creating networks to share basic skills, knowledge, and innovations on key conservation issues and connecting the often-isolated conservation leaders. The *Micronesians in Island Conservation* (MIC), a peer-learning network that brings together senior government officials and NGO leaders, has been expanding to include members of the six jurisdictions. The Pacific Islands Managed and Protected Area Community (PIMPAC) network includes marine and terrestrial protected area managers and other key practitioners. This network is complemented by the Micronesia Challenge Young Champions intern program to begin to develop future leaders.

As in other parts of the world, increased financial resources and sustainable financing plans are essential for the expanded MPAs and other management activities needed to achieve the goals of the Challenge. Hence, a central element of the Micronesia Challenge is a shared commitment from the five jurisdictions, the development community and two International NGOs to establish a regional trust fund to help provide a sustainable revenue stream. At the launch, an initial commitment of $6 million from The Nature Conservancy and Conservation International ($3 million each) was pledged to leverage an additional $12 million from the countries. A regional sustainable finance plan is currently being finalized and each of the five jurisdictions in the Micronesia Challenge have endorsed the Micronesia Conservation Trust as the regional finance institution to house the trust fund to ensure that the resources will be effectively managed.

A few years after the launch of the initiative, the jurisdictions have made important progress to meet their commitment. For example, the Republic of Palau became the first developing country in the world to enact a national Protected Area Network law. A key provision of the law established a $15 visitor's fee, to go towards the sustainable financing mechanism of Palau's Protected Areas Network. The law took effect in November 2009, and over $800,000 in visitor fees have been raised so far.

The Micronesia Challenge has set a global example for collaborative, sustainable conservation efforts, initiated by a coalition of regional governments, endorsed at an international level, and implemented on the ground with local communities. It inspired other regions to develop similar initiatives, in particular the Caribbean Challenge and the Coral Triangle Initiative outlined below.

Rock Islands, Palau. © Imèn Meliane

The "Caribbean Challenge" – Seeking the end of Paper Parks

In May 2008, The Governments of the Bahamas, Grenada, Jamaica, the Dominican Republic, and St. Vincent and the Grenadines launched the Caribbean Challenge, a region-wide campaign to protect the health of the Caribbean's lands and waters.

The Caribbean challenge aims at a wholesale transformation of countries' national park systems by nearly tripling the amount of marine and coastal habitat currently under protection, setting aside almost 21 million acres of coral reefs, mangroves, sea grass beds and other important habitat for sea turtles, whales, sharks and other wildlife.

The three core components of the Challenge include:

- Creating networks of marine protected areas expanding across 21 million acres of territorial coasts and waters
- Establishing protected area trust funds to generate permanent, dedicated and sustainable funding sources for the effective management, expansion and scientific monitoring of all parks and protected areas
- Developing national level demonstrations projects for climate change adaptation

In addition, each participating country has formulated its own conservation commitment under the Challenge:

- Grenada set a goal to effectively conserve at least 25% of its near shore marine and terrestrial resources by 2025.
- The Bahamas committed to effectively conserve at least 20% of its near shore marine resources, and to effectively manage a minimum of 50% of existing marine and terrestrial protected areas, by 2020.
- Jamaica committed to effectively manage 20% of its marine and terrestrial area by 2015.
- The Dominican Republic, with the addition of 31 recently declared protected areas, has approximately 56% of its near shore marine environment and 22% of its land within protected areas; its focus is on consolidating and effectively managing its existing protected areas.

In all participating countries, the conservation commitments and plans for their implementation are based on national protected area master plans (including ecological gap assessments and, in some cases, financing strategies). Multi-organizational National Implementation Support Partnerships created in most countries as a vehicle for implementing the CBD programme of work on Protected Areas played a major role in building national consensus and support for the goals.

Nevertheless, the countries in the region recognize that to ensure lasting conservation results, it is not enough to establish new parks or marine protected areas and that efforts should be made to improve the management of existing protected areas and to ensure the provision of increased and sustained funding for management. Legally protected binding trusts dedicated solely to the expansion and management of national parks and protected area systems are the tool of choice of the Caribbean challenge to ensure permanent sustainable funding for conservation. The creation of such trusts ensures that funds intended for conservation will not be channelled into other activities and withstand political instability. The creation of a $40 million permanent regional endowment—the Caribbean Biodiversity Fund (CBF) that will aggregate endowments for each participating country is a major feature of the Caribbean Challenge.

National Protected Area Trust Funds will be created via government legislation and will be administered by majority non-government boards of directors within each country. They will also include a revolving fund window that will receive funding from the respective country's newly established sustainable finance mechanisms. These could include protected area fees to be collected from international visitors, park entrance fees, tourism fees, developer's fees, and other similar income sources that are developed by the individual country governments to help sustain their national parks and protected areas.

To date, the Caribbean Challenge has leveraged nearly $25 million from various international donors, including the Global Environment Facility (GEF) and the German Development Bank (KfW), to capitalize the Caribbean Biodiversity Fund. In addition to the public funding sources, The Nature Conservancy has committed to raising 8 million dollars from private donors.

The Coral Triangle Initiative - linking human needs and conservation

The Coral Triangle Initiative (CTI) was launched in May 2009 by the leaders of Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor Leste at a summit held in conjunction with the World Ocean Conference in Manado, Indonesia. "The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security", focuses on the links between healthy coastal and marine resources and sustainable development. It aims to reverse the decline of coastal and marine resources in the six countries and address transnational fisheries, conservation and climate adaptation issues through the collaboration and synergies of the six countries.

Data Coordination in The Coral Triangle Initiative – The Coral Triangle Atlas

To track the progress of the Plan of Action, there was a need to centralize data from the six countries. To support this spatial approach to conservation management, The Nature Conservancy (TNC), World Wildlife Fund (WWF), Conservation International (CI), Wildlife Conservation Society (WCS), International Union for Conservation of Nature - Global Marine Species Assessment (IUCN-GMSA), World Fish Centre and ReefBase developed the Coral Triangle Spatial Data Atlas (CT Atlas). The CT Atlas (http://ctatlas.reefbase.org) is an online GIS database that aims to compile the core layers essential for management decisions at local and regional levels and focuses in particular on MPAs and MPANs, identifying key layers from sites and scaling up the process to a regional level. The datasets are often incomplete or incompatible and the CT Atlas works towards creating uniform layers and makes them accessible to managers, decision makers and scientists.

The CT Atlas is evolving into an interactive database for the CT countries and organizations that will facilitate keeping the database current as well as promoting the use of the datasets for planning and refinement of MPA networks that are resilient to local threats as well as climate change. The 5-year MPA goal for the CT countries is to design and agree on the framework for the "Coral Triangle MPA System." A functional and current CT Atlas as designed will be essential to facilitate this outcome for the CT Region.

Map 6.1: Coral Triagle ©TNC

The CTI Regional Plan of Action (RPoA) announced at the summit outlines several overarching commitments that include making sustainable management of marine and coastal resources as a high and urgent ongoing priority on national agendas; implementing needed economic, policy and legal reforms; establishing a system of sustainable funding to support the CTI Plan of Action; and to integrate conservation, management and development. The goals of the RPoA are:

- Priority seascapes designated and effectively managed
- Ecosystem approach to management of fisheries and other marine resources fully applied
- Marine protected areas established and effectively managed (including community-based resource utilization and management)
- Climate change adaptation measures achieved
- Threatened species status improved

Time-bound targets are outlined for each goal and 38 regional actions with target completion dates establish a comprehensive agenda of regional action and collaboration across the five goals. Each country has developed a national plan of action to implement specific activities within the scope of the Initiative. These are coordinated in each country by a National Coordinating Committee that includes stakeholder and NGO representatives, in addition to key national agencies. More specific, quantitative targets will be set in these national plans in 2011 such as Indonesia's commitment to increase its marine area within MPAs to 20% by 2020. The CTI also involves coordination mechanisms at the regional level, a permanent secretariat has been established, hosted in Indonesia and a Council of Ministers was established to maintain high-level political attention and address major policy issues at the regional level.

The ambitious aims and scale of the Coral Triangle Initiative have attracted a significant international support to assist the six governments in achieving their vision. A CTI Partnership group that includes an NGO consortium of World Wildlife Fund, The Nature Conservancy and Conservation International, the United States and Australian governments, the Asian Development Bank (ADB), and the Global Environment Facility (GEF) aims to coordinate technical and financial support to this process and the CTI Plan of Action. The U.S. government, through USAID and the Department of State, provided funding to the NGO consortium to initiate a major Coral Triangle Support Program to support implementation of the RPoA at the country and field level and to support a series of consultations and technical meetings that led to the CTI summit in Manado.

In addition, a working group comprised of technical experts from the WorldFish Center, the NGO consortium, ADB, several national government agencies, and the CTI Secretariat was established in 2008 to develop a monitoring and evaluation plan and a set of measureable indicators with tentative numerical targets for each. A biannual "State of the Coral Triangle" report has been identified as a mechanism for regular monitoring and reporting on progress toward the CTI goals and targets.

In summary, the CTI is the largest regional marine conservation initiative in the world and a grand experiment that is in its early stages of development and implementation. Success for the CTI will depend on the commitments of the six countries and a continuing focus on the goals set out in the RPoA as well as ongoing collaboration of the countries through regional forums coordinated by the CTI Regional Secretariat. The role of donors and assisting organizations in providing support for implementation activities is critical while it is equally important that the countries through their National committees are the lead decision makers in the process so that national ownership of the initiative is maintained and enhanced.

Contributions of the "Challenges" to improved management of ocean and coastal resources

It is too early to determine the success of the three regional initiatives in actually changing the pace at which marine and coastal resources are effectively managed. However, in the short time since their launch, tangible steps have been taken and enabling conditions for effective conservation have been created, including increased political will, better integration into development priorities, improved policies, strengthened organizational collaboration and development of sustainable finance. This is resulting in increased resources being generated to address these needs.

The Micronesia Challenge was inspired by a commitment to marine conservation made by Fiji at the Barbados+10 meeting of Small Island Developing States in Mauritius in 2005. The Micronesia Challenge, in turn, has provided inspiration for leaders in the Caribbean and the Coral Triangle to launch their initiatives. All three are providing approaches and experience on which other regions such as the Western Indian Ocean can build.

Through these initiatives, countries are increasingly making links between effective natural resource management and sustainable development. They are also working together to address large-scale threats like climate change that transcend national boundaries. Through the initiatives, countries are beginning to integrate climate change adaptation strategies into ocean and coastal management and development priorities.

Finally, the initiatives are seeking to address one of the major challenges to effective conservation identified by the Parties to the CBD: sustainable financing. They have become a major vehicle to implement sustainable financing strategies developed as a step to implement the PoWPA. The Micronesia and Caribbean Challenges in particular have attracted additional resources for ocean and coastal management and have catalyzed the development of permanent endowments and new domestic funding sources.

Table 6.1: Summary Characteristics of Three Regional Initiatives

	Micronesia Challenge	Caribbean Challenge	Coral Triangle Initiative
Scope and year of launch	2006; Palau, FSM, Marshall Islands, Guam, CNMI	2008; potentially all of the insular Caribbean; 8 countries currently	2009; Coral Triangle defined ecologically and includes all or part of 6 nations
Commitments and goals	Effectively protect at least 30% of near shore marine resources and 20% of terrestrial resources by 2020	Individual goals by each country; generally effectively manage 20% of near shore marine area by 2020	9 overarching, general commitments and 5 general goals with time bound targets included in Regional Plan of Action
Origins and development process	Inspired by Fiji commitment at Barbados+10; government leaders declaration of commitment; details and coordination mechanisms developed later	Inspired by Micronesia and Grenada commitments in 2006; developed through a series of GEF projects	Intention to develop initiative and principles announced in 2007; 18 month design process resulting in RPoA
Important pre-conditions	Existing political fora, formal and informal networks; gap assessments and financial plans as part of PoWPA implementation	PA master plans and NISPs developed as part of PoWPA implementation	Leaders make links between natural resource management and sustainable development; strong NGO presence and history of collaboration
Financing targets	Initial target of $18m in endowment funding to support Palau, FSM and Marshall Islands	$40 m for regional trust + $35m for on the ground activities	None identified yet
Organizational structure/coordination mechanisms	Steering committee, regional coordination office, support team, several networks of government and NGOs	Recently began to identify; CBF will administer regional endowment	CTI secretariat and inter-governmental meetings; NGO consortium, CTI Partnership
Monitoring & evaluation	Measures working group identified biological and socio-economic indicators and score card on commitments	Country specific, including through GEF projects	Measures working group identified indicators and continue to develop a monitoring system
Key external partners	TNC, USA, GEF, CI	TNC, GEF, Germany	TNC, WWF, CI, USA, GEF, ADB, Australia

Incorporating MPAs into Broader Spatial (Multi-Objective) Seascape Management

As discussed in Chapter 2, MPAs were never intended to be a fix all solution to the problems of the oceans. The earliest calls to establish MPA networks recognized the need to address the broader management of the marine environment and prevent outside activities from detrimentally affecting the marine protected areas. MPA networks were promoted as a way to strategically plan and place MPAs to increase connectivity between them and achieve a greater impact on the environment than the sum of the individual sites (Agardy 2005). As the number, coverage and effective management of MPAs increases around the world, the body of scientific evidence documenting their benefits to conservation and to local communities is growing. In addition, experiences around the world further highlight that despite their proven utility and benefits, MPAs and even MPA networks, cannot address alone the multiple problems facing the ocean and the people who depend on its resources (Allison et al. 1998). The future of most MPAs—however, well designed, and well managed they may be as well as their roles within an ecosystem-based approach will largely depend on their surrounding environments and the type of threats that need to be addressed by management outside of MPAs (Halpern et al. 2010; The World Bank 2006).

The need for integrated management of coastal areas and the marine environment has been recognized for a long time. The 1970 Decision of the UN General Assembly to convene a UN Conference on the Law of the Sea to prepare a single comprehensive treaty on all aspects of the oceans comes from the very recognition that the problems of ocean space are interrelated and need to be considered as a whole (UNGA Resolution 2750 (XXV)). During the Earth Summit in Rio de Janeiro, in 1992, coastal Governments already committed themselves to "integrated management and sustainable development of coastal areas and the marine environment under their national jurisdiction". (Agenda 21, Chapter 17).

The calls for holistic and integrated approaches in the management of coasts and oceans have since increased. Various conventions and organizations called for the application of an eco-system approach, including the Convention on Biological Diversity, the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme and the United Nations Development Programme.

At the 2002 World Summit on Sustainable Development, Governments committed to promote the sustainable development of marine ecosystems. More specifically, the WSSD Plan of implementation encouraged the application of the ecosystem approach by 2010, and promoted integrated, multi-sector, coastal and ocean management at the national level. As noted in previous chapters, WSSD also promoted

a suite of tools to achieve the ecosystem approach, including, but not limited to MPAs.

With the increased recognition for the need to shift from the traditional sectoral and single species approaches to managing the ocean environment and resources, numerous experiences and attempts to achieve integrated management approaches were being tested, particularly integrated coastal zone management and the application of the ecosystem approach to fisheries management. These experiences have been valuable in providing key lessons and models that are being incorporated in the management of marine and coastal ecosystems.

The application of the ecosystem approach or ecosystem-based management (EBM) to the oceans has also evolved over the recent years with the increased recognition for the need to explicitly accounts for the interconnectedness among systems, such as between air, land and sea, and cumulative impacts to the systems and to integrate ecological, social, economic and institutional perspectives, recognizing their strong interdependences. The concept of EBM can be overwhelming and complicated to implement. Marine Spatial Planning (MSP) is emerging as one of the most pragmatic tools to advance EBM, because it focuses on the most concrete aspects of EBM – area-based planning and management and addresses multiple human uses, their cumulative impacts and interactive effects.

Marine spatial planning and zoning

Marine spatial planning (MSP) and ocean zoning in particular have emerged as increasingly important tools for planning an ecosystem-based management approach and ensuring a coordinated governance structure in the world's oceans. This approach strives to distribute and manage the numerous human uses of ocean areas in a more coordinated fashion while supporting healthy ecosystems and sustaining the provision of ecosystem services for current and future generations.

Management objectives that are often considered in marine spatial planning include conservation, energy extraction (oil and gas), shipping, aquaculture, fisheries, and tourism (Foley et al. 2010). Below we review some new efforts at integrated planning across large areas of ocean space to identify some of the emerging ecological principles and planning practices that inform the development of integrated planning or MSP processes. We also examine what can be learned from these early efforts in terms of achieving the proposed benefits and the challenges these projects face.

MPAs need to be integrated in a broader management framework that addresses threats outside the protected area. Venice, Italy. © Karl Heinz Gaudry

Ecological Principles to guide spatial planning

Achieving ecosystem-based management in the ocean ultimately means maintaining the delivery of ecosystem services. Processes for planning and managing human activities should be guided by ecological principles to ensure maintaining healthy, functioning marine ecosystems. A recent review by Foley et al. (2010) of guiding ecological principles for spatial planning settles on four overarching principles that are often common to MPA design and that describe critical ecological attributes that must be considered in a planning process to maintain ecosystem service provisioning. These principles are to maintain or restore native species diversity, habitat diversity and heterogeneity, key species and connectivity. Two additional overarching guidelines proposed are context and uncertainty that need to be addressed in the planning process to account for spatial and temporal variability and nonlinearities in ecological systems. Using these ecological principles in a planning process will ensure that necessary ecological criteria for maintaining ecosystem service provisioning are considered when allocating human uses in marine space.

Developing best practices for spatial planning

While ecological principles are required for maximizing protection of ecosystem services, planning principles guide how an MSP process can actually take shape. Through an examination of many regional planning approaches, we have identified some of the best practices for marine spatial planning (Beck et al. 2009). We have highlighted some of the key elements of these findings.

Boundaries. Fundamental to every spatial planning process is a decision about boundaries. It is most critical to be clear and consistent on the reasoning for the landward (coastal) boundary and somewhat less crucial for the alongshore and then seaward boundaries. The coastal boundary should be the farthest extent of saltwater influence or head of tide. Consider using an existing jurisdictional boundary as the offshore edge of the planning area and adjusting if necessary for consistency in human uses and ecological features.

Geographic Scale. Decisions about the geographic scope or scale (i.e., total size of the planning area is) and resolution (i.e., the size of planning units such as grid cells) are critical for effective planning. Marine spatial plans should consider information at two scales and resolutions: a subregional scale (100s of kilometres) with relatively fine resolution (~5 km^2) and (b) a regional scale (1000s of km) with coarser resolution (e.g., 20 km^2).

Multi-Objective Planning. The most important challenge for MSP is to explicitly consider multiple management objectives (e.g., energy production, environmental conservation, fishery production, transportation). Whenever possible formal or informal considerations of trade-offs among objectives should be included in plans. These may involve the development of alternative scenarios. Focus the planning effort on the few, overarching management objectives first and then on more detailed consideration of the many human uses of the ocean.

Undertaking risk and environmental impact assessments. Risk assessments and environmental impact assessments (EIA) are useful tools for evaluating the likely environmental, social and economic

Potential Benefits of Marine Spatial Planning

MSP is a tool for achieving the best possible trade-off of multiple and conflicting spatial goals within the larger marine management landscape. The U.S. Interagency Ocean Policy Task Force outlines the expected benefits of MSP that will "reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security and social objectives"(USIOPTF 2009).

Reduce conflict among uses and users:
When activities are proactively zoned in the ocean, uses can be grouped to avoid incompatibilities such as renewable energy and shipping (see below). The distribution of uses into marine space should also reduce conflict among the users that are frequently in tension (e.g. trawlers versus static gear fishing). A straightforward zoning scheme can increase stability for business interests and ease permitting burdens as it will be clearer where these uses can and cannot be developed (Douvere & Ehler 2009). A comprehensive MSP should also gain support and buy-in from multiple users. While MPAs are often defined by limiting access and restricting use, MSP, in contrast, aims to distribute all uses into appropriate locations based on ecology, economics, and other planning principles.

Reduce environmental impacts:
MSP considers the cumulative impacts of multiple human uses in managing the marine environment. It is expected that recognizing these will enable managers to plan proactively for the cumulative negative effects of combined human uses of the marine environment (Halpern et al. 2008).

Concentrate compatible and separating incompatible uses:
A marine spatial plan will evaluate and distribute human uses based on compatibility, assuring better ecosystem protection and reducing conflicts among users. For example, zoning schemes may designate high-use marine industrial zones in less ecologically sensitive areas, while focusing non-extractive uses in ecologically sensitive areas.

Preserve ecosystem services:
A spatial plan or marine zoning system can distribute uses according to ecological principles to maximize the sustainable use of marine resources. For instance, habitat conservation zones that prevent benthic disturbances but allow pelagic fishing could be designed around sensitive benthic habitats that support productive fisheries. This type of zone will maximize the economic benefit (e.g. fish extraction) to humans while protecting the ecology and ability of the ecosystem to continue providing the service. A well-designed spatial plan will incorporate a protected area network within a broader spatial context of appropriately distributed human uses. This comprehensive and ecosystem-based approach may improve ecosystem health and service provision.

Better coordinate management:
Many countries recognize that their marine management has developed in a piecemeal fashion with various sectors and agencies having disjointed focus and jurisdiction. An ecosystem-based approach is difficult in this management scenario since oversight of the ecosystem is lacking continuity. A comprehensive spatial plan should improve coordination among agencies. With a comprehensive ocean management plan, ocean use, permitting and enforcement should be streamlined and better coordinated.

impacts of a proposed activity or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

Decision Support. In many areas, one of the most useful approaches for planning is to develop interactive decision support systems (DSS), which provide transparency and engage a diverse array of people in the planning process. Interactive DSS can capture, share, and compare many people's ideas about planning options; help people understand the real-world implications of different management regimes and environmental conditions; and reveal tradeoffs among possible management scenarios. When stakeholders can be involved in developing alternative solutions, it can enable much greater buy-in to the planning process (Gleason et al. 2010).

Experiences in marine spatial planning and lessons from the water

Originally, marine spatial planning, with a primary focus on conservation was used to improve the management of marine protected areas. The Great Barrier Reef Marine Park (GBRMP) in Australia was the first large-scale marine zoning effort, established in 1979, and often cited as one of the most successful examples of marine spatial planning. The GBRMP has the legislated purpose of providing for conservation and reasonable use of the Great Barrier Reef, associated ecosystems, and natural resources, potentially making successful management from a conservation point of view easier as many human uses are not permitted. However, the Park does balance a suite of human uses (including many types of fishing, aquaculture, shipping, recreation and tourism) within its boundaries that are distributed throughout six zones. The GBRMP was rezoned in 2004 and this reflective and adaptive management practice is one of the major strengths of its zoning success. Other strong points of the GBRMP zoning scheme outlined by Day (2002) include:

- The six zones of the GBRMP all have clear objectives that help accomplish the overarching goal of conservation, and allowable activities are clearly outlined with some activities subject to permitting based on zone objectives.
- The zoning scheme is stipulated by legislation and evidence from other projects supports that those with clear legislative mandates precede more smoothly.
- The GBRMP involves public input and process and the importance of stakeholder involvement and "buy-in" has been emphasized broadly as a key element to a successful spatial plan (Gleason et al. 2010).
- In the GBRMP, educational materials explain zone goals, again promoting user compliance, and are accompanied by accurate maps of zones.
- The GBRMP zoning scheme is adaptive and open to input of new information such as emerging human uses, new scientific understanding, feedback from important monitoring and evaluation programs and other unforeseen changing circumstances. The adaptive and evolving management plan through the use of MSP and the implementation of the GBR Plan constitutes the overall management regime for the GBR.

More recently, marine spatial planning has become increasingly more important for the planning of management for entire marine areas where the principal objective is to achieve integration and balance between economic development, social interests and ecological objectives.

Some evidence from MSP projects support the idea that multi-objective management reduces user conflicts and improves economic benefits and stability. In Germany, zoning of a "Priority Wind Farm

Table 6.2: Summary table of multi-objective, Marine Spatial Management projects proposed or underway internationally. Achievements range from framework development through the planning process to implementation and measured results. Perceived benefits include both the motivation for initiating a MSP project or in some cases, measured achievements.

MSP Project	Management Objectives	Achievements	Perceived Benefits	Citation
Australia – Bi-oregionalisation Program	Conservation Multiple activities as they relate to ecological criteria of marine plans	Framework developed Planning in progress	By zoning activities based on ecological criteria, will ensure ecologically-sustainable development.	(Day et al. 2008)
Australia – GBRMP	Conservation* Transportation Fisheries Tourism Aquaculture	Spatial Management Implemented Results measured	Extensive conservation zones in place High level of compliance	(Day et al. 2002)
Belgium – Part of the North Sea (BPNS)	Conservation Fisheries Transportation Resource extraction (dredging, sand and gravel) Alternative energy Tourism Aquaculture Infrastructure (cables and pipelines) Dumping Defense	Spatial Management Implemented	Reduces user conflict Enables proactive, anticipatory action to address new and emerging human uses.	(Douvere et al. 2007)
Canada – Eastern Scotian Shelf (EESIM)	Conservation Fisheries Transportation Resource extraction (offshore oil and gas, minerals) Infrastructure (cables and pipelines) Tourism Defense Research	Plan complete		DFO (2007)
Germany – North Sea and Baltic Sea	Conservation Fisheries Transportation Resource extraction Alternative energy	Plan complete 2007. Adopted 2009.	Enables proactive, anticipatory action to address new and emerging human uses.	Federal Maritime and Hydrographic Agency. (2009)
The Netherlands	Conservation Fisheries Resource extraction (sand) Alternative energy Transportation	Plan complete in 2005	Enables planning for emerging human uses and increasing intensity of human uses, as well as future planning for sea-level rise.	Interdepartmental Directors' Consultative Committee North Sea (2005)
Norway	Energy (oil and gas) Fishereis Transportation External pressures (e.g. pollution)	Plan complete in 2006	Integration of previously separate management regimes	(Olsen et al. 2007)
Sweden	Not specified	Framework developed	Improved ecological conditions	Better management of the marine environment (2008)
United Kingdom	Not specified	Framework developed	A more coherent and integrated approach to addressing marine threats.	
US – Massachu-setts	Conservation* Alternative energy Aquaculture Infrastructure (cables and pipelines) Resource extraction (sand and gravel)	Plan complete in 2008	Enables proactive, anticipatory action to address new and emerging human uses.	EEA (2009)
US – Florida Keys	Conservation Tourism Fishing Transportation Energy	Spatial Management Implemented Results measured	Protects the environment from and for heavy tourism	
China	Conservation Marine development	Spatial Management Implemented	Controlling development and use of marine resources.	Li (2006)

Area" means that individual projects will benefit from significantly reduced review time and cost for individual environmental impact assessments (USIOPTF 2009). However a recent study of Lyme Bay in the UK suggests that a "win-win" situation for all stakeholders, as is often proposed in the MSP process, is an unrealistic expectation in the short-term (Rees et al. 2010). Long-term evaluations of environmental, social and economic values of marine biodiversity may support a win-win situation, but some stakeholders will likely feel some loss in the short-term.

A major shortcoming in many MSP projects underway is the lack of integration or application at the appropriate ecosystem scale. This is especially a problem in Europe where national waters tend to be small, compared to the size of the ecosystem. Countries such as Belgium, Germany and the Netherlands have enacted laudable efforts at MSP in territorial waters, but lack integration at the larger scale (Douvere & Ehler 2009). In contrast, efforts in Australia outside of the GBR have focused on defining appropriate bioregional scales for approaching ecosystem-based management. While this "bioregionalization" effort in Australia is useful in terms of defining ecosystem boundaries, these efforts do not address near shore waters, uses and impacts within 3 nautical miles or consideration of current or future human uses at a level needed for zoning or planning within the regions.

This new direction is gaining particular importance and is being adopted as a key element in marine related policies in various regions of the world particularly in countries with heavily used national waters in North America, Europe, China and Australia. The European Union (EU) green paper 'Toward a Future Maritime Policy for the Union: A European Vision for the Oceans and Seas' sees marine spatial planning as a key instrument for the management of a growing and increasingly competing maritime economy, while at the same time safeguarding marine biodiversity. Recently, the US president issued an executive order that identifies coastal and marine spatial planning as one of nine priority implementation objectives and outlines a flexible framework for effective spatial planning to address conservation, economic activity, user conflict, and sustainable use of the ocean, coasts and Great Lakes in the US.

In order to be truly sustainable and advance ocean protection and human needs, the social and economic valuations and priorities of marine spatial planning must be integrated in a consistent way with ecological valuations and many marine spatial planning efforts have failed to do this (Douvere & Ehler 2009). Ecological criteria tend to be the first criteria applied to a spatial planning or zoning effort and while necessary for conservation of ecosystem services, integrating economics and social considerations are equally necessary for marine spatial planning to move beyond the shortcomings and failures of a single objective management and effectively address the drivers of the various threats to coasts and oceans. As the experiences of implementing marine spatial planning increase, several initiatives are looking at synthesizing the information and lessons learned and providing guidance to managers (Beck et al. 2009; www.marineplanning.org; http://www.unesco-ioc-marinesp.be/marine_spatial_planning_msp).

The need to move towards multi-objective management efforts that address cumulative human impacts is overwhelmingly clear. Success in the GBRMP and other promising integrated planning and management regimes worldwide suggest that the appropriate application of marine spatial planning is an important step forward towards more effective coastal and marine management and true ecosystem-based management.

Our ability to quantitatively assess multiple ecosystem stressors and deliver integration between ecological, economic and social needs is still at its infancy. International initiatives that provide a framework to further promote and advance such integration are needed. These should be a primary focus of the new course that the global community is charting to significantly increase biodiversity conservation and achieve development goals and greener economies. A foundation of well planned and effectively managed MPAs and MPA networks is one of the fundamental cores for the development of integrated management plans and for meeting multi-objective management goals for coastal and marine resources.

Two brothers (28 and 14 years-old) fishing in the Padre Ramos Estuary, Nicaragua © IUCN / Marco Calvo

Aerial photo showing development and construction pressure on the Chesapeake Bay estuary at Cape Charles on Virginia's Eastern shore.

Chapter 7
Conclusions and Recommendations

The global community has made considerable progress in supporting ocean conservation both at national and international levels, particularly in establishing ecologically representative and effectively managed MPAs. We have witnessed a significant increase in the number of MPAs over the last few years.

However, despite these efforts and progress, the coverage achieved remains patchy and falls far short of the 10% target that contracting parties to the CBD have agreed for 2010. The nearly 5880 individual MPAs cover just 1.17% of the global ocean area. Rather than a representative network, coverage is very uneven and does not adequately represent all ecoregions, habitats and species important for conservation. Moreover, the vast majority of established MPAs lack human capacity and financial resources for effective management.

While MPA coverage must be expanded, new efforts must be mounted to better manage the remaining 90% of ocean space, beyond current targets. Although we have not documented it here, some significant progress has been made in applying ecosystem approaches to fisheries management, yet the degradation and overexploitation of the oceans and coast by fisheries continues to increase alarmingly. Global population growth, coastal development, pollution and climate change are adding significant pressures to the status of already weakened marine and coastal environments.

To reverse these trends, the global ocean conservation agenda must incorporate strengthened measures and accelerated implementation to avoid the growing consequences of inaction.

Building Broader Context For Ocean Protection

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Efforts to secure a foundation of well planned and effectively managed MPA networks, as one of the fundamental cores of more comprehensive ocean management strategies, should be accelerated. Marine protected areas are essential for conserving priorities sites and processes, however they cannot be managed effectively as islands of conservation in a sea of depletion and degradation. For MPAs to fulfil their conservation objectives and contribute to ocean conservation and restoration more broadly, the design of the MPA system, and the selection, governance and management of sites should be part of an overall strategy of ocean management. Such a strategy must take into account the multiple factors that influence the persistence of coastal and marine resources, including the structure and function of the natural ecosystem, the existing and potential consumptive and non-consumption uses, the range of maritime activities and security considerations and the manner in which these interact with and impact the marine environment.

Apply principles of ecosystem-based management at large scales

Though there have been important advances, more efforts should be dedicated to establishing comprehensive management regimes for coastal and marine resources that are defined on the basis of ecological, rather than only political boundaries, and that integrate ecological, social, economic and institutional perspectives, recognizing their strong interdependences. Often this will require a change in the governance and institutional arrangements at the relevant scales to facilitate better integration.

Mainstreaming: Planning for both conservation and development

There is increased recognition of the need for mainstreaming conservation objectives into development planning, and the welcome emergence of new approaches and tools. Marine spatial planning is one such pragmatic approach that helps incorporate protected area networks and other conservation objectives within a broader spatial context of appropriately distributed human uses. Increased efforts are now required to apply this approach in a variety of geographic and jurisdictional contexts. Documenting and sharing lessons learned is critical to furthering our understanding and capacity to use these new approaches effectively for advancing both ocean protection and sustainable use.

Consideration of synergistic and cumulative impacts

Environmental impact assessments (EIAs) and strategic environmental assessments (SEAs) are frequently used to identify the potential risks associated with specific proposed activities and plans. A commonly reported weakness is that they are too activity or sector-specific, and do not adequately consider synergistic or cumulative impacts. Embedding SEA and EIA processes in marine spatial planning (and vice-versa) should be encouraged to enable better prediction of the magnitude and significance of the overall impacts resulting from human activities on conservation outcomes. In particular, the explicit analysis of trade-offs and potential “win-wins” among conservation and development objectives would be enhanced.

Accelerating Efforts to Establish MPA Networks: Addressing Gaps and Selecting the Right Places

Village fishermen explore the edge of a coastal mangrove forest in Micronesia. The bounty of Pohnpei's sea and forests has sustained people for thousands of years. ©Ami Vitale

Chapter 3 highlights that the existing coverage and connectivity of marine protected areas, though improved, remains insufficient to meaningfully contribute to reversing the trends of overexploitation and degradation in coastal and marine environments. Two parallel trends in establishing MPAs are observed, namely the increased designation of very large MPAs in areas far from coastlines and human settlements, and the continued expansion of locally initiated MPAs, often involving local communities. It is likely and essential that both trends will continue and accelerate.

However, there remains much more to be done to achieve an ecologically representative and socio-economically relevant MPA system in accordance with the broader objective of ocean conservation. In particular the establishment of new MPAs should be guided by:

Improving representative conservation

Systematic conservation planning based on biogeographical criteria must be improved. Targets and planning should take biodiversity patterns and processes into account, and this should encourage the expansion of MPAs in major gaps. This will incorporate increased attention towards waters beyond territorial seas, including areas within EEZ and in the high seas;

Targetting vulnerable and high value systems

Variable targets may be required for different ecosystems. Under-represented and vulnerable ecosystems such as shellfish reefs, seamounts and deepwater corals, may be singled out for urgent attention. At the same time certain ecosystems of high ecological value or which provide critical ecosystem services, including coral reefs and mangrove forests, may benefit from higher targets –even if they already benefit from relatively high levels of protection;

The need to secure ecosystems, communities and resource management programmes likely to be severely disrupted by global change or resource demands should be prioritised.

Building effective MPAs

Natural ecosystem dynamics must feature in MPA designation and management, with sites located to maximise ecological benefits, and the development of sites, or networks, of sufficient size to ensure sustained benefits;

The efficiency and effectiveness of management of the overall system must further take into account the institutional and individual capacity needs and constraints, in both conservation and related marine and coastal resource management sectors.

Linking MPAs to people

Existing stewardship of marine and coastal resources by indigenous people and local communities should be encouraged. Where there is the possibility of recognizing traditional means for conservation involving local governance and management this will provide considerable benefits;

MPAs coverage should be increased to meet targets especially in areas close to human populations where threats may be high. The potential benefits of protection to human health and well-being in such areas will be considerable;

Setting targets for strict protection

There are considerable benefits from a broad range of management approaches, and a range of such approaches is highly appropriate in most settings. At the same time the considerable benefits from strictly protected areas (no-take areas or marine reserves) must be acknowledged and such areas should be included in MPA networks. New targets for strict protection should be actively considered.

Improving Management Effectiveness

Numerous commercial fishing boats pursuing migrating salmon in the coastal waters off southwest Alaska. ©Ami Vitale

Paper parks do not contribute to ocean management. A substantial focus on management effectiveness is needed to ensure that marine protected areas, once designated, are managed to successfully achieve their objectives. Elements of management effectiveness that are of particular concern include the following:

Sustainable financing

An explicit consideration of the costs of establishment and ongoing management of all marine protected areas and networks should be addressed from the outset The development of a business plan and financing strategy, that involves all relevant stakeholders, is essential to effectiveness and sustainability. The full portfolio of financing mechanisms need be explored and utilized including government budgets, capital trust funds, revenues and levies, payments for ecosystem services, tourism fees and licences, and voluntary contributions. Additional innovations to address financial sustainability will be required in the long-term.

Involvement of communities and stakeholders

MPAs that do not consider the rights and interests of stakeholders, or strategies that do not fully recognize the power of partners for ocean conservation represented by communities and resource user groups, are unlikely to be successful. Fortunately, there has been much progress in the processes for planning and managing MPAs with enhanced consultation and involvement of stakeholders. This is supported by the emergence and use of processes and tools for social impact assessment and for incorporating traditional and customary knowledge. Further efforts should be made in documenting and sharing lessons learned from engaging stakeholders, particularly when these involve innovative and interactive processes, so that these become the norm.

Co-management

Co-management approaches that assign or share management responsibilities with stakeholders of MPAs and MPA networks should be encouraged, thereby sharing the burden of respective management bodies, and taking advantage of the expertise and capacity of multiple stakeholders (government, public sector, NGOs, communities, fishers and other user groups, private sector). When considering the further development or expansion of MPA systems, or contemplating changes in their management, explicit attention should be paid to existing rights and responsibilities and the opportunity to engage a range of actors, including indigenous peoples, local communities, the private sector and special interest groups in marine and coastal conservation. In some cases this requires the formalisation of existing arrangements, but should always respect and consider existing governance and other management arrangements. Special attention should also be dedicated to increasing the capacity of all stakeholders to fulfil their management responsibilities.

Cross-sectoral cooperation

The process of expanding involvement among stakeholders and sectors can engender new areas of co-operation, but also potentially engender conflicts of interest among existing sectors where collaboration has been limited or where objectives are misaligned. Building trust among partners also takes time. Efforts should be made to break though the existing barriers and work together to address conflicts when they arise, and to promote synergies in the longer term. Stakeholders should try to determine the common benefits in the development and management of MPA networks and use them as a basis for building collaborative efforts.

Addressing Climate Change

An aerial view of one of the many islands which comprise the Federated States of Micronesia showing the coastal forest, mangrove and coral reefs that shelter birds and provide protection for a vast aray of marine life. ©Ami Vitale

The marine environment has a critical role to play in helping address the causes and impacts of climate change, and MPAs may have an important part to play in safeguarding these function and thus in building adaptation and mitigation actions. This is both for safeguarding biodiversity and enhancing carbon capture and storage functions, but also for securing livelihoods and sustaining the benefits that are derived from the ocean. This role can be enhanced by:

Promoting and delivering in-situ ecosystem resilience, resistance and recovery

High levels of protection should be afforded within and across MPA networks, and as part of broader effective ecosystem management measures, to promote ecosystem resilience and resistance. This is essential for minimizing the impacts of climate change and ensuring rapid recovery from debilitating episodic occurrences such as extreme ocean and weather events. Achieving such goals and ensuring healthy examples of all habitat types covering sufficient area acts as an insurance against losses in the broader marine landscape.

Creating understanding and actions to deliver ecosystem resilience, resistance and recovery in temperate and polar regions

In tropical regions, a considerable body of work has been undertaken and effectively communicated to create understanding and generate action for increased ecosystem resilience, through improved design, establishment and management of MPA networks. Such principles work equally well in temperate and polar regions. However, the understanding and acceptance still lags well behind that of the tropics. 'Re-inventing the wheel' would put efforts back by years. Learning from the experiences from tropical regions and applying these to other regions is urgently needed to accelerate efforts and improve actions to combat climate change. Work on resilience toolkits in tropical areas should therefore be further encouraged and strongly promoted as having much wider application. A programme of activities to transfer resilience theory and practice to temperate and polar areas should be urgently put in place.

Creating climate-smart MPAs

By bringing together science, policy and management information, it is possible to develop and promote a suite of actions that enable MPAs to play a full role in climate change mitigation and adaptation. Marine and coastal ecosystems can help protect coastal populations from climate-induced coastal hazards, e.g. by improving storm and flood defences, and are an essential tool for ecosystem-based adaptation. It is recommended that further investment be made to adjust the design and management of MPAs so that they are not only 'climate proof' but also to enable them to contribute to future actions to secure livelihoods and reduce societal vulnerability in a changing world.

Using MPAs to secure key components of the carbon cycle

Recent research has demonstrated that some coastal marine habitats act as particularly valuable carbon sinks, in the same way as tropical forests, peatlands and soils. Whilst experts work to see how far such habitats can be brought into carbon finance markets there is a more basic need to ensure that the future of such areas is secured in the long-term interests of mitigating climate change. MPAs, as part of broader coastal management provide a readymade tool for this. Assessments and actions should be taken to ensure that the coverage of MPAs and MPA networks, and the associated management is implemented to secure these carbon capture and storage functions. Furthermore, action should be taken to avoid loss and degradation as well as to enhance the sustainable use and management of coastal carbon sinks as a contribution to reducing global GHG emissions.

Increasing Cooperation and Protection at Scale

Local fishermen in Palabuhan Ratu beach, West Java. ©Ahmad Fuadi, TNC

Foster and support regional commitments and initiatives

It is heartening to see that various like-minded countries sharing the same goal have come together in important regional efforts to establish MPA networks. They have been fostering political will and inspiring other nations and regions with bold political commitments that explicitly link ocean protection to the well-being of their people and the development and prosperity of their nations. Such efforts need to be supported and sustained, and their lessons well documented and applied.

Regional efforts should be further encouraged to facilitate the creation of enabling conditions for effective conservation, including increased political will, better integration into development priorities, improved policies, strengthened organizational collaboration and the development of sustainable finance mechanisms. Regional initiatives should further strengthen links between effective natural resource management and sustainable development, and addressing large scale threats like climate change that transcend national boundaries.

Beyond political boundaries

It is well known that ocean ecosystems are interrelated and do not respect political boundaries. While many nations are now adopting a more integrated approach to managing ocean space and uses within their EEZs, existing international mechanisms for managing areas beyond national jurisdiction remain primarily through sectoral approaches.

Though some progress has been made, further efforts are needed to galvanize cooperation and address the challenges of conserving and managing marine environment and resources that lie beyond national jurisdiction. Existing tools like the CBD criteria for identifying ecologically and biologically significant areas and the guidance for strategic environmental assessments and environmental impact assessments could help promote a common approach to identification of areas and management of risks to biodiversity beyond national jurisdiction while respecting the varying competences of the regional and sectoral bodies. However, agreement on common principles and goals for spatial management, and guidance on implementation are sorely needed to facilitate more coherent policies and practices across the numerous relevant agencies as well as national states.

Facilitating information exchange on biodiversity, its uses and management measures in areas beyond national jurisdiction is a priority. The wealth of new scientific and technical data and information from the scientific community and management organizations should be shared to inform improved management and conservation in the open-ocean and deep sea and capacity development initiatives are required to support this purpose.

Though much of the open-ocean and deep sea lies beyond national jurisdiction, changes in these systems will impact associated regions and nations directly or indirectly. The interconnectedness of these system need to be recognised, and adjacent regions and states therefore need to be engaged in managing these areas in an integrated and transboundary manner consistent with the ecosystem approach.

The Right Target and Indicators

Aerial shot of Roatan Island, Honduras ©Wolcott Henry

The 2002 goals and targets adopted by both the CBD and WSSD have created significant momentum and sparked new and important efforts towards improving ocean conservation and management. They have helped establish the enabling conditions, especially the sustained political will, to achieve these targets at a national level, and in turn to motivate a rapid increase in marine conservation, particularly in conjunction with wider policy concerns such as food security, human welfare and health.

However, the increased focus on MPAs and MPA networks with a specific numerical target for area coverage, though extremely important, may have diverted attention from the original intent of integration of MPAs in ecosystem-based management, and the application of the other management tools that are equally needed to achieve the desired conservation and management results.

To move forward on effective ocean conservation, it is necessary and urgent to achieve a balance between spatial conservation and sectoral integration. Further global commitments should be articulated to advance integrated strategies for coastal and ocean management at the appropriate scale that accounts for the interconnectedness among systems, such as between air, land and sea, and proactively manage multiple human uses, their cumulative impacts and interactive effects.

A practical, and we hope effective, means to achieve this could include the following elements, of common interest and which can and should be advanced together:

- Further advance the establishment of ecologically representative and effectively managed networks of marine protected areas that conserve high priority areas and provide socio-economic benefits;
- Develop and implement methodologies to assess and address the cumulative impacts of human activities on the marine environment;
- Further advance the implementation of ecosystem-based management principles in fisheries management and introduce similar management strategies in other major sectors that involve marine resource management;
- Apply marine spatial planning tools for better integration of conservation objectives in marine and other sectoral development programmes, and in overall plans for economic development.

Efforts to monitor progress towards these elements should be strongly encouraged at national, regional and global levels.

Acknowledgments and References

Acknowledgments

This report reflects an enormous and largely voluntary group effort. Each of the chapters was developed through input from various experts and practitioners from numerous organizations working in the field of marine conservation. The substantial support and contribution made by our colleagues greatly assisted in our writing. We would like to acknowledge the contributions from a number of individuals.

For their contributions with text and case studies, we would like to acknowledge Mike Beck, Georgina Bustamante, Yuko Chiba, Isabelle M. Côté, Caitlyn Muller Crain, Nigel Dudley, Claire Fitzgerald, Suzanne Garrett, Kristina Gjerde, Robert Glazer, Dorothée Herr, Kohei Hibino, Charlotte Karibuhoye, Richard Kenchington, Dan Laffoley, Christophe Lefebvre, Anne McDonald, Imèn Meliane, Emily Pigeon, Trevor Sandwith, Scott Smith, Mark Spalding, Jerker Tamelander, Moi Kim Tan, Caitlyn Toropova, Jay Udelhoven, Alessandra Vanzella-Khouri, Ole Vestergaard, Marjo Vierros, Lauren Wenzel, Alan White, Louisa Wood, and Kim Wright.

For their helpful comments and edits during the review process, the editors thank Jacqueline Alder, Jeff Ardron, Ruth Blyther, Isabelle Cote, Nigel Dudley, Carolina Garcia, Suzanne Garrett, Carlos Gaymer, Lynne Hale, Marea E. Hatziolos, Richard Kenchington, Thomas Laughlin, Trina Leberer, Liz Moore, Nyawira Muthiga, Trevor Sandwith, Alifereti Tawake, Ole Vestergaard, Marjo Vierros, Kathy Walls, and Kim Wright.

The preparation of this report was an intense but exciting process. We hope that everyone has been acknowledged; if names inadvertently fell off the list, please accept our sincere apologies.

We also want to thank Georgios Sarantakos and James Oliver for their efforts and patience with the layout and design.

This report could not have been produced without the assistance of all our partner organizations: The Nature Conservancy, the International Union for the Conservation of Nature and its World Commission on Protected Areas-Marine, the United Nations Environment Programme, The United Nations University, UNEP-World Conservation Monitoring Centre, The Wildlife Conservation Society and the French MPA Agency.

The editors also thank all the photographers who contributed their images and Jemma Aitken for her assistance in researching photos.

Aalbersberg, B. Tawake, A. & Parras, T. 'Village by village: Recovering Fiji's coastal fisheries' in *World Resources 2005 — The wealth of the poor: managing ecosystems to fight poverty*. United Nations Development Programme, United Nations Environment Programme, The World Bank, World Resources Institute, Washington, DC, 2005.

Abdulla, A. Gomei, M. Maison, E. & Piante, C. *Status of Marine Protected Areas in the Mediterranean Sea*. IUCN, Malaga and WWF, France, 2008.

Abesamis, RA. Alcala, AC. & Russ, GR. 'How much does the fishery at Apo Island benefit from spillover of adult fish from the adjacent marine reserve?' *Fishery Bulletin* Vol. 104, 2006, pp. 360-375.

Agardy, T. 'Global marine conservation policy versus site-level implementation: the mismatch of scale and its implications', *Marine Ecology Progress Series* Vol. 300, 2005, pp. 241–296.

Agardy, T. Bridgewater, P. Crosby, M.P. Day, J. Dayton, P.K. Kenchington, R. Laffoley, D. McConney, P. Murray, P.A. Parks, J.E. & Peau, L. 'Dangerous targets? Unresolved issues and ideological clashes around marine protected areas', *Aquatic Conservation: Marine and Freshwater Ecosystems* Vol. 13, 2003, pp. 353-367.

Agardy T, & Staub, F. 'Marine Protected Areas and MPA Networks. Educational Module', Network of Conservation Educators and Practitioners (NCEP), 2006.

Alcala, AC. Russ, GR. Maypa, AE. & Calumpong, HP. 'A long-term, spatially replicated experimental test of the effects of marine reserves on local fish yields.' *Canadian Journal of Fisheries and Aquatic Science*, Vol. 62, 2005, pp. 98-108.

Allison, G. Lubchenco. J. & Carr, MH. 'Marine reserves are necessary but not sufficient for marine conservation', *Ecological Applications* Vol. 8, Suppl. 1998, pp. S79–92.

Allison, I. Bindoff, NL. Bindschadler, RA. Cox, PM. de Noblet, N. England, MH. Francis, JE. Gruber, N. Haywood, AM. Karoly, DJ. Kaser, G. Le Quéré, C. Lenton, TM. Mann, ME. McNeil, BI. Pitman, AJ. Rahmstorf, S. Rignot, E. Schellnhuber, HJ. Schneider, SH. Sherwood, SC. Somerville, RCJ. Steffen, K. Steig, EJ. Visbeck, M. & Weaver, AJ. *The Copenhagen Diagnosis, 2009: Updating the world on the Latest Climate Science.* The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia, 2009.

Ardron J. 'The challenge of assessing whether the OSPAR network of marine protected areas is ecologically coherent', *Hydrobiologia* Vol. 606, 2008, pp. 45-53.

Ardron, J. Gjerde, K. Pullen, S. & Tilot, V. 'Marine spatial planning in the high seas', *Marine Policy* Vol. 32, 2008, pp. 832-839.

Australian Government. 'Great Barrier Reef Outlook Report 2009. In Brief.' Great Barrier Reef Marine Park Authority, Townsville, Australia, 2009.

Ballantine, WJ. & Langlois, TJ. 'Marine reserves: the need for systems', *Hydrobiologia* Vol. 606, 2008, pp. 35-44.

Balmford, A. Gravestock, P. Hockley, N. McClean, CJ. & Roberts, CM. 'The worldwide costs of marine protected areas' *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 101, issue 26, 2004, pp. 9694–9697.

a) Bartlett, CY. Manua, C. Cinner, J. Sutton, S. Jimmy, R. South, R. Nilsson, J. Raina, J. 'Comparison of outcomes of permanently closed and periodically harvested coral reef reserves.' *Conservation Biology* Vol. 23, 2009, pp. 1475-1484.

b) Bartlett CY, Pakoa K, & Manua C. 'Marine reserve phenomenon in the Pacific islands', *Marine Policy* Vol. 33, 2009 (doi: 10.1016/j.marpol.2009.1001.1004).

Baxter, JM. Buckley, PJ. & Wallace, CJ. (Eds.) *Marine Climate Change Impacts Annual Report Card 2010 – 2011*. Summary Report. MCCIP, Lowestoft, 2010.

Beck, MW. Marsh, TD. Reisewitz, SE. & Bortman, ML. 'New Tools for Marine Conservation: the Leasing and Ownership of Submerged Lands'. *Conservation Biology* Vol. 18, 2004, pp. 1214-1223.

Beck, MW. Ferdana, Z. Kachmar, J. Morrison, KK. Taylor, P. and others. *Best Practices for Marine Spatial Planning*. The Nature Conservancy, Arlington, VA. 2009.

Benzaken, D. Miller-Taei, S. & Wood, L. *Status of policy and target development and implementation for marine protected areas/marine managed areas in the Pacific Islands Region - a preliminary assessment and future directions*. SPREP, 2007.

Bjork M. Short, F. McLeod, E. & Beer, S. *Managing seagrasses for resilience to climate change*. IUCN, Gland, Switzerland, 2008.

Bossar, A., Capanna, S., Gilera, C.L. and Von Der Weppen, J. *Weighing Governance Options to Improve the Conservation and Management of Biodiversity Beyond National Jurisdiction*. Johns Hopkins School of Advanced International Studies (SAIS), Energy, Resources and Environment Department Practicum Project. September 2009 - April 2010. Prepared for the International Union for Conservation of Nature (IUCN). 2010. Online at http://cmsdata.iucn.org/downloads/sais_iucn_report_final.pdf

a) Brander, L. Florax, R. & Vermaat, J. 'The empirics of wetland valuation: a comprehensive summary and a meta-analysis of the literature', *Environmental and Resource Economics* Vol. 33, 2006, pp. 223-250.

b) Brander, LM. van Beukering, P. & Cesar, HSJ. *The recreational value of coral reefs: a meta-analysis* IVM Working Paper 06/07. Amsterdam, Netherlands, July 19, 2006.

Breitburg, DL. & Riedel, GF. 'Multiple stressors in marine systems' in *Marine conservation biology: the science of maintaining the sea's biodiversity* eds. E. Norse & LB. Crowder LB. Island Press, Washington, DC, 2005.

Brockman, CF. 'Supplement to the Report to the Committee on Nomenclature' in *First World Conference on National Parks* ed. Adams, AB. National Park Service, Washington, DC, 1962.

Brooke SD, Lim, TY. & Ardron, J. *Surveillance and enforcement of remote maritime areas. Paper 1: surveillance technical options*. Marine Conservation Biology Institute, USA 2009.

Brown, O. Crawford, A. & Hammill, A. *Natural Disasters and Resource Rights: Building resilience, rebuilding lives,* International Institute for Sustainable Development, Manitoba, Canada, 2006.

Bryant, D. Burke, L. McManus, J. & Spalding, M. *Reefs at Risk: a map-based indicator of threats to the world's coral reefs*. World Resources Institute, International Center for Living Aquatic Resources Management, World Conservation Monitoring Centre and United Nations Environment Programme, Washington, DC, 1998.

Burke, L. Kura,Y. Kassem, K. Revenga, C. Spalding, M. & McAllister, D. *Pilot Analysis of Global Ecosystems: Coastal Ecosystems*. World Resources Institute, Washington, DC. 2000.

Burke, L. & Maidens, J. *Reefs at Risk in the Caribbean*. World Resources Institute, Washington, DC, 2004.

Burke, L. Reytar, K. Spalding, M. & Perry, AL. *Reefs at Risk Revisited*. World Resources Institute, WorldFish Centre, The Nature Conservancy, UNEP World Conservation Monitoring Centre and GCRMN, Washington, D.C, in prep.

Bustamante, G. & Paris, C. 'Marine population connectivity and its potential use for the nomination of new World Heritage Sites in the Wider Caribbean' in *Proceedings of a Special Symposium, November 9-11, 2006, 59th Annual Meeting of the Gulf and Caribbean Fisheries Institute, Belize City, Belize*. Eds. Grober-Dunsmore, R. & Keller, BD. Marine Sanctuaries Conservation Series ONMS-08-07. US Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD, 2008.

Butchart, SHM. Walpole, M. Collen, B. van Strien, A. Scharlemann, JPW. Almond, REA. Baillie, JEM. Bomhard, B. Brown, C. Bruno, J. Carpenter, KE. Carr, GM. Chanson, J. Chenery, AM. Csirke, J. Davidson, NC. Dentener, F. Foster, M. Galli, A. Galloway, JN. Genovesi, P. Gregory, RD. Hockings, M. Kapos, V. Lamarque, J-F. Leverington, F. Loh, J. McGeoch, MA. McRae, L. Minasyan, A. Morcillo, MH. Oldfield, TEE. Pauly, D. Quader, S. Revenga, C. Sauer, JR. Skolnik, B. Spear, D. Stanwell-Smith, D. Stuart, SN. Symes, A. Tierney, M. Tyrrell, TD. Vie, J-C. & Watson, R 'Global Biodiversity: Indicators of Recent Declines', *Science* Vol. 328, 2010, pp. 1164-1168.

Caribbean Tourism Organization (CTO) 'Statistics & Market Research 2004. Table 50: Estimates of Visitor Expenditures.' <http://www.onecaribbean.org/content/files/2004visitorexptables.pdf>.2004 (accessed June 10, 2010)

Carr, M. & P. Raimondi. 'Marine protected areas as precautionary management' .CalCOFI Rep Vol. 40, 1999.

Chape, S. Blyth, S. Fish, L. Fox, P. & Spalding, M. *2003 United Nations List of Protected Areas*. IUCN - World Conservation Union and UNEP World Conservation Monitoring Centre, Gland, Switzerland and Cambridge, UK, 2003.

Chape, S. Harrison, J. Spalding, M. & Lysenko, I. 'Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets' *Philosophical Transactions of the Royal Society B* Vol. 360. 2005. pp. 443-455.

Chape, S. Spalding, M. & Jenkins, M. *The World's Protected Areas. Status,*

values, and prospects in the twenty-first century. University of California Press, Berkeley, CA, 2008.

Chmura, GL. Shimon, CA. Cahoon, DR. & Lynch, JC. 'Global carbon sequestration in tidal, saline wetland soils'. *Global Biogeochemical Cycles* Vol. 17, no. 4, 2003 (doi:10.1029/2002GB001917).

Christ. C. 'Ecoturism is transforming the travel industry'. Maine Center for Economic Policy. <http://www.mecep.org/MeChoices05/ch_06242005.htm>. June 24th 2005. (accessed July 8, 2010)

Christie, P. & White, AT. 2006. Background Paper 4: Best Practices in Governance and Enforcement of Marine Protected Areas: An Overview.

Christie, P. & White, AT. 'Best practices in governance and enforcement of marine protected areas: an overview' in *Report and documentation of the expert workshop on marine protected areas and fisheries management: review of issues and considerations*. FAO Fisheries Report no. 825, Rome Italy, 2007.

Cinner, JE. McClanahan, TR. Daw, TM. Graham, NAJ. Maina, J. Wilson, SK. & Hughes, TP. 'Linking Social and Ecological Systems to Sustain Coral Reef Fisheries'. *Current Biology* Vol.19, 2009, pp. 206.

Clarke, P. & Jupiter, S. 'Law, custom and community-based natural resource management in Kubulau District (Fiji)'. *Environmental Conservation* Vol. 37, no. 1, 2010, pp. 98–106.

Claudet, J. Osenberg, CW. Benedetti-Cecchi, L. Domenici, P. Garcia-Charton, JA. Pérez-Ruzafa, A. Badalamenti, F. Bayle-Sempere, J. Brito, A. Bulleri, F. Culiol,. JM. Dimech, M. Falcon, JM. Guala, I. Milazzo, M. Sanchez-Meca, J. Somerfield, PJ. Stobart, B. Vandeperre, F. Valle, C. & Planes, S. 'Marine reserves: size and age do matter.' *Ecology Letters* Vol. 11, 2008, pp. 481-489.

Coad, L. Burgess, ND. Bomhard, B. & Besancon. C. *Progress towards the Convention on Biological Diversity's 2010 and 2012 Targets for Protected Areas*. UNEP-WCMC, Cambridge, UK, 2009

Commonwealth of Australia 2003. ISBN 0 642 54949 4. Prepared by the Commonwealth Department of Environment and Heritage from material supplied by Richard Kenchington, Trevor Ward, and Eddie Hegerl.

Conservation International. 'Top 10 Coral Reef Hotspots Fact Sheet.' <http://www.charitywire.com/charity48/03034.html>. 2002.

Convention on Biological Diversity. *Convention on biological diversity. Concluded at Rio de Janeiro on 5 June. 1992. Article 2: Use of terms*. United Nations Environment Programme, 1993.

Convention on Biological Diversity. *COP 7 - Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity. Kuala Lumpur. Malaysia. 9 - 20 February 2004. Decision VII/28: Protected areas (Articles 8 (a) to (e))*. United Nations Environment Programme, 2004.

Convention on Biological Diversity, Decision VII/30. Strategic Plan: future evaluation of progress. United Nations Environment Programme, 2004. Online at <http://www.cbd.int/decision/cop/?id=7767>

Convention on Biological Diversity. *COP 8 - Eighth Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity. Curitiba, Brazil. 20 - 31 March 2006. Decision VIII/15: Framework for monitoring implementation of the achievement of the 2010 target and integration of targets into the thematic programmes of work. Annex 4.* United Nations Environment Programme, 2006.

Convention on Biological Diversity. *COP 9 - Ninth meeting of the Conference of the Parties to the Convention on Biological Diversity. Bonn. Germany 19 - 30 May 2008. Decision IX/18: Protected areas. A. Review of implementation of the programme of work on protected areas*. United Nations Environment Programme, 2008.

Convention on Biological Diversity. *COP 9 - Ninth Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity. Bonn. 19 - 30 May 2008. Decision IX/20: Marine and coastal biodiversity.* United Nations Environment Programme, 2008.

Convention on Biological Diversity, *COP 9 - Ninth Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity. Bonn. 19 - 30 May 2008. Decision IX/20, Annex 1: Scientific criteria for identifying ecologically or biologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats.* United Nations Environment Programme, 2008.

Convention on Biological Diversity, *COP 9 - Ninth Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity. Bonn. 19 - 30 May 2008. Decision IX/20, Annex II: Scientific guidance for selecting areas to establish a representative network of marine protected areas, including in open ocean waters and deep-sea habitats*. United Nations Environment Programme, 2008.

Convention on Biological Diversity. COP 9. Ninth meeting of the Conference of the Parties to the Convention on Biological Diversity. Bonn. Germany 19 - 30 May 2008. COP IX/18 Protected areas. A. Review of implementation of the programme of work on protected areas. United Nations Environment Programme, 2009.

Convention on Biological Diversity. *Subsidiary Body on Scientific, Technical and Technological Advice 10 - Draft Global Outcome-oriented Targets for the Programme of Work on Marine and Coastal Biological Diversity. UNEP/CBD/SBSTTA/10/8/Add.1.* Bangkok, Thailand. 7-11 February 2005. United Nations Environment Programme, 2005.

Corrigan, C. & Kershaw, F. *Working Toward High Seas Marine Protected Areas: An Assessment of Progress Made and Recommendations for Collaboration*. UNEP World Conservation Monitoring Centre. Cambridge, UK, 2008.

Costanza, R. Pérez-Maqueo, O. Martinez, ML. Sutton, P. Anderson, SJ. & Mulder, K 'The Vale of Coastal Wetlands for Hurricane Protection'. *Ambio* Vol. 37, 2008, pp. 241-248.

Costello. C. Gaines, SD. & Lynham, J. 'Can catch shares prevent fisheries collapse?' *Science* Vol. 321, 2008, pp.1678–1681.

Côté, IM. Mosqueira, I. & Reynolds, JD. 'Effects of marine reserve characteristics on the protection of fish populations: a meta-analysis'. *Journal of Fish Biology* Vol. 59 (suppl. A), 2001, pp. 178-189.

Cudney-Bueno, R. Lavin, MF. Marinone, SG. Raimondi, PT. & Shaw, WW. 'Rapid effects of marine reserves via larval dispersal'. *PLoS ONE* Vol. 4. 2009, e4140 (doi:10.1371/journal.pone.0004140).

Day, J. 'Zoning lessons from the Great Barrier Reef Marine Park'. *Ocean & Coastal Management* Vol. 45, 2002, pp. 139–156.

Day, JC. & Roff, JC. *Planning for Representative Marine Protected Areas: A Framework for Canada's Oceans*. World Wildlife Fund Canada, 2002.

Diaz, RJ. & Rosenberg, R. 'Spreading dead zones and consequences for marine ecosystems'. *Science* Vol. 321, 2008, pp. 926-929.

Done, T. 'Scientific principles for establishing MPAs to alleviate coral bleaching and promote recovery' in *Coral bleaching and marine protected areas. proceedings of the workshop on mitigating coral bleaching impact through MPA design. Asia Pacific Coastal Marine Program Report #0102*. eds. Salm, RV. & Coles, SL. The Nature Conservancy. Honolulu. HI, 2001.

Donner, SD. & Potere, D. 'The inequity of the global threat to coral reefs'. *BioScience* Vol. 57, 2007, pp. 214-215.

Douvere, F. & Ehler, CN. 'New perspectives on sea use management: Initial findings from European experience with marine spatial planning'. *Journal of Environmental Management* Vol. 90. 2009. pp. 77-88.

Dudley, N. (Ed) *Guidelines for Applying Protected Area Management Categories*. Gland. Switzerland. 2008.

Dudley, N. Stolton, S. Belokurov, A. Krueger, L. Lopoukhine, N. MacKinnon, K. Sandwith, T. & Sekhran, N. *Natural Solutions: Protected areas helping people cope with climate change.* IUCN-WCPA, TNC, UNDP, WCS, World Bank, WWF, 2010.

Edwards, M. & Richardson, AJ. 'Impact of climate change on marine pelagic phenology and trophic mismatch'. *Nature* Vol. 430, 2004, pp. 881-884.

Elliott, H.B. (Ed). *Second World Conference on National Parks, Proceedings.* Morges: IUCN, 1974.

Fabry, VJ. Seibel, BA. Feely, RA. & Orr, JC. 'Impacts of ocean acidification on marine fauna and ecosystem processes'. *ICES Journal of Marine Science* Vol. 65, 2008, pp.414-432.

FAO (2009) International Guidelines for the Management of Deep-sea Fisheries in the High Seas. Rome, FAO. 73p.

Fernandes, L. Day, J. Lewis, A. Slegers, S. Kerrigan, B. Breen, D. Cameron, D. Jago, B. Hall, J. Lowe, D. Innes, J. Tanzer, J. Chadwick, V. Thompson, L. Gorman, K. Simmons, M. Barnett, B. Sampson, K. De'Ath, G. Mapstone, B. Marsh, H. Possingham, H. Ball, I. Ward, T. Dobbs, K. Aumend, J. Slater, D. & Stapleton, K. 'Establishing representative no-take areas in the Great Barrier Reef: large-scale implementation of theory on marine protected areas'. *Conservation Biology* Vol. 19, 2005, pp.1733-1744.

FIBA/WWF/UICN. *Rapport des Journées de réflexion sur les priorités Sous-Régionales de Conservation de la Zone Côtière en Afrique de l'Ouest.* Saint-Louis du Sénégal. Avril 2000.

Fiske, SJ. 'Sociocultural Aspects of Establishing MPAs'. *Ocean & Coastal*

Management Vol. 17, no. 1, 1992, pp. 25-46.

Flanders Marine Institute (2009) VLIZ Maritime Boundaries Geodatabase. <www.vliz.be/vmdcdata/marbound/index.php>. Flanders Marine Institute. Oostende, Belgium.

Foley, M. Halpern, BS. Micheli, F. Armsby, M. Caldwell, MR. Crain, CM. Prahler, E. Rohr, N. Sivas, D. Beck, MW. Carr, MH. Crowder, LB. Duffy, JE. Hacker, SD. McLeod, KL. Palumbi, S. Peterson, CH. Regan, HM. Ruckelshaus, M. Sandifer, PA. & Steneck, RS. 'Guiding ecological principles for marine spatial planning'. *Marine Policy* Vol. 34, 2010, pp. 955-966.

Forcada, A. Valle, C. Bonhomme, P. Criquet, G. Cadiou, G. Lenfant, P. & Sanchez-Lizaso, JL. 'Effects of habitat on spillover from marine protected areas to artisanal fisheries.' *Marine Ecology Progress Series* Vol. 379, 2009, pp. 197-211.

Frank, KT. Petrie, B. Choi, JS. & Leggett, WC. 'Trophic cascades in a formerly cod-dominated ecosystem'. *Science* Vol. 308, no. 5728, 2005, pp.1621-1623.

Freudenberg, WR. Gramling, RB. Laska, SB. & Erikson, K. *Catastrophe in the Making: The Engineering of Katrina and the Disasters of Tomorrow*. Island Press, Washington DC, 2009.

Friedlander, AM. & DeMartini, EE. 'Contrasts in density, size, and biomass of reef fishes between the northwestern and the main Hawaiian islands: the effects of fishing down apex predators'. *Marine Ecology Progress Series* Vol. 230, 2002, pp. 253-264.

Fung. IY. Doney, SC. Lindsay, K. & John, J. 'Evolution of carbon sinks in a changing climate. *PNAS* Vol. 102, no. 32, 2005, pp.11201-11206.

Game, ET. Grantham, HS. Hobday, AJ. Pressey, RL. Lombard, AT. Beckley, LE. Gjerde, K. Bustamante, R. Possingham, HP. & Richardson, AJ. 'Pelagic protected areas: the missing dimension in ocean conservation'. *Trends in Ecology and Evolution* 2009 (doi:10.1016/j.tree.2009.01.011:10)

García-Chartón, JA. Pérez-Ruzafa, A. Marcos, C. Claudet, J. Badalamenti, F. Benedetti-Cecchi, L. Falcon, JM. Milazzo, M. Schembri, PJ. Stobart, B. Vandeperre, F. Brito, A. Chemello, R. Dimech, M. Domenici, P. Guala, I. Le Direach, L. Maggi, E. & Planes, S. 'Effectiveness of European Atlanto-Mediterranean MPAs: Do they accomplish the expected effects on populations. communities and ecosystems?' *Journal for Nature Conservation* Vol. 16, issue 4, 2008, pp. 193-221.

Garrick, LD. 'The Black River Lower Morass: A threatened wetland in Jamaica' *Oryx* Vol. 20, 1986, pp. 155-160.

Gelcich, Kaiser, SMJ. Castilla, JC. & Edwards-Jones, G. 'Engagement in co-management of marine benthic resources influences environmental perceptions of artisanal fishers'. *Environmental Conservation* Vol. 35, 2008, pp. 36–45.

Gell, FR. & Roberts, CM. 'Benefits beyond boundaries: the fishery effects of marine reserves'. *Trends in Ecology and Evolution* Vol. 18, 2003, pp. 448-455.

Gitay, H. Suárez, A. Watson, RT. & Dokken, DJ. (eds). 'Climate change and biodiversity. IPCC Technical Paper V'. United Nations Environment Programme and World Meteorological Organization. 2002.

Gleason, M. McCreary, S. Miller-Henson, M. Ugoretz, J. Fox, E. Merrifield, M. McClintock, W. Serpa, P & Hoffman, K. 'Science-based and stakeholder-driven marine protected area network planning: A successful case study from north central California'. *Ocean & Coastal Management* Vol. 53. 2010. pp. 52-68.

Goñi, R. Adlerstein, S. Alvarez-Berastegui, D. Forcada, A. Renones, O. Criquet, G. Polti, S. Cadiou, G. Valle, C. Lenfant, P. Bonhomme, P. Pérez-Ruzafa, A. Sanchez-Lizaso, JL. García-Chartón, JA. Bernard, G. Stelzenmuller, V. & Planes, S. 'Spillover from six western Mediterranean marine protected areas: evidence from artisanal fisheries.' *Marine Ecology Progress Series* Vol. 366. 2008. pp. 159-174.

Goñi, R. Hilborn, R. Diaz, D. Mallol, S. & Adlerstein, S. 'Net contribution of spillover from a marine reserve to fishery catches'. *Marine Ecology Progress* Series Vol. 400, 2010, pp. 233-243.

Govan, H. Tawake, A. Tabunakawai, K. Jenkins, A. Lasgorceix, A. Schwarz, A-M. Aalbersberg, B. Manele, B. Vieux, C. Notere, D. Afzal, D. Techera, E. Rasalato, ET. Sykes, H. Walton, H. Tafea, H. Korovulavula, I. Comley, J. Kinch, J. Feehely, J. Petit, J. Heaps, L. Anderson, P. Cohen, P. Ifopo, P. Vave, R. Hills, R. Tawakelevu, S. Alefaio, S. Meo, S. Troniak, S. Malimali, S. Kukuian, S. George, S. Tauaefa, T. Obed, T. *Status and potential of locally-managed marine areas in the South Pacific: meeting nature conservation and sustainable livelihood targets through wide-spread implementation of LMMAs*. SPREP/WWF/WorldFish-Reefbase/CRISP, 2009.

Graham, NAJ. Spalding, M. & Sheppard, C. 'Reef shark declines in remote atolls highlight the need for multi-faceted conservation action'. *Aquatic Conservation: Marine and Freshwater Ecosystems* 2010 (doi: 10.1002/aqc.1116).

Gravestock, P. 'Towards a better understanding of the Income Requirements for MPAs'. Cranfield University at Silsoe, 2002.

Green, A. Lokani, P. Sheppard, S. Almany, J. Keu, S. Aitsi, J. Warku Karvon, J. Hamilton, R. & Lipsett-Moore, G. *Scientific Design of a Resilient Network of Marine Protected Areas. Kimbe Bay. West New Britain. Papua New Guinea*. The Nature Conservancy. Brisbane, Australia, 2007.

Guidetti, P. & Claudet, J. 'Comanagement practices enhance fisheries in marine protected areas'. *Conservation Biology* Vol. 24, 2010, pp. 312-318.

Guidetti, P. & Sala, E. 'Community-wide effects of marine reserves in the Mediterranean Sea'. *Marine Ecology Progress Series* Vol. 335, 2007, pp. 43-56.

Guidetti, P. Milazzo, M. Bussotti, S. Molinari, A. Murenu, M. Pais, A. Spano, N. Balzano, R. Agardy, T. Boero, F.Carrada, G. Cattaneo-Vietti, R. Cau, A. Chemello, R. Greco, S. Manganaro, A. di Sciara, GN. Russo, GF. & Tunesi, L. 'Italian marine reserve effectiveness: Does enforcement matter?' *Biological Conservation* Vol. 141, 2008, pp. 699-709.

Hale, LZ. Meliane, I. Davidson, S. Sandwith, T. Beck, M. Hoekstra, J. Spalding, M. Murawski, S. Cyr, N. Osgood, K. Hatziolos, M. Van Eijk, P. Davidson, N. Eichbaum, W. Dreus, C. Obura, D. Tamelander, J. Herr, D. McClennen, C. & Marshall, P. 'Ecosystem-based adaptation in marine and coastal ecosystems'. *Renewable Resources Journal* Vol. 25, no. 4, 2009, pp. 21-28.

Halpern, BS. 'The impact of marine reserves: Do reserves work and does reserve size matter?' *Ecological Applications* Vol. 13, 2003, pp. S117-S137.

Halpern, BS. Lester, SE. & McLeod, KL. 'Placing marine protected areas onto the ecosystem-based management seascape'. *Proceedings of the National Academy of Sciences* 2010 (doi: 10.1073/pnas.0908503107).

Halpern, BS. McLeod, KL. Rosenberg, AA. & Crowder, LB. 'Managing for cumulative impacts in ecosystem-based management through ocean zoning'. *Ocean & Coastal Management* Vol. 51, 2008, pp. 203-211.

Harley, CDG. Hughes, AR. Hultgren, KM. Miner, BG. Sorte, CJB. Thornber, CS. Rodriguez, LF. Tomanek, L. & Williams, SL. 'The impacts of climate change in coastal marine systems'. *Ecology Letters* Vol. 9, 2006, pp. 228-241.

Harris, PT. Heap, AD. Whiteway, T. & Post, A 'Application of biophysical information to support Australia's representative marine protected area program'. *Ocean & Coastal Management* Vol. 51, 2008, pp.701-711.

Hays, GC. Richardson, AJ. & Robinson, C. 'Climate change and marine plankton'. *Trends in Ecology & Evolution* Vol. 20, no. 6, 2005, pp. 337-344.

Herr, D. & Galland, GR. *The Ocean and Climate Change. Tools and Guidelines for Action*. IUCN, Gland, Switzerland, 2008.

Higgins-Zogib, L. 'Misali Island Case Study' in *Beyond Belief*. Dudley, N. Higgins-Zogib, L. & Mansourian, S. WWF and ARC. Gland, Switzerland, 2006.

Hockings, M. Stolton, S. & Dudley, N. *Evaluating Effectiveness: A Framework for Assessing the Management of Protected Areas*. IUCN, Gland, Switzerland & Cambridge, UK, 2000.

Hockings, M. Stolton, S. Leverington, F. Dudley, N. & Courrau, J. *Evaluating Effectiveness: A Framework for Assessing Management Effectiveness of Protected Areas. (Second edition)*. IUCN, Gland, Switzerland and Cambridge, UK, 2006.

Hoegh-Guldberg, O. 'Climate change, coral bleaching and the future of the world's coral reefs'. *Marine & Freshwater Research* Vol. 50, 1999, pp. 839-866.

Hoegh-Guldberg, O. 'Coral reefs: Interactions and synergies between local and global factors' in *The Ocean and Climate Change. Tools and Guidelines for Action*. Herr, D. & Galland, GR. IUCN, Gland, Switzerland, 2008.

Hoegh-Guldberg, O. 'Low coral cover in a high-CO_2 world'. *Journal of Geophysical Research* Vol. 110, 2005 (doi: 10.1029/2004JC002528).

Hoegh-Guldberg, O. Mumby, PJ. Hooten, AJ. Steneck, RS. Greenfield, P. Gomez, E. Harvell, CD. Sale, PF. Edwards, AJ. Caldeira, K. Knowlton, N. Eakin, CM. Iglesias-Prieto, R. Muthiga, N. Bradbury, RH. Dubi, A. & Hatziolos, ME. 'Coral reefs under rapid climate change and ocean acidification'. *Science* Vol. 318, no. 5857, 2007, pp. 1737-1742.

Holdgate, M. *The Green Web.* Earthscan London. 1999.

Hoyos, CD. Agudelo, PA. Webster, PJ. & Curry, JA. 'Deconvolution of the

factors contributing to the increase in global hurricane intensity'. *Science* Vol. 312, no. 5770, 2006, pp. 94-97.

Hughes, TP. Bellwood, DR. Folke, C. Steneck, RS. & Wilson, J. 'New paradigms for supporting the resilience of marine ecosystems'. *Trends in Ecology & Evolution* Vol. 20, 2005, pp. 380–386.

Hughes, TP. Rodrigues, MJ. Bellwood, DR. Ceccarelli, D. Hoegh-Guldberg, O. McCook, L. Moltschaniwskyj, N. Pratchett, MS. Steneck, RS. & Willis, B. 'Phase shifts, herbivory, and the resilience of coral reefs to climate change'. *Current Biology* Vol. 17, no. 4, 2007, pp. 360-65.

IPCC. *Climate Change 2007: Synthesis Report. Contribution of working groups I. II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Eds. Pachauri, RK. & Reisinger, A. IPCC, Geneva, Switzerland, 2007.

IUCN. *Marine Menace. Alien invasive species in the marine environment*. IUCN, Gland, Switzerland, 2009.

IUCN. *The Mediterranean and Black Sea Region: Celebrating successes and addressing challenges in marine protected areas*. Vol. 1 in Protect Planet Ocean Review Series. 2009.

IUCN. *Recommendation 17.38 Protection of the coastal and marine environment* adopted by the 17th IUCN General Assembly, San José, 1988.

IUCN World Commission on Protected Areas, *Establishing Marine Protected Area Networks – Making It Happen.* IUCN-WDPA, National Oceanic and Atmospheric Administration and The Nature Conservancy, Washington, DC, 2008.

IUCN - World Commission on Protected Areas. "Sala & Gomez Island protection moves forward ", http://blog.protectplanetocean.org/2010/09/sala-gomez-island-protection-moves.html (accessed 23 Sept 2010).

IUCN World Commission on Protected Areas with the assistance of the World Conservation Monitoring Centre. *Guidelines for Protected Area Management Categories.* IUCN, Gland, Switzerland and Cambridge, UK 1994.

Jameson, SC. Tupper, MH. & Ridley, JM. 'The three screen doors: *can* marine "protected" areas be effective?' *Marine Pollution Bulletin* Vol. 44, 2002, pp. 1177-1183

Johannes, RE. & Hickey, FR. 'Evolution of village-based marine resource management in Vanuatu between 1993 and 2001'. Coastal region and small island papers 15. UNESCO, Paris, France, 2004. http://www.unesco.org/csi/wise/indigenous/vanuatu1.htm

Jones, PJS. 'Collective action problems posed by no-take zones'. *Marine Policy* Vol. 30, issue 2, 2006, pp. 143-156.

Kelleher, G. *Guidelines for Marine Protected Areas*. IUCN, Gland, Switzerland and Cambridge, UK, 1999.

Kelleher, G. & Kenchington, R. *Guidelines for Establishing Marine Protected Areas.* A Marine Conservation and Development Report. IUCN, Gland, Switzerland, 1992.

Keller, BD. Gleason, DF. McLeod, F. Woodley, CM. Airame, S. Causey, BD. Friedlander, AM. Grober-Dunsmore, R. Johnson, JE. Miller, SL. & Steneck, PS. 'Climate change, coral reef ecosystems, and management options for marine protected areas'. *Environment Management* Vol. 44, no. 6, 2009, pp. 1069-1088

Kenchington, R. **'**Strategic roles of marine protected areas in ecosystem scale conservation'. *Bulletin of Marine Science*: Vol. 86, no. 2, 2010, pp. 303-313.

Khalil, G.M. 'Cyclones and storm surges in Bangladesh: Some mitigative measures'. *Natural Hazards* Vol. 6, no. 1, 1992, pp 11-24.

Laffoley, D d'A., & Baxter, JM. (Eds) 'Ocean Acidification: The Facts. A special introductory guide for policy advisers and decision makers'. European Project on Ocean Acidification (EPOCA), Ocean Acidification Reference User Group. 2009

Laffoley, D.d'A. & Grimsditch, G. (eds). *The management of natural coastal carbon sinks*. IUCN, Gland, Switzerland, 2009.

Leeworthy, VR. *Preliminary Estimates from Versions 1-6: Coastal Recreation Participation. National Survey on Recreation and the Environment (NSRE) 2000.* NOAA, National Ocean Service, Special Projects Office, Silver Spring, MD, 2000.

Leisher, C. van Beukering, P. & Scherl, LM. *Nature's investment bank: how marine protected areas contribute to poverty reduction*. The Nature Conservancy, Arlington, VA, 2007.

Le Quéré, C. Rödenbeck, C. Buitenhuis, ET. Conway, TJ. Gomez, A. Labuschange, C. Ramonet, M. Nakazawa, T. Metzl, N. Gillett, N. & Heimann, M. 'Saturation of the Southern Ocean CO_2 sink due to recent climate change'. *Science* Vol. 316, no. 5832, 2007, pp. 1735-1738.

Leslie, H. 'A Synthesis of Marine Conservation Planning Approaches'. *Conservation Biology* Vol. 19, 2005, pp. 1701-1713.

Lester, SE. & Halpern, BS. 'Biological responses in marine no-take reserves versus partially protected areas.' *Marine Ecology Progress Series* Vol. 367, 2008, pp. 49-56.

Lester, SE. Halpern, BS. Grorud-Colvert, K. Lubchenco, J. Ruttenberg, BI. Gaines, SD. Airame, S. & Warner, RR. 'Biological effects within no-take marine reserves: a global synthesis'. *Marine Ecology Progress Series* Vol. 384, 2009, pp. 33-46.

a) Leverington, F. Hockings, M. & Costa, KL. *Management Effectiveness evaluation in protected areas - A global study*. IUCN, Gland, Switzerland, 2008.

b) Leverington, F. Hockings, M. Pavese, H. Costa, KL. & Courrau, J *Management Effectiveness evaluation in protected areas - A global Study: Overview of approaches and methodologies*. IUCN, Gland, Switzerland, 2008.

c) Leverington. F. Hockings, M. & Costa, KL. *Management effectiveness evaluation in protected areas: Report for the project 'Global study into management effectiveness evaluation of protected areas'*. The University of Queensland, Gatton, IUCN WCPA, TNC, WWF, Australia, 2008.

Ling, SD. Johnson, CR. Frusher, SD. & Ridgway, KR. 'Overfishing reduces resilience of kelp beds to climate-driven catastrophic phase shift'. *Proceedings of the National Academy of Sciences.* Vol. 106, no. 52, 2009, pp. 22341-22345.

LMMA Network. <www.lmmanetwork.org>. 2010 (accessed 30 June. 2010).

Lombard, AT. Reyers, B. Schonegevel, LY. Cooper, J. Smith-Adao, LB. Nel, DC. Froneman, PW. Ansorge, IJ. Bester, MN. Tosh, CA. Strauss, T. Akkers, T. Gon, O. Leslie, RW. & Chown, SL. 'Conserving pattern and process in the Southern Ocean: designing a Marine Protected Area for the Prince Edward Islands'. *Antarctic Science* Vol. 19, 2007, pp. 39-54.

Lotze, HK. Lenihan, HS. Bourque, BJ. Bradbury, RH. Cooke, RG. Kay, MC. Kidwell, SM. Kirby, MX. Peterson, CH. and & Jackson, JBC. 'Depletion, degradation, and recovery potential of estuaries and coastal seas'. *Science* Vol. 312, 2006, pp. 1806-1809.

Lowry, G. White, AT. & Christie, P 'Scaling up to networks of marine protected areas in the Philippines: biophysical, legal, institutional, and social considerations'. *Coastal Management* Vol. 37, 2009, pp. 274-290.

Lutchman. I. *Marine Protected Areas: Benefits and Costs for Islands*. WWF, The Netherlands, 2005.

Mace, GM. Cramer, W. Diaz, A. Faith, DP. Larigauderie, A. Le Prestre, P. Palmer, M. Perrings, C. Scholes, RJ. Walpole, M. Walther, BA. Watson, JEM. & Mooney, HA. 'Biodiversity targets after 2010'. *Current Opinion in Environmental Sustainability*. 2010 (doi:10.1016/j.cosust.2010.03.003).

Maliao, RJ. White, AT. Maypa, AP. & Turingan, RG. 'Trajectories and magnitude of change in coral reef fish populations in Philippine marine reserves: a meta-analysis.' *Coral Reefs* Vol. 28, 2009, pp. 809-822

a) Marshall, P. & Schuttenberg, H. *A reef manager's guide to coral bleaching*. Great Barrier Reef Marine Park Authority, Townsville, Australia 2006.

b) Marshall, P. & Schuttenberg, H. 'Adapting coral reef management in the face of climate change' in *Coral reefs and climate change: science and management*. Eds. Phinney, JT. Hoegh-Guldberg, O. Kleypas, J. Skirving, WJ. & Strong, A. American Geophysical Union, Washington, DC, 2006.

Martin, K. Samoilys, MA.. Hurd, AK. Meliane, I. & Lundin, CG. 'Experiences in the use of marine protected areas with fisheries management objectives- a review of case studies' in *Report and documentation of the expert workshop on marine protected areas and fisheries management: review of issues and considerations.* FAO Fisheries Report no. 825. Rome, Italy, 2007.

Martínez, ML. Intralawana, A. Vázquez, G. Pérez-Maqueoa, O. Sutton, P. & Landgrave, R. 'The coasts of our world: Ecological, economic and social importance'. *Ecological Economics* Vol. 63, 2007, pp. 254-272.

Mascarenhas, A. 'Oceanographic validity of buffer zones for the east coast of India: A hydrometeorological perspective'. *Current Science* Vol. 86, no. 3, 2004, pp 399-406.

Mastny, L. *Traveling light: new paths for international tourism*. Worldwatch Paper 159. Worldwatch Institute, Washington, DC, 2001.

McClanahan, TR. 'Effects of fisheries closures and gear restrictions on fishing income in a Kenyan coral reef'. *Conservation Biology* 2010 (doi: 10.1111/j.1523-1739.2010.01530).

McClanahan, TR. & Mangi, S. 'Spillover of Exploitable Fishes from a Marine Park and Its Effect on the Adjacent Fishery,' *Ecological Applications* Vol. 10, issue 6, 2000, pp. 1792-1805

McClanahan, TR. Verheij, E. & Maina, J. 'Comparing the management effectiveness of a marine park and a multiple-use collaborative fisheries management area in East Africa'. *Aquatic Conservation: Marine and Freshwater Ecosystems* Vol. 16, 2006, pp.147–165.

McLeod, E. Salm, R. Green, A. & Almany, J. 'Designing marine protected area networks to address the impacts of climate change'. *Frontiers in Ecology and the Environment* Vol. 7, 2009, pp. 362-370 (doi:10.1890/070211).

McNeely, JA. Mooney, HA. Neville, LE. Schei, P. & Waage, JK (eds.) *A Global Strategy on Invasive Alien Species*. IUCN, Gland, Switzerland, and Cambridge, UK, 2001.

McQuistan, CI. Fahmi, Z. Leisher, C. Halim, A. & Adi, SA. *Protected Area Funding in Indonesia, A Study Implemented Under the Programmes of Work on Protected Areas of the Seventh Meeting of the Conference of Parties on the Convention on Biological Diversity – PA financing in Indonesia.* Ministry of Indonesia, Jakarta, 2006.

Micheli, F. Halpern, BS. Botsford, LW. & Warner, RR. 'Trajectories and correlates of community change in no-take marine reserves.' *Ecological Applications* Vol. 14, 2004, pp. 1709-1723.

Millennium Ecosystem Assessment. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC, 2005a.

Millennium Ecosystem Assessment. *Ecosystems and Human Well-being: Current State and Trends. Volume 1*. Island Press, Washington, DC, 2005b.

Molloy, PP. McLean, IB. & Côté, IM. 'Effects of marine reserve age on fish populations: a global meta-analysis'. *Journal of Applied Ecology* Vol. 46, issue 4, 2009, pp. 743-751.

Mora, C. Andrefouet, S. Costello, MJ. Kranenburg, C. Rollo, A. Veron, J. Gaston, KJ & Myers, RA. 'Coral reefs and the global network of marine protected areas'. *Science* Vol. 312, 2006, pp. 1750-1751.

Mosqueira, I. Côté, IM. Jennings, S. & Reynolds, JD. 'Conservation benefits of marine reserves for fish populations.' *Animal Conservation* Vol. 3, 2000, pp. 321-332.

Muller, EM. Rogers, CS. Spitzack, AS. & van Woesik, R. 'Bleaching increases likelihood of disease on *Acropora palmata* (Lamarck) in Hawksnest Bay, St. John, US Virgin Islands'. *Coral Reefs* Vol. 27, no. 1, 2008, pp. 191-195.

Mumby, PJ. & Harborne, AR. 'Marine reserves enhance the recovery of corals on Caribbean reefs'. *PLoS ONE* Vol. 5, 2010, e8657.

Mumby, PJ. & Steneck, RS. 'Coral reef management and conservation in light of rapidly evolving ecological paradigms'. *Trends in Ecology and Evolution* Vol. 23, issue 10, 2008, pp. 555-563.

Murawski, SA. Brown, R. Lai, HL. Rago, PJ. & Hendrickson, L. 'Large-scale closed areas as a fishery-management tool in temperate marine systems: The Georges Bank experience.' *Bulletin of Marine Science* Vol. 66, 2001, pp. 775-798.

Murawski, SA. Wigley, SE. Fogarty, MJ. Rago, PJ. & Mountain, DG. 'Effort distribution and catch patterns adjacent to temperate MPAs.' *ICES Journal of Marine Science* Vol. 62, 2005, pp. 1150-1167.

National Marine Protected Areas Center. *Framework for the National System of Marine Protected Areas of the United States of America*. National Ocean and Atmospheric Administration, Washington, DC, 2008.

National Research Council. Marine Protected Areas: Tools for Sustaining Ocean Ecosystems. National Academy Press, Washington, DC, 2001.

Notarbartolo-di-Sciara, G. Agardy, T. Hyrenbach, D. Scovazzi, T. & Van Klaveren, P 'The Pelagos Sanctuary for Mediterranean marine mammals'. *Aquatic Conservation: Marine and Freshwater Ecosystems* Vol. 18, 2008, 367-391.

Parks, JE. Pomeroy, RS. & Philibotte, J. 'Experiences and Lessons Learned from Evaluating the Management Effectiveness of Marine Protected Areas in Southeast Asia and the Pacific Islands'. Invited Paper Presentation from the CBD/IUCN International Workshop for Better Management of Protected Areas, Jeju Island, Korea, October 24-27, 2006.

Perry, AL. Low, PJ. Ellis, JR. & Reynolds, JD. 'Climate change and distribution shifts in marine fisheries'. *Science* Vol. 308, no. 5724, 2005, pp, 1912-1915.

Perry, I. Planque, B. Jennings, S. Brander, K. Cury, P. & Möllman, C. 'Sensitivity of marine systems to climate and fishing: Concepts, issues and management responses'. *Journal of Marine Systems* Vol. 79, nos. 3-4, 2010, pp. 427-435.

Pinto da Silva, S. 'From common property to co-management: Lessons from Brazil's first maritime extractive reserve'. *Marine Policy* Vol. 28, 2004, pp. 419-428.

Pollnac, RB. Crawford, BR. & Gorospe, MLG. 'Discovering factors that influence the success of community-based marine protected areas in the Visayas. Philippines'. *Ocean & Coastal Management* Vol. 44, 2004, pp. 683–710.

Pomeroy, RS. Parks, JE. & Watson, LM. *How is Your MPA Doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness*. IUCN, Gland, Switzerland & Cambridge, UK, 2004.

Programme Régional de Conservation de la Zone Côtière et Marine de l'Arique de l'Ouest (PRCM). *Regional strategy for marine protected areas in West Africa*. Nouakchott, Mauritania, 2003. www.pcrm.mr

Rees, SE. Attrill, MJ. Austen, MC. Mangi, SC. Richards, JP & Rodwell, LD. 2010. 'Is there a win-win scenario for marine nature conservation? A case study of Lyme Bay, England'. *Ocean & Coastal Management* Vol. 53, 2010, pp. 135-145.

Reid, PC. Fischer, CC. Lewis-Brown, E. Meredith, MP. Sparrow, M. Andersson, AJ. Antia, A. Bates, NR. Bathmann, U. Beaugrand, G. Brix, H. Dye, S. Edwards, M. Furevik, T. Gangstø, R. Hátún, H. Hopcroft, RR. Kendall, M. Kasten, S. Keeling, R. Le Quéré, C. Mackenzie, FT. Malin, G. Mauritzen, C. Ólafsson, J. Paull, C. Rignot, E. Shimada, K. Vogt, M. Wallace, C. Wang, Z. & Washington, R. 2009. Impacts of the Oceans on Climate Change. In *Advances in Marine Biology. Vol. 56*. Sims, DW ed. Academic Press, St. Louis, MO, US, 2009.

Roberts, CM. & Hawkins, JP. *Fully-protected marine reserves: a guide*. WWF Endangered Seas Campaign, Washington, DC, USA, and Environment Department, University of York, UK, 2000.

Ruddle, K. & Hickey, FR. 'Accounting for the mismanagement of tropical nearshore fisheries'. *Environment. Development and Sustainability* Vol. 10, issue 5, 2008, pp. 565-589.

Russ, GR. Alcala, AC. Maypa, AP. Calumpong, HP. & White, AT. 'Marine reserve benefits local fisheries.' *Ecological Applications* Vol. 14, 2004, pp. 597-606.

Sabine, CL. Feely, RA. Gruber, N. Key, RM. Lee, K. Bullister, JL. Wanninkhof, R. Wong, CS. Wallace, DWR. Tilbrook, B. Millero, FJ. Peng, T-H. Kozyr, A. Ono, T. & Rios, AF. 'The oceanic sink for anthropgenic CO_2'. *Science* Vol. 305, no. 5729, 2004, pp. 367-371.

Sadovy, YJ. Donaldson, TJ. Graham, TR. McGilvray, F. Muldoon, GJ. Phillips, MJ. Rimmer, MA. Smith, A. Yeeting, B *While Stocks Last: the Live Reef Food Fish Trade*. Asian Development Bank, Manila, Philippines, 2003.

Sala, E. Aburto-Oropeza, O. Paredes, G. Parra, I. Barrera, JC. & Dayton, PK. 'A general model for designing networks of marine reserves'. *Science* Vol. 298, 2002, pp. 1991-1993.

Sale, PF. Butler IV, MJ. Hooten, AJ. Kritzer, JP. Lindeman, KC. Sadovy de Mitcheson, YJ. Steneck, RS. & van Lavieren, H. *Stemming Decline of the Coastal Ocean: Rethinking Environmental Management*. UNU-INWEH, Hamilton, Canada, 2008.

Sale, PF. Van Lavieren, H. Ablan Lagman, MC. Atema, J. Butler, M. Fauvelot, C. Hogan, JD. Jones, GP. Lindeman, KC. Paris, CB. Steneck R. & Stewart, HL. *Preserving Reef Connectivity: A Handbook for Marine Protected Area Managers. Connectivity Working Group, Coral Reef Targeted Research & Capacity Building for Management Program*, UNU-INWEH, Ontario, Canada, 2010.

Salm, RV. Done, T. McLeod, E. 'Marine protected area planning in a changing climate' in *Coral reefs and climate change: science and management*. Eds. Phinney, JT. Hoegh-Guldberg, O. Kleypas, J. Skirving, WJ. & Strong, A. American Geophysical Union, Washington, DC, 2006.

Salm, RV. Clark, J. & Siirila, E. *Marine Protected Areas: A guide for planners and managers*. IUCN, Washington, DC, 2000.

Sand, PH. 'Green Enclosure of Ocean Space – *Déjà Vu*?' *Marine Pollution Bulletin* Vol. 54, 2007, pp. 374-376.

Scholz, A. Bonzon, K. Fujita, R. Benjamin, N. Woodling, N. Black, P & Steinback, C. 'Participatory socioeconomic analysis: drawing on fishermen's knowledge for marine protected area planning in California'. *Marine Policy.* Vol. 28, issue 4, 2004, pp. 335–349.

Scovazzi, T. 'Marine Protected Areas on the High Seas: Some Legal and

Policy Considerations'. *The International Journal of Marine and Coastal Law* Vol. 19, 2004, pp. 1-17.

Secrétariat du Réseau Régional des Aires Marines Protegées en Afrique de L'ouest (RAMPAO). *Rapport de l'assemblée constituante du RAMPAO 16 avril à Praia, Cap Vert*. IUCN, Dakar, Sénégal, 2007.

a) Secretariat of the Convention on Biological Diversity. Invasive Alien Species. A Threat to Biodiversity. Montréal, Québèc, Canada. 2009.

b) Secretariat of the Convention on Biological Diversity. Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Technical Series No. 41. Montréal, Québèc, Canada. 2009.

Secretariat of the Convention on Biological Diversity. Global Biodiversity Outlook 3. Montréal, Québèc, Canada. 2010.

Selig, ER. & Bruno, JF. 'A global analysis of the effectiveness of marine protected areas in preventing coral loss'. *PLoS ONE* Vol. 5, 2010, e9278 (doi:10.1371/journal.pone.0009278).

Selman, M. Sugg, Z. Greenhalgh, S. & Diaz, R. 'Eutrophication and Hypoxia in Coastal Areas: A Global Assessment of the State of Knowledge'. WRI Policy Note. Water Quality: Eutrophication and Hypoxia 1. World Resources Institute, Washington, DC, 2008.

Spalding, MD. Agostini, V. Grant, S. & Rice, J. 'Pelagic provinces of the world: a biogeographic classification of the world's surface pelagic waters'. In review.

Spalding, MD. Fox, HE. Allen, GR. Davidson, N. Ferdaña, ZA. Finlayson, M. Halpern, BS. Jorge, MA. Lombana, A. Lourie, SA. Martin, KD. McManus, E. Molnar, J. Recchia, CA. & Robertson, J. 'Marine Ecoregions of the World: a bioregionalization of coast and shelf areas'. *BioScience* Vol. 57, 2007, pp. 573-583.

Spalding, MD. Kainuma, M. & Collins, L. *World Atlas of Mangroves*. Earthscan, with International Society for Mangrove Ecosystems, Food and Agriculture Organization of the United Nations, UNEP World Conservation Monitoring Centre, United Nations Scientific and Cultural Organisation, United Nations University, London, UK, 2010.

a) Spalding, M. Fish, L. & Wood, J. 'Marine Protected Areas - Coverage and Gaps' in *Convention on Biological Diversity. Working Group on Protected Areas meeting 2*. Rome, 2008.

b) Spalding, M. Fish, L. & Wood, J. 'Towards representative protection of the world's coasts and oceans – progress, gaps and opportunities'. *Conservation Letters* Vol. 1, 2008, pp. 217-226.

Spergel, B. & Moye, M. *Financing Marine Conservation, a Menu of Options*. WWF Centre of Conservation Finance, Washington, DC, 2004.

Staub, F. & Hatziolos, ME. *Score Card to Assess Progress in Achieving Management Effectiveness Goals for Marine Protected Areas*. The World Bank, Washington, DC, 2004.

Stefansson, G. & Rosenberg, AA. 'Combining control measures for more effective management of fisheries under uncertainty: quotas, effort limitation and protected areas'. *Philosophical Transactions of the Royal Society B: Biological Sciences* Vol. 360, 2005, pp. 133-146.

Stefansson, G. & Rosenberg, AA. 'Designing marine protected areas for migrating fish stocks'. *Journal of Fish Biology* Vol. 69, 2006, pp. 66-78.

Stewart, GB. Kaiser, MJ. Côté, IM. Halpern, BS. Lester, SE. Bayliss, HR. & Pullin, AS. **'**Temperate marine reserves: global ecological effects and guidelines for future networks'. *Conservation Letters* Vol. 2, issue 6, 2009, pp. 243–253.

Stobart, B. Warwick, R. Gonzalez, C. Mallol, S. Diaz, D. Renones, O. & Goñi, R. 'Long-term and spillover effects of a marine protected area on an exploited fish community'. *Marine Ecology Progress Series* Vol. 384, 2009, pp. 47-60.

Stolton, S. & Dudley, N. [eds.] *Arguments for Protected Areas*. Earthscan, London, 2010.

Stoner, AW. & Ray, M. 'Queen conch. *Strombus gigas*. in fished and unfished locations of the Bahamas: Effects of a marine fishery reserve on adults, juveniles, and larval production.' *Fishery Bulletin* Vol. 94, 1996, pp. 551-565.

Tawake, A. Parks, J. Radikedike, P. Aalbersberg, B. Vuki, V. & Salafsky, N. 'Harvesting Clams and Data'. *Conservation Biology in Practice* Vol. 2, no. 4, 2001, pp. 32-35.

The World Bank. 2006. *Scaling up Marine Management: The role of Marine Protected Areas*. The World Bank Environment Department, Report No. 36635 – GLB, Washington, DC, 2006.

The World Bank. *Convenient Solutions for an Inconvenient Truth: Ecosystem Based Approaches to Climate Change*. The World Bank, Washington, DC, 2009.

Tupper, MH. 'Spillover of commercially valuable reef fishes from marine protected areas in Guam. Micronesia.' *Fishery Bulletin* Vol. 105, 2007, pp. 527-537.

United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982. United Nations Environment Programme, 1982.

United Nations Educational, Scientific and Cultural Organization (UNESCO). *Global Open Oceans and Deep Seabed (GOODS) – Biogeographic Classification*. Intergovernmental Oceanographic Commission (UNESCO-IOC). ed. Paris, 2009.

United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC). *National and Regional Networks of Marine Protected Areas: A Review of Progress*. UNEP World Conservation Monitoring Centre, Cambridge, UK, 2008.

United Nations General Assembly. *Resolution adopted by the General Assembly. 61/105. Sustainable fisheries. including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments*. United Nations General Assembly. 2006.

United Nations General Assembly. 'Oceans and the law of the sea - Report of the Secretary-General'. A/64/66/Add.1, 2009.

United States Defense Mapping Agency. *World Vector Shoreline. GIS dataset.* Bethesda, MD, USA, not dated.

United States Interagency Ocean Policy Task Force (USIOPTF). 'Final Recommendations of the Interagency Ocean Policy Task Force'. http://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf, 2009 (accessed on August 23rd 2010).

Veron, JEN. Hoegh-Guldberg, O. Lenton, TM. Lough, JM. Obura, DO. Pearce-Kelly, P. Sheppard, CRC. Spalding, M. Stafford-Smith, MG. & Rogers, AD. 'The coral reef crisis: The critical importance of <350ppm CO_2'. *Marine Pollution Bulletin* Vol. 58. 2009, pp. 1428-1437.

Vierros, M. Tawake, A. Hickey, F. Peteru, C. Tiraa, A. & Noa, R. 'Traditional Marine Management Areas of the Pacific in the Context of National and International Law and Policy'. *United Nations University – Traditional Knowledge Initiative*. Darwin, Australia, in press.

Waycott, M. Duarte, CM. Carruthers, TJB. Orth, RJ. Dennison, WC. Olyarnik, S. Calladine, A. Fourqurean, JW. Heck, KL. Hughes, AR. Kendrick, GA. Kenworthy, WJ. Short, FT. & Williams, SL. 'Accelerating loss of seagrasses across the globe threatens coastal ecosystems'. *Proceedings of the National Academy of Sciences* Vol. 106, 2009, pp. 12377-12381.

Webster, PJ. Holland, GJ. Curry, JA. & Chang, HR. 'Changes in tropical cyclone number, duration and intensity in a warming environment'. *Science* Vol. 309, no. 5742, 2005, pp. 1844-1846.

Wells, S. & Mangubhai, S. *A Workbook for Assessing Management Effectiveness of Marine Protected Areas in the Western Indian Ocean*. IUCN Eastern Africa Regional Program, Nairobi, Kenya, 2007.

White, A. & Cruz-Trinidad, A. *The Values of Philippine Coastal Resources: Why Protection and Management are Critical*. Coastal Resource Management Project, Cebu City, Philippines, 1998.

White, A. Porfirio, A. & Meneses, A. 'Creating and Managing Marine Protected Areas in the Philippines'. *Fisheries Improved Sustainable Harvest Project*. Coastal Conservation and Education Foundation, Inc., and University of the Philippines Marine Science Institute, Cebu City, Philippines, 2006.

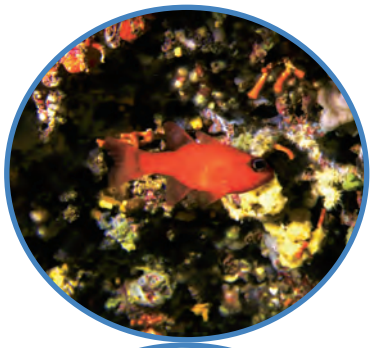
Wilkinson, CR. *Status of Coral Reefs of the World: 2008*. GCRMN/ Australian Institute of Marine Science, 2008

Wood, LJ. Fish, L. Laughren, J. & Pauly, D. 'Assessing progress towards global marine protection targets: shortfalls in information and action'. *Oryx* Vol. 42, 2008, pp. 340-351.

World Tourism Organization (UNWTO). press release. June 2004.

World Tourism Organization (UNWTO). *Declaration on* "*Harnessing Tourism for the Millennium Development Goals"*. New York, NY, September 13, 2005.

World Wildlife Fund (WWF). 'MPA Management: How is Your MPA Doing?' *WWF International. Gland, Switzerland*. <http://assets.panda.org/downloads/12investinginpeople.pdf>.(accessed 2nd September 2009)



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