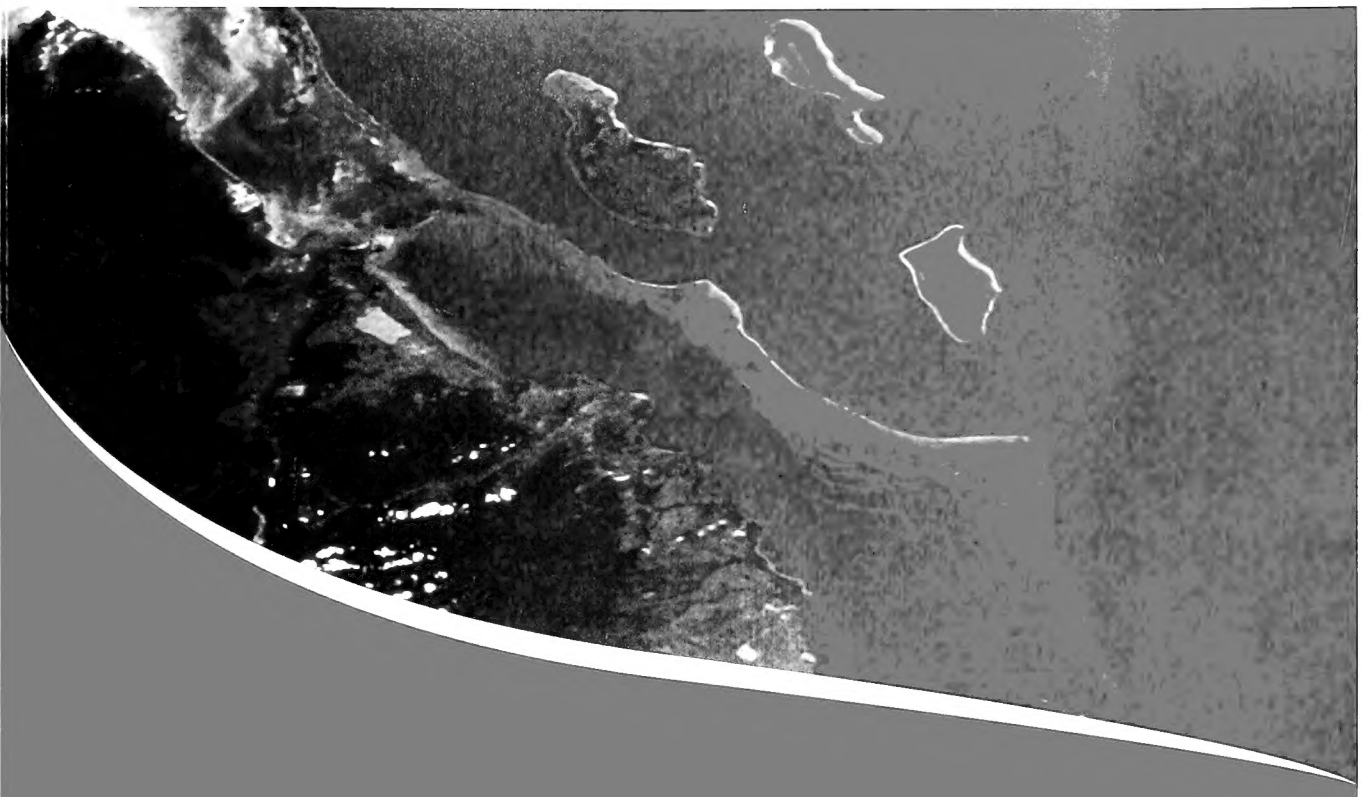


National and Regional Networks of Marine Protected Areas: A Review of Progress

UNEP WCMC

National and Regional Networks of Marine Protected Areas: A Review of Progress

UNEP World Conservation Monitoring Centre
219 Huntingdon Road,
Cambridge CB3 0DL,
United Kingdom
Tel: +44 (0) 1223 277314
Fax: +44 (0) 1223 277136
Email: info@unep-wcmc.org
Website: www.unep-wcmc.org

ISBN: 978-92-807-2975-7

This publication is also available online at
http://www.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series/

DISCLAIMER

The contents of this report do not necessarily reflect the views or policies of UNEP-WCMC or contributory organisations. The designations employed and the presentations do not imply the expressions of any opinion whatsoever on the part of UNEP-WCMC or contributory organisations concerning the legal status of any country, territory, city or area or its authority, or concerning the delimitation of its frontiers or boundaries.

The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) is the biodiversity assessment and policy implementation arm of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organisation. UNEP-WCMC has been in operation since 1989, combining scientific research with innovative analysis and practical policy advice.

The UNEP World Conservation Monitoring Centre would like to thank the UNEP Division of Environmental Policy Implementation (DEPI), and the UNEP Regional Seas Programmes for funding this report.

Since 1981 UNEP-WCMC has compiled the World Database on Protected Areas (WDPA), a joint project of UNEP and IUCN, produced by UNEP-WCMC and the IUCN World Commission on Protected Areas (IUCN WCPA). The WDPA is the largest assembly of data on the world's terrestrial and marine protected areas. The database holds spatial and attribute information from governments and NGOs on over 120,000 national and international protected areas. Increasingly, the WDPA also holds information on private, community and co-managed reserves. It is also the basis for the UN List responding to the United Nations General Assembly resolution in 1962 to record the status of the world's protected areas.

In January 2005 an online and searchable database on marine protected areas, MPAGlobal, was launched as a collaborative effort to improve the marine specific contents of the WDPA. This effort was managed within the *Sea Around Us* Project, an activity initiated and funded by the Pew Charitable Trusts, and hosted by the University of British Columbia's (UBC) Fisheries Centre. In late 2008, the data improvements made through the MPA Global process were fully re-integrated into the WDPA, which had undertaken a two year process of redesign and redevelopment.

CITATION

UNEP-WCMC (2008). National and Regional Networks of Marine Protected Areas: A Review of Progress. UNEP-WCMC, Cambridge.

EXECUTIVE SUMMARY

Most of the marine protected areas (MPAs) around the world, estimated to number about 5000, have been established both on an *ad hoc* basis and through systematic planning processes. The Convention on Biological Diversity (CBD) requires that Party states establish, by 2012, comprehensive, effectively managed, and ecologically representative national and regional systems of protected areas, and that there should be effective conservation of at least 10% of each of the world's ecological regions by 2010. Many countries have established their own national targets which provide an incentive for the introduction of a systematic conservation planning approach to the establishment of MPAs, and there are now many initiatives to develop ecologically representative MPA networks. This report reviews the progress being made, using information from the literature, MPA practitioners and planners, and conservation experts. The objectives of the report are to:

- Disseminate experiences and lessons learned from initiatives under way at regional, national and sub-national levels;
- Promote a better understanding of the underlying principles and concept of, the scientific basis for, and the issues to be considered when developing MPA networks, as laid out in the guidelines prepared by the World Commission on Protected Areas (WCPA)-Marine and the CBD;
- Recommend actions needed to promote the establishment of effective MPA networks.

NATIONAL ECOLOGICAL MPA NETWORKS

The report describes 30 national and 35 sub-national ecological MPA network initiatives. Most are still under development with very few formally gazetted, and even fewer fully managed. Those that have been declared and are being implemented are primarily networks that cover small areas, or that are part of large management initiatives or multiple-use MPAs. Comparison is difficult because of the wide range of approaches and different spatial or geographical scales, but the many initiatives underway provide much experience on how MPA networks can be established in practice, and how they can be adapted to different needs and priorities. As the CBD Programme of Work for the protection of marine biodiversity recognises, there are at least three levels of spatial planning for MPAs within a country: a core system of no-take areas (NTAs) within a large MPA; a larger system of multiple-use MPAs, including fishery management areas; and a national MPA system embedded within a national integrated coastal management programme and overall management framework for the Exclusive Economic Zone (EEZ). This will inevitably result in a degree of complexity.

Most national ecological MPA networks being planned comprise a range of different types of MPAs including both NTAs and multiple use sites. In several countries, such as Belize, Cuba, and Mexico, MPAs are part of a broad conservation planning process to develop a national protected area system plan. In other countries and territories, such as South Africa, Tanzania, Rodrigues (Mauritius), USA and Canada, MPA networks are being developed separately from, although sometimes in coordination with, the process being used to establish terrestrial protected area systems. Where MPA management is devolved to state or local-level governments, MPA networks are generally being planned using a hierarchical approach, with small networks nested within larger national networks, as in Mexico, Indonesia, Australia, and the USA. This approach can however lead to a lack of harmonisation, as seen in Australia, where the state of Victoria is establishing a system of NTAs only, whereas other states and the Commonwealth are including multiple use MPAs in their networks.

Increasingly, NTA networks are being developed as part of the zonation of multiple use MPAs, particularly large ones such as the Great Barrier Reef Marine Park in Australia, the SeaFlower MPA in the San Andrés Archipelago, Colombia, the Channel Islands Marine Sanctuary in California, or as an integral part of a broader coastal management plan as on Socotra Island in Yemen. The South-east

Region MPA System Plan in Australia demonstrates how an MPA network can be integrated into a range of broader measures, such as recovery plans for listed species, fishery management closures and regulations for oil and gas activities. Belize demonstrates how a national MPA network can be part of not only a national integrated coastal management plan but also a regional MPA network (the Mesoamerican Barrier Reef), which incorporates international protected area designations, such as World Heritage Site (WHS).

REGIONAL MPA NETWORKS

20 regional MPA networks (i.e. networks involving two or more countries) are described in the report. Regions with a strong co-ordinating framework and with a supportive treaty or agreement tend to have progressed furthest in terms of planning, including Europe through its Natura 2000 programme in the EU states, and the North-East Atlantic and Baltic through the Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and Helsinki Commission (HELCOM) respectively. The UNEP Regional Seas Programme (RSP) regions for East Africa, the North-east Pacific, South-East Pacific, and Wider Caribbean have Protocols specifically aimed at promoting the establishment of MPAs, and are starting to address the need to promote the establishment of ecological MPA networks. The more recently created RSPs, such as the North-West Pacific and South Asian Seas, plan to address MPAs in the near future or have MPA related activities under development. Discussions are underway through the relevant regional mechanisms concerning the urgent need for MPA networks in the Antarctic and Arctic. Regional MPA networks are also being planned through direct agreements between countries, as in the case of the WWF ecoregion based programmes (such as the East African Marine Ecoregion (EAME) and Western Indian Ocean Marine Ecoregion (WIOMER) programmes in the Western Indian Ocean, and the Regional Network of MPAs in West Africa (RAMPOA) programme) and the Conservation International (CI) seascape based programmes (such as Birds Head Seascape in Indonesia and the Eastern Tropical Pacific Seascape). South-East Asia for example, has several nested regional and national network programmes that are being supported and co-ordinated through the Coral Triangle Initiative (CTI) which involves six countries.

Issues of sovereignty mean that regional MPA networks will be made up of their constituent national MPA networks, but there is demonstrated added value in countries collaborating in the process, to ensure that principles such as connectivity are fully addressed, and an ecosystem-based approach taken. At present there are no guidelines for regional MPA networks and it may be useful to look at how the different types of regional groupings (such as UNEP RSPs, ecoregions, seascapes) can be used for systematic conservation planning, and whether there is need for further harmonisation.

APPLICATION OF ECOLOGICAL PRINCIPLES FOR MPA NETWORKS

Some of the best examples of the application of theory and science are at sub-national level, and are being undertaken by non-governmental organisations (NGO) and academic institutions, with the involvement of local communities and other stakeholders, as in Kimbe Bay in Papua New Guinea, and the Gulf of California in Mexico. Several regions and countries have developed their own sets of criteria and principles, such as Australia, the North-East Atlantic and Baltic, through the OSPAR and HELCOM processes, and the Sulu-Sulawesi Marine Ecoregion (SSME) programme. These reflect the generic principles that have been developed over the last decade and that are now encapsulated in the guidelines available from WCPA-Marine. This reports looks particularly at four of these: adequacy, representation, resilience and connectivity.

The principle of representation is proving relatively easy to address, provided adequate classifications and biodiversity distribution (or suitable proxies) are available. However, the principles of adequacy, resilience and connectivity are proving more difficult to incorporate, since there are few specific guidelines on applying them due to a lack of clear scientific understanding. 'Rules of thumb' are being used where possible and the rapid growth of research in this field means that new information is constantly becoming available.

Representativity: A fully ecologically representative network requires one or more MPAs to be established for each example of the full range of biological diversity (from genes to ecosystems) and the associated oceanographic environment within the given area. Most MPAs are on the

continental shelf and in coastal waters, and offshore and deep-sea habitats are grossly under represented at present, although important steps are now being taken to address this shortcoming. For example, MPAs have been established for hydrothermal vents in Canada and the Azores, seamounts in Australia and the UK, and deep-water cold coral reefs in Norway, and a process is underway to develop a mechanism for establishing MPAs on the High Seas. Representation at the ecoregion level has been analysed in a recent study, using the Marine Ecoregion of the World (MEOW) classification. Global level analyses are available that show representation of reefs and mangroves has already surpassed the 10% target for protection, but for such vulnerable ecosystems, much higher conservation targets are needed. In most case studies in the report, conservation targets for protection of different marine ecosystems and biodiversity within a network are often 20% or above for example: Belize has conservation targets of 30% for reefs; 80% for spawning aggregations; and 60% for turtle nesting sites, and is making good progress in meeting these. However, at the national and smaller regional level, and for other less high profile ecosystems and habitats, the necessary data are often lacking to assess representation.

Adequacy: This refers to the need to ensure that the individual components of the network are of sufficient size and appropriate shape and distribution to maintain the ecological viability and integrity of populations and species. Globally, the estimated total of 5045 MPAs cover about 2.59 million km², or 0.72% of the world's ocean surface, with only 12.8% of the total MPA area (or 0.08% of the world's oceans) in NTAs. For most countries, data are still insufficient to carry out a full analysis of adequacy. Although size, shape and spatial distribution should be easy to measure, in practice it has proved difficult to collate accurate data for several reasons, including variations in definitions of MPAs (e.g. extent to which inter-tidal or terrestrial areas is included), lack of information on boundaries, and poor reporting. Provisional analyses, including those undertaken by individual countries, or through global assessments using the World Database on Protected Areas (WDPA), indicate that few if any countries have adequate MPA networks at present. Some countries and regions are however, starting to make good progress towards planning for protection of their territorial waters and EEZs, for example, in Kenya, Mexico, and several European countries. There is a growing tendency to designate large MPAs covering several linked ecosystems. Most research on optimal MPA size has been in relation to NTAs and recommended sizes range from 10 to 100 km². A separate global analysis suggests that about 35-60% of the world's MPAs are in this size range; to assess adequacy at national and regional levels, similar analyses would need to be undertaken.

Resilience: Also referred to as replication or redundancy, resilience describes the ability of a natural system, or MPA network, to survive natural catastrophes and major impacts. It has been used relatively little in the planning of MPA networks, perhaps because scientific understanding of it in the marine environment is still incomplete, although good progress has been made in relation to coral reefs and spawning aggregations, for which guidelines are being tested at sites in Papua New Guinea, Indonesia, and Belize. Given the importance of this principle, efforts must be made to accelerate its adoption in MPA network design.

Connectivity: This refers to the linkages between sites in a network created through larval dispersal, migration of organisms and the mixing of waters through currents and other oceanic physical processes. Mechanisms for ensuring and maintaining good connectivity in an MPA network have yet to be fully demonstrated, and may require a variety of innovative approaches such as dynamic sites. National or even regional level MPA networks may not be able to protect all the key sites for particular species, and this emphasises the need for ensuring that appropriate transboundary linkages are made. Research is suggesting that there is more localised retention of propagules than previously thought, and sites within a network may need to be within 10-100 km of each other.

METHODOLOGIES FOR MPA NETWORK ESTABLISHMENT

The methods and processes being developed for designing MPA networks range from simple, as in Tanzania where sites were selected based on the knowledge of experts, to the more sophisticated where decision-support tools such as the software package Marxan are used. Where resources are available, as in the Bahamas, detailed inter-disciplinary studies can be undertaken. A key lesson from the case studies is the length of time needed to develop a MPA network, if stakeholders are to be

fully involved and scientific design principles applied. Although some MPA networks are being designed to be implemented as a single package, as in some states in Australia, USA and Canada, a step-wise process is often more practical. Pilot areas can be implemented, lessons learnt, and the network progressively built up, the plan being refined as information, funding and capacity becomes available.

The establishment of clear goals and objectives for the network is essential. The main issue is often deciding whether the network is primarily for biodiversity protection or for resource management for human use (such as fisheries management), since different approaches may be required. The International Union for Conservation of Nature (IUCN) Protected Area Management Categories can be used to ensure that MPAs with a range of objectives are incorporated into a network, as demonstrated by Cuba and Australia. An MPA network will also often consist of sites under different forms of governance. Although individual MPAs need to work together so that overall goals and objectives are achieved, if an MPA network is to function fully, the sites do not necessarily have to be managed in the same way. The IUCN typology of governance types (divided into four categories: Government managed; Co-managed; Private; and Community managed) may provide a useful tool for the development of MPA networks.

SOCIAL NETWORKS

Social and learning networks, comprising managers and other MPA practitioners and linking different institutions, are essential catalysts and facilitators for the development of ecological networks of MPAs. At the global level, WCPA-Marine provides an umbrella network of experts, and numerous social networks are being established at regional and national levels. Examples include the Locally Managed Marine Area (LMMA) network in the Pacific, the Caribbean MPA Managers Network and Forum (CaMPAM), the Mediterranean Protected Area Network (MedPAN), and national social networks in the Philippines and Vietnam.

RECOMMENDATIONS

These reflect Resolution CGR4.MOT067, passed at the World Conservation Congress in Barcelona, October 2008:

1. Clarify terminology and harmonise approaches: Common terms need to be agreed and clear definitions and standardised nomenclature should be developed to facilitate monitoring of progress. WCPA-Marine, with The Nature Conservancy (TNC), has already started this process through the production of its guidelines, and other organisations such as the CBD Secretariat should be consulted to ensure an agreed approach. For example, use of terms such as 'marine and coastal protected areas' (MCPAs) and 'fully protected' MPAs need clarification. Further guidance is needed on how the different types of MPA network, such as those comprising NTAs only or those that exclude sites with very little sub-tidal habitat, can contribute to broader marine spatial planning approaches.

2. Strengthen capacity for MPA network establishment: Capacity building is needed at both individual and institutional levels. Technical support, training, and the development of tools and resources must be expanded, methodologies for MPA network and systematic conservation planning should be promoted and disseminated, and additional guidelines and materials produced where necessary. Greater awareness of the benefits of and reasons for MPA networks will increase support from all stakeholders. The compilation of case studies and lessons learned should be encouraged and facilitated, and shared between countries and regions. Social networks facilitating the sharing of experiences, challenges and successes amongst regions should be enhanced through workshops, study tours and twinning arrangements, and electronic networking. Organisations including IUCN, the CBD, UNEP-RSP, international NGOs, and donors have a role to play in building capacity for MPA network development, and initiatives such as the Marine Learning Partnership that was established by TNC, CI, Wildlife Conservation Society (WCS) and WWF, should be encouraged.

3. Expand regional, national and local initiatives to establish MPA networks: This will require governments to accelerate their efforts, and civil society, regional organisations, and bilateral and multilateral assistance agencies to provide support. MPA networks need to be larger, and based on the principles that have been determined for effective ecological networks (adequate, representative, resilient, and connected), using appropriate biogeographical classifications and decision-support tools (e.g. Marxan). At the same time, research is needed to develop a better understanding of concepts such as adequacy, connectivity and resilience. The necessary funding should be made available. Assessments of the costs and benefits of the network approach are needed so that countries can budget for it and appreciate its value. Linking the development of MPA networks with overall national conservation system planning, and harmonising the process with the establishment of terrestrial protected area systems should be considered. Appropriate policies and legislation must be introduced where needed. Gaps in MPA network development at the regional level could be reduced by improved coordination between government, international organisations and NGOs, and the development of guidance on how regional networks might best be established. Support for the growing number of social networks will help to promote the development of ecological MPA networks.

4. Monitor and evaluate progress in the development of ecological MPA networks: This will require the identification of indicators to measure progress, perhaps based on the self-assessment checklist prepared by WCPA-Marine, and improved mechanisms for tracking and reporting progress. Increased efforts are required to establish effective and structured data-gathering initiatives at national and regional levels. Organisations such as WCPA-Marine, UNEP-World Conservation Monitoring Centre (UNEP-WCMC), CBD Secretariat, UNEP-RSP and the many national MPA bodies and experts can play a role.

5. Improve management of MPAs and of the MPA networks as they are established: It will be important to ensure that the new focus on establishing MPA networks does not result in the creation of more unmanaged MPAs or 'paper parks'. Assessing management effectiveness can help to encourage good management, and such evaluations should be undertaken on a regular basis. The basic principles of good MPA network management and governance, as opposed to those for individual MPAs have yet to be clearly identified, with indicators that can be used to measure the success of the network in reducing the rate of biodiversity loss.

6. Ensure that MPA networks are established within a broader spatial planning and ecosystem-based management framework: MPA networks alone, even if effectively managed, will not protect all marine biodiversity effectively. Systematic conservation planning must be extended to the oceans as a whole, as called for by the CBD.

CONTENTS

ACRONYMS AND ABBREVIATIONS

ABNJ	Areas beyond national jurisdiction
ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area
AECID	Spanish Agency for International Cooperation for Development
AEPS	Arctic Environmental Protection Strategy
AFD	Agence Française pour le Développement
AHTEG	*ad hoc* Technical Expert Group
ANGAP	Association Nationale pour la Gestion des Aires Protégées (Madagascar)
APAI	African Protected Areas Initiative
ARAP	Authority for Aquatic Resources (Panama)
ASCI	Area of Special Conservation Interest (EU)
ASCLME	Agulhas-Somali Current Large Marine Ecosystems
ASEAN	Association of South-East Asian Nations
ASMA	Antarctic Specially Managed Area
ASPA	Antarctic Specially Protected Area
AusAID	Australian Agency for International Development
BAOI	Broad Area of Interest (Australia)
BBP	Bahamas Biocomplexity Project
BCLME	Benguela Current Large Marine Ecosystem
BCMCA	British Columbia Marine Conservation Analysis
BIOT	British Indian Ocean Territory
BPA	Benthic Protected Area (New Zealand)
BREEF	Bahamas Reef Environment Education Foundation
BRTF	Blue Ribbon Task Force (USA)
BSPA	Baltic Sea Protected Area
BSSE	Bismarck Solomon Seas Ecoregion
BVI	British Virgin Islands
B2B	Bering Sea Initiative
CAFF	Conservation of Arctic Flora and Fauna (Working Group)
CAMPAM	Caribbean MPA Managers Network and Forum
CAR	Comprehensive, Adequate and Representative
CBC	Centre for Biodiversity and Conservation
CBD	Convention on Biological Diversity
CBMP	Circumpolar Biodiversity Monitoring Programme
CCA	Caribbean Conservation Association
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CEC	Commission for Environmental Co-operation (North America)
CEP	Caspian Environmental Programme/Caribbean Environment Programme/ Committee for Environmental Protection that serves to implement the Madrid Protocol under the Antarctic Treaty

CGFZ	Charlie Gibbs Fracture Zone
CI	Conservation International
CIESM	The Mediterranean Science Commission
CMAR	Corredor Marino - Tropical Eastern Pacific Marine Corridor Network
CNAP	National Centre for Protected Areas (Cuba)
COBI	Communidad y Biodiversidad (Mexico)
COBSEA	Coordinating Body on the Seas of East Asia
COCATRAM	Comisión Centroamericana de Transporte Marítimo
COI	Indian Ocean Commission
COMPAS	Co-managed MPA System (Korea)
CONABIO	National Commission for the Knowledge and Use of Biodiversity (Mexico)
CONAMA	Comisión Nacional del Medio Ambiente (Chile)
CONANP	National Commission of National Protected Areas (Mexico)
CONSDEV	Coherence of Public Policy of Conservation and Development of Coastal and Marine Protected Areas in West Africa
COP	Conference of the Parties
CPAN	Circumpolar Protected Area Network
CPAW	Canadian Parks and Wilderness Society
CPPS	Permanent Commission on the Exploitation and Conservation of the Marine Resources of the South Pacific
CRISP	Coral Reef Initiative for the South Pacific
CRRF	Coral Reef Research Foundation
CSRP	Commission Sous-Régionale des Pêches (West Africa)
CTC	Coral Triangle Center
CTI	Coral Triangle Initiative
DINRAC	Data and Information Network Regional Activity Centre of NOWPAP
EAME	East African Marine Ecoregion
EAS	East Asian Seas
EASAP	East Asian Seas Action Plan
ECLSP	Exuma Cays Land and Sea Park
ECNAMP	Eastern Caribbean Natural Areas Management Programme
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMPA	Environmentally Sound Fishery Management Areas (EU)
ETPS	Eastern Tropical Pacific Seascape
EU	European Union
FAC	Federal Advisory Committee
FAO	Food and Agricultural Organization of the United Nations
FFEM	Fonds Français pour l'Environnement Mondial
FIBA	Fondation Internationale du Banc d'Arguin
FIME	Fiji Islands Marine Ecoregion
FISH	Fisheries Improved for Sustainable Harvest Project
FLMMA	Fiji Local Managed Marine Area Network
FRRP	Florida Reef Resilience Programme
FSPI	Foundation of the Pacific People International
GBRMP	Great Barrier Reef Marine Park
GEF	Global Environment Facility

GEMPA-EA	Group of Experts in Marine Protected Areas for Eastern Africa
GCFI	Gulf and Caribbean Fisheries Institute
GIS	Geographic Information System
GMR	Galapagos Marine Reserve
GOODS	Global Open Oceans and Deep Sea-habitats
GPS	Global Positioning System
HELCOM	Helsinki Commission
HSMPA	High Seas Marine Protected Areas
IBA	Important Bird Area
ICES	International Council for the Exploration of the Sea
ICM	Integrated Coastal Management
ICRAM	Central Institute for Applied Marine Research (Italy)
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
IDO	Institute of Oceanology (Cuba)
IFREMER	French Research Institute for Exploitation of the Sea
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IMMMA	Indonesia Marine Mammal Management Area
IMO	International Maritime Organisation
IMPASP	Integrated Marine Protected Areas Systems Plan (Seychelles)
INE	National Institute of Ecology (Mexico)
INRENA	National Institute for Natural Resource
IOC	Intergovernmental Oceanographic Commission
IRF	Island Resources Foundation (BVI)
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
KBA	Key Biodiversity Areas
km^2	Kilometres squared
KZN	KwaZulu Natal
LGCMP	Local Governance for Coastal Management Project
LME	Large Marine Ecosystem
LMMA	Locally Managed Marine Area
MACEMP	Marine and Coastal Environment Management Project (Tanzania)
MaB	Man and Biosphere
MAP	Mediterranean Action Plan
MAR	Mesoamerican Reef
MCBI	Marine Conservation Biology Institute
MCPA	Marine and Coastal Protected Area
MEABR	Management and Exploitation Areas for Benthic Resources (Chile)
MedWet	Mediterranean Wetlands Initiative
MedPAN	Mediterranean Protected Area Network
MedPOL	Programme for the Assessment and Control of Pollution in the Mediterranean region
MEOW	Marine Ecoregion of the World
MER	Marine Extractive Reserves (Brazil)
MESH	Mapping European Seabed Habitats Project
MLPA	Marine Life Protection Act

MMA	Marine Managed Area (USA)
MMED	Marine Mediterranean Group of the WCPA
MNR	Marine Nature Reserves (China)
MoFI	Ministry of Fisheries (Vietnam)
MPA	Marine Protected Area
MPA Center	National Marine Protected Areas Center (USA)
MRSD	Marine Reserves for Sustainable Development (Brazil)
MWA	Marine Wildlife Area (Canada)
n. mi	Nautical miles
NAMPAN	North American Marine Protected Areas Network
NRHP	National Register of Historic Places (USA)
NBSAP	National Biodiversity Strategy and Action Plan
NEAFC	North-East Atlantic Fisheries Commission
NEPAD	New Partnership for African Development
NGO	Non-governmental organisation
NIPAS	National Integrated Protected Areas System (Phillipines)
NMCA	National Marine Conservation Area (Canada)
NMS	National Marine Sanctuary (USA)
NOAA	National Oceanic and Atmospheric Administration (USA)
NOWPAP	North-West Pacific Action Plan
NPAPSP	National Protected Areas Policy and System Plan (Belize)
NRSMPA	National Representative System of Marine Protected Areas (Australia)
NSBAP	National Spatial Biodiversity Assessment Programme (South Africa)
NSPA	National System of Protected Areas (Venezuela)
NSW	New South Wales (Australia)
NTA	No-take area
NWHI	North West Hawaiian Islands
OSPAR	OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic
OTEP	Overseas Territory Environment Programme
PAME	Protection of the Arctic Marine Environment (Working Group)
PAN	Protected Areas Network Act (Palau)
PCS	Palau Conservation Society
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PIPA	Phoenix Islands Protected Area (Kiribati)
PICRC	Palau International Coral Reef Centre
Plan GRAP	Plan de Gestion du Réseau National des Aires Protégées (Madagascar)
PRCM	Regional Conservation Programme for the Coastal and Marine Zone of West Africa
pSCI	proposed Sites of Community Interest (EU)
RAC/SPA	Regional Activity Centre for Specially Protected Areas (Barcelona Convention)
RAMPAO	Regional Network of MPAs in West Africa
RAP	Regional Action Plan
REDS	Special Regions of Sustainable Development (Cuba)
RFMO	Regional Fisheries Management Organisation
RIRM	Iberoamerican Network of Marine Reserves
ROPME	Regional Organization for the Protection of the Marine Environment (UNEP Regional Seas Programme)

RSGA	Red Sea and Gulf of Aden
RSP	Regional Seas Programme
SAC	Special Area of Conservation (EU)
SACEP	South Asia Co-operative Environment Programme
SACRTF	South Asia Coral Reef Task Force
SAMP	Special Area Management Plan (Tanzania)/ Protected Marine Coastal Areas (Cuba)
SAP	Strategic Action Plan
SAP/BIO	Strategic Action Plan for the Conservation of Marine and Coastal Biological Diversity in the Mediterranean
SARSMPA	South Australian Representative System of Marine Protected Areas
SASAP	South Asian Seas Action Plan
SAUP	Sea Around Us Project
SCI	Site of Community Importance (EU)
SDS-SEA	Sustainable Development Strategy for the Seas of East Asia
SEACMPA	South East Asia Center for Marine Protected Areas
SEMPA	South-east MPA (Seychelles)
SERMP	South-East Regional Marine Plan (Australia)
SEYMEMP	Seychelles Marine Ecosystem Management Project
SINANPE	National System for Protected Areas (Peru)
SINAP	National System for Protected Areas (Panama)
SIOBMPA	Sandy Island and Oyster Bay MPA (Grenada)
SIODFA	Southern Indian Ocean Deepwater Fishers' Association
SMPA	Special Marine Protected Areas (China)
SMR	State Marine Reserves
SNAP	National System of Marine Protected Areas (Cuba)
SNUC	National System of Conservation Units (Brazil)
SOA	State Oceanic Administration (China)
SPA	Special Protected Area (EU Wild Bird Directive); Specially Protected Area (Barcelona Convention)
SPA/BD	Protocol Concerning Specially Protected Areas and Biological Diversity (Barcelona Convention)
SPAMI	Specially Protected Area of Mediterranean Importance
SPAW	Specially Protected Areas and Wildlife
SPREP	Secretariat for the Pacific Regional Environment Programme
SSME	Sulu-Sulawesi Marine Ecoregion
SSS	Sulu-Sulawesi Seascape
TFMPA	Task Force on MPAs (Australia)
TMPAS	Tasmanian Marine Protected Area Strategy
TNC	The Nature Conservancy
TRANSMAP	Transboundary Networks of MPAs for Integrated Conservation and Sustainable Development (East Africa)
UBC	University of British Columbia
UK	United Kingdom
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Education and Science Commission
UNU INWEH	United Nations University International Network on Water, Environment and Health

USAID	United States Agency for International Development
WAMER	West African Ecoregion
WCMC	World Conservation Monitoring Centre
WCPA	World Commission on Protected Areas
WCS	Wildlife Conservation Society
WDPA	World Database on Protected Areas
WFC	World Fish Center
WHS	World Heritage Site
WIO	Western Indian Ocean
WIOMER	Western Indian Ocean Marine Eco-region
WIOMSA	West Indian Ocean Marine Science Association
WSSD	World Summit on Sustainable Development (Johannesburg 2002)
WWF	World Wildlife Fund

ACKNOWLEDGEMENTS

This report was written by Sue Wells, in collaboration with Victoria Sheppard and Hanneke van Lavieren, with support from Nicola Barnard, Francine Kershaw, Colleen Corrigan, Kristian Teleki, Penny Stock and Ellik Adler.

Grateful acknowledgement is made to the following for assistance in providing information and helpful comments.

General
Francine Kershaw, Colleen Corrigan, Mike Skuja, Andrew Harvey, Lucy Fish, Corinna Ravilious and Neil Burgess (UNEP-WCMC) Ed McManus, Stuart Chape (previously with UNEP-WCMC)
Kristian Teleki and Nicola Barnard (ICRAN)
Dan Laffoley and Segundo Coello (WCPA-Marine)
Rod Salm, Alison Green, Jeanine Almany, Marianne Kleiberg, Mark Spalding, Georgina Bustamante and Alan White (TNC)
Margarita Astrálaga and Louisa Wood (IUCN)
Jackie Alder (SAUP/UBC)
Stefan Hain (UNEP Coral Reef Unit)
Sarat Babu Gidda and Jihyun Lee (CBD Secretariat); Marjo Vierros (previously with CBD Secretariat)
UNEP Regional Seas Programme (Nairobi): Ellik Adler, Alberto Pacheco, Ulrika Gunnartz, Carrie Brenenan and Risa Kasai
Annie Hillary and Elizabeth Mclanahan (NOAA)
Helen Fox and Kate Newman (WWF-US)
Tundi Agardy (Sound Seas, USA)
Matthew Watts and Hugh Possingham (University of Queensland, Australia),
Graeme Kelleher, Richard Kenchington (Australia)
Sebastian Treong (Conservation International)
James Anderson (ReCoMaP, Mauritius)

Caribbean: Alessandra Vanzella-Khouri (Caribbean Environment Programme)
Bahamas: Dan Brumbaugh, Peter Mumby
Belize: Janet Gibson (WCS), Melanie McField (TNC)
British Virgin Islands: Joseph Smith-Abbott (BVI National Parks Trust)
Colombia (Seaflower Biospshere Reserve and MPA): CORALINA, Elizabeth Taylor, Marion Howard
Cuba: Jose Gerhartz, WWF Canada, Havana Field Office
Ecuador (Galapagos): Graham Edgar (CI), Scott Henderson (CI)
Grenada: Clare Morrall (St. George's University)
Mexico: Marianne Kleiberg, Juan Bezaury-Creel

Canada: Jennifer Smith (WWF Canada), Doug Yurick and Francine Mercier (Canada)
USA: John Ogden, Joseph Uravitch and Charles Ehler

North-east Pacific: Rosa María Rodríguez (COCATRAM)
South-east Pacific: Fernando Félix and Diana Arauz (CPPS)

East Africa: Dixon Waruinge (Nairobi Convention), Julius Francis (WIOMSA)
Madagascar: Charlotte de Fontaubert, Fran Humber (Blue Ventures)
Seychelles: Nirmal Shah (Nature Seychelles)
Yemen (Socotra): Catharine Cheung and Lyndon de Vantier
Red Sea and Gulf of Aden: Ziad Abu-Gharah
Staff of ROPME Secretariat
West Africa: Charlotte Karibuhoye (WCPA-Marine)

South Asian Seas: Nishanti Perera
East Asia: Srisuda Jarayabhand (East Asian Seas Regional Co-ordination Unit); Shinichiro, Kazumi Wakita (PEMSEA, Philippines), Eleanor Cartor (Coral Triangle Initiative)
China: Wanfei Qiu
Japan: Shinichiro Kakuma and Kohei Hibino
Indonesia: Cherryta Yunia, Lida Pet-Soede, Sangeeta Manghubai
Philippines: Porfirio Alino (Marine Science Institute)
NOWPAP: Jeung Sook Park

Mediterranean and Black Sea: Abderrahmen Gannoun, Daniel Cebrian and Christine Pergent-Martini (RAC/SPA, Mediterranean Action Plan); Paul Mifsud (UNEP/MAP); Alessandra Pome (WWF Mediterranean Programme), Giuseppe Notarbartolo di Sciara (WCPA - Marine); Catherine Piante (WWF France); Oksana Tarasova (Black Sea Commission); Zrinka Jakl and Anamarija Francic (Croatia)

Europe: Hanna Paulomäki (Helsinki Commission, Finland); Richard Emmerson, Paulo Domingos-Paixao Stefan Leiner and Micheal O'Briain (European Commission Environment Directorate-General); Richard Emmerson (OSPAR Commission); Iain Shepherd (European Commission's Maritime Task Force); Jeff Ardron (MCBI - formerly of Bundesamt für Naturschutz)
UK: Paul Gilliland (Natural England)
Baltic: Åsa Andersson (Baltic Sea Programme, WWF Sweden)

Pacific: Dominique Benzakem (SPREP); Eric Clua (CRISP Programme)
Fiji: Bill Aalbersberg
Solomon Islands: Shankar Aswani
New Zealand: Jeremy Helson

Arctic: Jeanne Pagnan (WCPA-Marine Arctic Region); Soffía Guðmundsdóttir (PAME)
Antarctic: Denzil Miller and Keith Reid (CCAMLR, Hobart, Tasmania)
High Seas: Colleen Corrigan and Francine Kershaw (UNEP-WCMC)

Thanks also to all individuals and institutions who gave permission to use their images:
Alejandro Arrivillaga, Philip Kramer Jeanine Almany and Nate Peterson (TNC)
Marion Howard (Brandeis University)
Anthony Mitchell (CORALINA)
Alessandra Pome and Catherine Piante (WWF)
Melanie McField (Healthy Reefs for Healthy People Initiative)
Dan Laffoley (WCPA-Marine)
John Turner (University of Wales - Bangor)
Susie Grant (BAS)
Charlotte Karibuhoye (IUCN)
Frances Humber (Blue Ventures)
Richard Wilson (Australian Government Department of the Environment, Water, Heritage and the Arts)
Sebastian Troeng (CI)
Anne Walton and Sean Hastings (NOAA)
David Johnson and Corinne Michel (OSPAR)

1 INTRODUCTION

Historically, protected areas were established on an individual *ad hoc* basis rather than through a systematic, planned process. In the case of marine protected areas (MPAs), the need for a global representative system was recognised as early as 1988, at the 17th IUCN General Assembly in San José, Costa Rica, and again at the Fourth World Parks Congress in Caracas, Venezuela, in 1992 and the 19th IUCN General Assembly in 1994. The World Summit on Sustainable Development (WSSD) in 2002 called for the "*establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012*". The Evian agreement, signed by the G8 nations in 2003, similarly called for a global network of MPAs. The Durban Action Plan, developed at the Fifth World Parks Congress in 2003, called for regional action and targets to establish protected area systems by 2010, within the framework of regional environmental conventions and protocols, and the Congress also recommended the establishment of MPA networks across 20 to 30% of the world's oceans by 2012.

The Convention on Biological Diversity (CBD) took on board these recommendations and responded by requiring that all Parties establish protected areas that are planned and managed as a system or network. At the Seventh meeting of the Conference of the Parties to the CBD (COP7) in 2004, the parties committed to the target in the WSSD Plan of Implementation, which was laid out in the CBD's 2004 Programme of Work on protected areas as follows:

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 at the global, regional, national and sub-national levels and contribute to poverty reduction and the pursuit of sustainable development.*

Decision VII/28 of COP7 laid out the process by which these targets are to be met, with the following deadlines:

- By 2006, complete protected area system gap analyses at national and regional levels.
- By 2008, take action to address the under-representation of marine ecosystems in existing national and regional systems of protected areas, taking into account marine ecosystems beyond areas of national jurisdiction in accordance with applicable international law.
- By 2009, designate the protected areas identified through the gap analyses.
- By 2012, complete the establishment of comprehensive and ecologically representative national and regional systems of MPAs.

COP7 also set an additional target, endorsed at COP8 in 2006[1], that there should be:

Effective conservation of at least 10% of each of the world's ecological regions by 2010.

Many countries have established their own national targets (Table 1) and these are providing a strong incentive for the introduction of a systematic conservation planning approach in the design and location of MPAs in order to ensure comprehensive protection of marine biodiversity (Margueles and Pressey, 2000). This has led to rapid development in the number of national initiatives to set up MPA networks or systems. However, there has been little documentation of the experiences generated in the field and of the wide variety of approaches that are being taken, and this report is aimed at filling this gap by using information from the literature and from MPA practitioners to a review the current status of MPA network development.

The three objectives of the report are:

- **Dissemination of experiences and lessons learned from initiatives under way at regional, national and sub-national levels:** This involved a literature review and correspondence with individual experts to determine methods being used, and the extent

[1] Decision VIII/15, Annex IV, Eighth Meeting of the Conference of the Parties to the Convention on Biological Diversity

to which parameters such as representativity, adequacy, resilience and connectivity are being incorporated into MPA networks. The review is presented in Chapters three-eight and summarised in Chapter nine. Supporting data for this analysis was taken from a number of sources including the World Database on Protected Areas (WDPA), MPAGlobal, institutions and individuals.

- **Promotion of a better understanding of the underlying principles and concepts of, the scientific basis for and the issues to be considered when developing MPA networks:** This involved a review of the literature and relevant guidelines, the results of which are presented in Chapter two. This section promotes the guidelines prepared by the World Commission on Protected Areas (WCPA)-Marine and the CBD.
- **Provision of recommendations for improved action towards establishing MPA networks:** The recommendations outlined in Chapter 10 are directed at several audiences, including the CBD, United Nations Environment Programme (UNEP), WCPA-Marine, other international organisations, and the many national and regional bodies involved in monitoring and reporting on the WSSD targets and in developing and establishing MPA networks, including the 13 UNEP Regional Seas Programmes (RSPs)[2] and their independent partner programmes.

The report primarily details progress being made in establishing systems and networks, to document and learn from their approaches and experiences, and to relate them to the more theoretical guidance available. Given the speed with which this field is developing, the report does not provide a comprehensive review of all initiatives but, for each region, gives a general overview and selected examples. No particular methodology was used to select case studies beyond ensuring that a wide range of examples was included and that each region is represented. The report is aimed at assessing progress being made in systematic planning of MPA networks and does not address the management effectiveness of either individual MPAs or MPA networks and systems.

COP7 of the CBD recognised the importance of countries collaborating with other parties and relevant partners to establish effective regional systems of protected areas, particularly in areas identified as common conservation priorities such as barrier reef systems, large remaining forest areas, and critical habitat for endangered species. It also recommended the establishment of multi-country coordination mechanisms to support such systems. The UNEP RSPs and Action Plans have been identified as mechanisms to promote joint programmes of work on the establishment and management of marine and coastal protected areas[3]. This report thus pays particular attention to the role of the UNEP RSPs, whilst also reviewing other activities under way at the regional and national levels.

[2] http://www.unep.org/regionalseas/default.asp
[3] Decision UNEP/CBD/COP/VII/28.

Table 1. Examples of national targets relating to MPA networks compiled from information gathered in during preparation of this report

Country	Targets
American Samoa	20% of reefs to be protected as no-take areas by 2010
Australia - South Australia	19 MPAs by 2010
Bahamas	20% of the marine ecosystem to be fully protected (no-take) for fisheries replenishment; 20% of marine and coastal habitats to be protected by 2020 (Caribbean Challenge)
Belize	20% of all bioregions 30% of reefs 60% of turtle nesting sites 30% of manatee distribution 60% of American crocodile nesting 80% of spawning aggregations
Brazil	National MPA system by 2012
Chile	10% marine area protected by 2010; national marine network of conservation and management sites by 2015
Colombia - San Andres Archipelago	Seaflower MPA, 2000 km^2 to be no-take
Cuba	22% of continental shelf protected (14.678 km^2), including: 15% of insular shelf 25% of coral reef areas and 25% of each subtype of wetland
Dominican Republic	20% of marine and coastal habitats to be protected by 2020 (Caribbean Challenge)
Fed States of Micronesia	30% of nearshore marine ecosystems protected by 2020 (Micronesia Challenge)
Fiji	30% of reefs protected by 2015; 30% of waters managed as an MPA network by 2020
Germany	38% of waters as MPAs
Grenada	25% nearshore marine resources protected by 2020 (Caribbean Challenge)
Guam	30% nearshore marine ecosystems protected by 2020 (Micronesia Challenge)
Indonesia	100,000 km^2 protected by 2010; 200,000 km^2 protected by 2020
Jamaica	20% of marine and coastal habitats to be protected by 2020 (Caribbean Challenge)
Madagascar	100,000 km^2 marine waters protected by 2012
Marshall Islands	30% of nearshore marine ecosystems protected by 2020 (Micronesia Challenge)
New Zealand	10% of marine environment protected by 2010
Northern Marianas	30% of nearshore marine ecosystems protected by 2020 (Micronesia Challenge)
Palau	30% of nearshore marine ecosystems protected by 2020 (Micronesia Challenge)
Peru	Representative MPA system to be established by 2015
Philippines	10% fully protected (no-take) by 2020
Senegal	Creation of an MPA network
St Vincent and Grenadines	20% of marine and coastal habitats to be protected by 2020 (Caribbean Challenge)
Tanzania	10% of sea protected by 2010; 20% of sea by 2025
United Kingdom	Network of Marine Conservation Zones (MCZs) to be established by 2020
USA - Central California	29 MPAs covering 18% of state coastal waters (528 km^2), with 243 km^2 as no-take areas

2 WHAT ARE MPA NETWORKS & SYSTEMS?

The adoption of the 2012 targets on protected area systems and networks has generated much debate over terminology. This chapter provides a summary of the discussions, as it is important to have a common understanding of some of the terms used when describing initiatives in different parts of the world. The scientific criteria considered to be essential in the design or protected area systems and networks are also discussed.

2.1. DEFINITIONS

2.1.1. MPAS

Although not important in the day-to-day management of a site, a common understanding of what is meant by the term 'MPA' is essential when discussing global issues, obligations under the CBD and measurement of progress towards global targets. It is also very important to understand the full range of spatial management tools that can be used, and that may be essential, when developing effective MPA networks and systems. A fundamental point is that for an area to be regarded as an MPA, it needs to meet the general International Union for Conservation of Nature (IUCN) definition of a protected area, which is as follows[4]:

A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (IUCN/WCPA, 2008b).

The CBD provides a slightly different definition for a protected area in Article 2:

A geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives.

Both the IUCN and CBD definitions thus require that a site must be set aside principally for conservation if it is to be recognised as a protected area, although it may have additional objectives such as improving livelihoods or promoting education or research. Sites that are set aside primarily for other purposes, such as defence, and that may have value for marine biodiversity will not generally be classified as MPAs.

PA practitioners have felt it necessary to define MPAs specifically, in order to clarify whether terrestrial habitat may be included, and whether sites with intertidal but no sub-tidal habitat, also qualify as an MPA. IUCN's definition of an MPA is as follows:

Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment
(Kelleher, 1999).

Under this definition, three types of MPA can be distinguished:

- MPAs that are entirely marine, containing sub-tidal and inter-tidal but no terrestrial habitat;
- MPAs that contain terrestrial, inter-tidal and sub-tidal components; the relative size of each component may vary between two extremes:
  - Those with a large proportion of land, in which case the marine part is often overlooked. Whether a largely terrestrial protected area with a small amount of inter-tidal area can really be called an MPA is open to question, despite the IUCN definition;
  - Those with a very small amount of land in the form of beaches or small islands or islets, in which case the protected area is often managed as a marine area only;
- MPAs that contain terrestrial and inter-tidal ecosystems only, such as the many protected areas with mangroves, marshes and other kinds of inter-tidal swamps, but with no sub-tidal waters.

It can nevertheless be difficult to know whether some protected areas are technically 'MPAs'. For example, some coastal lagoons are saline or brackish because of seasonal seawater inundation or percolation, while others have a permanent surface connection to the sea. Another problem arises with beaches located mainly above the high tide level and small islands, as these may be important for a range of marine species such as turtles or seabirds, but have no inter-tidal habitat.

[4] This new IUCN definition replaces the 1994 definition: *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* (IUCN/WCMC, 1994).

The CBD has a specific definition for MPAs but uses the broader concept of 'Marine and Coastal Protected Area' (MCPA) that includes protected areas that lie adjacent to the ocean but that do not necessarily include intertidal or subtidal water. An MCPA is defined as:

> *Any defined area within or adjacent to the marine environment, together with its overlying waters and associated flora, fauna, and historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings* (CBD, 2003).

This emphasises the importance of addressing coastal areas as well as sub-tidal and inter-tidal habitats when thinking about conservation of marine biodiversity (CBD, 2002). The term 'adjacent' is not defined, but refers to terrestrial protected areas with their seaward boundary at or just above high tide level.

The term 'MPA' is normally used as a generic term to cover all marine sites that meet the IUCN protected area definition, regardless of purpose, design, management approach, or gazetted name including marine reserve, sanctuary, and marine park. The terms 'park' and 'reserve' can cause particular confusion. For example, in Kenya, National Marine Parks prohibit fishing and extraction of any kind but allow recreation, while in Tanzania, Marine Parks are zoned for a wide range of uses, including fishing. In Kenya and Belize, marine reserves allow for non-destructive forms of fishing. In Tanzania, marine reserves are no-take areas. In the scientific literature, the term 'reserve' is often used interchangeably with the term 'fully protected MPA' when referring to an area that is closed to all forms of extraction.

Given that the terms MPA and MCPA are so widely used with different meanings and connotations, often causing confusion, the World Bank has developed a typology of marine management areas (World Bank, 2006), which has been further developed by IUCN/WCPA (2008a). The typology categorises management areas according to where they lie on a scale from strict protection for biodiversity and ecosystem protection, to spatial planning of human activities. There are four basic categories:

- Category 1: established primarily for biodiversity conservation and habitat protection;
- Category 2: established for a balance of conservation and multiple use: include integrated coastal management programmes, multiple-use MPAs, collaborative management areas;
- Category 3: established for sustainable extractive use: include fishery management areas, etc; and
- Category 4: traditional and indigenous community protection: include marine sacred sites, customary marine tenure-based MPAs, etc.

The IUCN protected area management categories provide another typology based specifically on the objective of a protected area (Table 2.1). First developed in 1994 and endorsed in 2004 by COP7, the categories provide a framework for data collection, a set of international standards that allows comparison across countries, and a means of promoting international understanding (a 'common language'). The categories are assigned to each protected area according to its management objectives and thus do not reflect directly the approach used to manage it, the activities allowed or prohibited within it, or the effectiveness of its management. Being based on objectives, the categories provide a means of grouping and analysing the diverse array of managed areas that meet the definition of MPA regardless of the names given to them in national law. All categories are considered to be of equal importance. Guidance on how to apply the categories has recently been revised following extensive consultation and a global summit held in Spain in 2007[5], and more attention has been given to applying the categories to MPAs (IUCN/WCPA, 2008b); a more detailed discussion of the categories and MPAs is given in Wells and Day (2004).

Perhaps the most difficult issue is deciding whether marine areas managed for extractive purposes qualify as MPAs. The new IUCN definition of protected areas, whilst losing the specific reference to the marine environment provides a clearer demarcation between conservation focused sites and those where the primary uses are extractive such as fisheries management areas. It would not preclude the inclusion of fishery protection zones provided biodiversity conservation is paramount. Category VI of the IUCN protected area categories in fact allows for protected areas 'managed mainly for the sustainable use of natural ecosystems', and fishery management areas could be interpreted in this way. It could also be argued that an MPA established for fisheries purposes and in which trawling is prohibited will inevitably contribute to the protection of biodiversity.

Both the CBD (CBD, 2005) and IUCN recommend that a range of types of management areas be

[5] The IUCN-WCPA Marine backing paper for the Summit can be found at http://groups.google.com/group/wcpamarine-summit/web/marine-backing-paper-for-iucn-categories-summit-7---11-may-spain

Table 2.1. IUCN protected area management categories[6]

Cat	Definition - area managed mainly for:
I	a. science or as a Strict Nature Reserve b. wilderness protection
II	Ecosystem protection and recreation; often called a National Park
III	Conservation of specific natural features; often called a National Monument
IV	Conservation through management intervention (e.g. habitat/species management areas)
V	Land/seascape conservation and recreation
VI	Sustainable use of natural ecosystems (e.g. multiple-use protected area)

considered when designing a protected area system, and emphasise that protected areas should not be seen as isolated entities, but as part of the broader ecosystem approach to conservation, implemented across the land- and seascape as a whole. The following types of MPA and management area are likely to be common elements in an MPA network or system:

No-take areas (NTAs): NTAs, whether standalone MPAs or zones within a multiple use MPA, are fundamental to an effective MPA system. Such areas are now widely termed 'marine reserves' particularly in the scientific and North American literature and increasingly by WCPA-Marine. The term 'highly protected' or 'fully protected' is also commonly used for NTAs, particularly in North America and by the World Wildlife Fund (WWF), although it is virtually impossible to protect a marine area 'fully', given that transmission of processes and substances in water is so effective. The IUCN definition of an MPA allows for extraction or harvest of marine resources provided that the primary objective of biodiversity protection is achieved and at present there is no globally accepted definition for MPAs that are entirely no-take although this may ultimately be necessary for consistency. WCPA-Marine's regional group for South-East Asia defines NTAs as sites *"that are minimally disturbed but where people are welcomed for recreational or non-extractive purposes".*

Multiple-use MPAs: The vast majority of MPAs fall into this category, in that they allow for a range of uses, and are often managed through zoning. Increasingly, they follow best practice in having a minimum of one NTA, buffered from edge effects by one or more surrounding zones allowing different uses.

Community-managed areas: Many small community-managed MPAs have been set up, most notably in the Pacific. These are not always recognised as MPAs by the national agencies and thus may not feature on national or international lists, or have categories.

Internationally designated MPAs and managed areas: These help promote general principles, harmonise approaches, and facilitate countries working together, through the designation of sites of international importance:

- World Heritage Sites (WHS): The World Heritage Convention requires that parties protect sites that meet specific criteria as outstanding examples of the world's cultural and natural heritage. Marine areas are poorly represented, with only 31 marine sites designated out of over 800 sites[7]. However, a large number of marine sites that potentially meet the stringent criteria for listing have been identified (Hillary *et al.*, 2003; Ehler and Douvere, 2007);
- Biosphere Reserves: the United Nations Education and Science Commission (UNESCO) Man and the Biosphere (MaB) Programme[8] is a global network of protected areas, but is not bound by a Convention. Biosphere Reserves are designated to encourage a broad range of objectives linking humans and the environment. The general structure of a Biosphere Reserve is a core protected area with a surrounding larger buffer zone which may be inhabited and exploited under sustainable use regimes; they are thus similar in approach to many multiple-use MPAs. There are 109 Biosphere Reserves containing coastal and marine habitat (Ehler and Douvere, 2007);
- Ramsar Sites[9]: These are designated under the Convention on Wetlands and do not necessarily require formal legal protection as the focus is on 'wise use'. They are sometimes considered part of a national protected area system, and sometimes have no formal protected area status. The Convention on Wetlands defines a wetland to include "areas of marine water the depth of which at low tide does not exceed 6m" and efforts are underway to increase representation of marine habitats in the network of Ramsar Sites.

Fishery management areas: Areas managed in order to ensure a sustainable fishery rather than to protect biodiversity are generally not recognised as protected areas in the IUCN sense, even where these are more strictly protected, such as trawl-ban areas, than some areas set aside for marine biodiversity conservation. Most fishery management areas, including those closed to specific gear types and/or

[6] http://www.unep-wcmc.org/protected_areas/categories/
[7] http://whc.unesco.org/en/marine (accessed 13/10/08)
[8] http://www.unesco.org/mab/mabProg.shtml
[9] http://www.ramsar.org

to the take of certain species, are not considered MPAs. There are exceptions, however, such as the Fish Habitat Reserves in Australia, which have been assigned an IUCN protected area management category, and are established under fisheries legislation to protect key fishery habitats including estuaries and sea grass beds. Fishing is allowed in these areas, but activities that will damage the habitat are prohibited (Ward and Hegerl, 2003). There has been much recent discussion on the role of MPAs in fisheries management, some of which was summarised through the 2006 workshop hosted by the UN Food and Agriculture Organisation (FAO) on this topic, where a *Draft framework for Technical Guidelines on the design, implementation and review of MPAs as a tool for fisheries management was developed prepared* (FAO, 2007).

Seasonal and temporary management areas: These include areas such as the conservation 'boxes' established in European Union (EU) waters, or the seasonal closures found in inshore waters in Okinawa, Japan (Kakuma in litt., 2008) within which seasonal, full-time, temporary or permanent controls are placed on fishing methods and/or access. The Irish Sea Cod Box, for example, is designed to conserve cod stocks in the Irish Sea by restricting fishing activities during the spawning period. A similar box has been established for fisheries management in the waters of the Shetland Islands (Gubbay, 2004). These are critically important conservation areas for sites, such as fish spawning aggregation areas or migratory routes, where species are vulnerable at specific and predictable times of the year but may not need any greater management than surrounding areas at other times.

Whale Sanctuaries: The International Whaling Commission (IWC) has a mandate to establish whale sanctuaries that provide permanent no-take zones for cetaceans (Phillips, 1996; WWF, 1998). These are not recognised as MPAs, as their objectives address only the capture of certain species and they are not considered legally 'permanent', although they are subject to regular review.

Mangrove Forest Reserves: In some countries, all mangroves are classified as forest reserves (such as in Ecuador). Sometimes these are considered to be protected areas, as in Tanzania, while in other cases, they are not nationally recognised or have not been submitted for listing in the WDPA.

2.1.2. NETWORKS AND SYSTEMS

The words 'network' and 'system' are used interchangeably in much of the conservation literature to describe a group of protected areas spread across a country or region. The use of the two words can be confusing as neither term has a globally accepted definition and they are often used with the same meaning in the same document, as in the US Federal Register (US Federal Register, 2000). Although there are exceptions, the word 'system' tends to be used most frequently for protected areas in general, and also for terrestrial protected areas. The IUCN/WCPA guidelines, for example, refer to national protected area 'system' plans (Davey, 1998).

The term 'network' is more prevalent among MPA practitioners and is defined by WCPA-Marine as follows (IUCN/WCPA, 2008a):

> *A collection of individual MPAs or reserves operating co-operatively and synergistically, at various spatial scales and with a range of protection levels that are designed to meet objectives that a single reserve cannot achieve.*

Agardy and Wolfe (2002) suggest that 'systems' are protected area groupings that have an element of governance and management, as well as a biological rationale, for their structure and composition. A system thus has a functional sense in that it implies consistent institutional and managerial arrangements with co-ordinated planning, as well as describing geographical and physical relationships. It does not however imply that there should be a single management authority. An effective system could equally comprise a number of management areas under different governance regimes adapted to local conditions. In contrast, a 'network' has a primarily geographical and physical sense, i.e. a group of protected areas with 'connectivity' between them, although in the context of MPAs, the term 'network' is often used to imply governance and management relationships as well.

An additional confusion is due to the fact that the word 'network' is also used to describe organised groups of people, projects and institutions involved in protected area establishment and management. These 'social', 'institutional' and 'learning' networks may be regional (such as the North American MPA Network (NAMPAN), Mediterranean Protected Area Network (MedPAN), the Wider Caribbean MPA Managers Network and Forum (CaMPAM) and the Local Marine Management Areas (LMMA) network in the Pacific) or national (such as Vietnam and the Philippines) and all are equally important aspects of effective protected area management (Christie and White, 2007). The term 'ecological network' is often used to distinguish a group of MPAs from a 'social network' of individuals and organisations.

In Decision VII/5 on marine and coastal biodiversity, the CBD uses the term 'network' for the global level and 'system' for national and regional levels. The

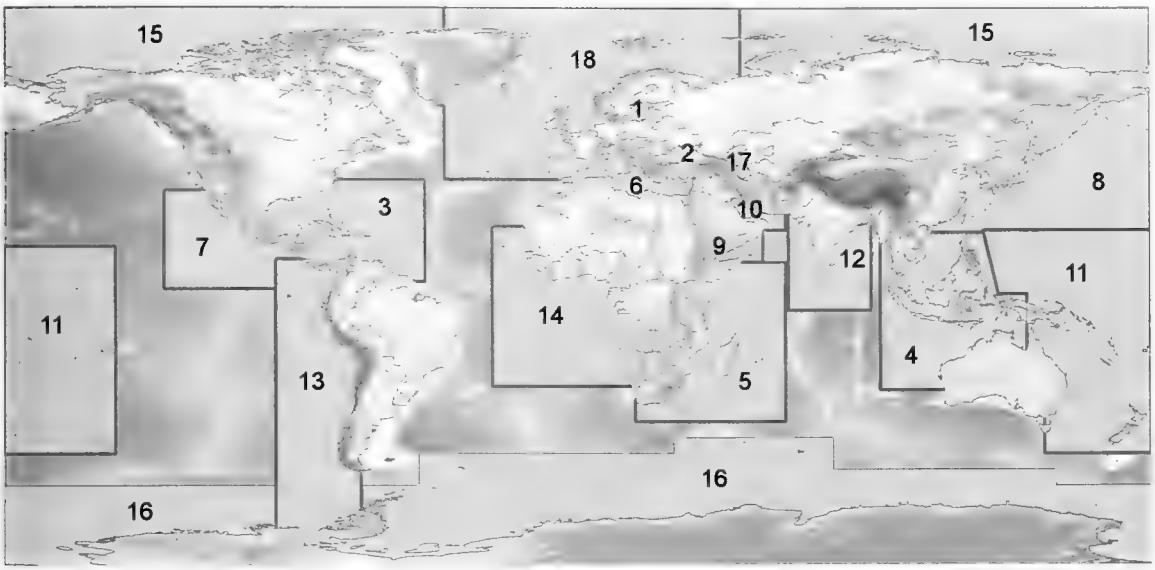


Figure 1: Regional Seas Conventions and Action Plans. Source: UNEP

1: Baltic Sea
2: Black Sea
3: Wider Caribbean
4: East Asian Seas
5: Eastern Africa
6: Mediterranean
7: North-east Pacific
8: North-west Pacific
9: Red Sea & Gulf of Aden
10: ROPME Sea Area
11: Pacific Ocean
12: South Asian Seas
13: South-east Pacific
14: Western Africa
15: Arctic
16: Antarctic
17: Caspian Sea
18: North-east Atlantic

'global network' of protected areas has no authority or mandate, but is the overall ecological entity that is made up of all the national and regional systems. As laid out in the CBD Programme of Work[10], the global network: *provides for the connections between Parties, with the collaboration of others, for the exchange of ideas and experiences, scientific and technical co-operation, capacity building and co-operative action that mutually support national and regional systems of protected areas which collectively contribute to the achievement of the programme of work.* It is thus essentially a social network that provides the mechanism for establishing national and regional systems.

Some countries have their own definitions. Thus, Canada defines a network, in its Federal MPA strategy (Government of Canada, 2005), as:

> *A set of complementary and ecologically linked MPAs, consisting of a broad spectrum of MPAs, established and managed within a sustainable ocean management planning framework and linked to transboundary, global and terrestrial protected area networks.*

Other related terms found in the literature include bio-regional and eco-regional planning, biological corridors, and the ecosystem approach. All aim to promote spatial planning and to develop cross-sectoral partnerships. This report uses the word 'network' when referring generally to groups of MPAs, but retains the specific nomenclature used by individual countries or programmes as appropriate.

Protected area networks can be established at different scales that, as this report will show, range from networks of NTAs within a multiple-use MPA to national networks within a single country and regional networks involving several countries. The CBD calls for the establishment of both national and regional systems of protected areas, but gives no guidance as to what constitutes a 'region'. To complicate matters, the world's oceans are divided into different regions according to several different schemes, reflecting ecological, geographical, economic and political characteristics, as explained below.

The UNEP-RSP comprises 13 regions (Figure 1) and five independent partner programmes. RSP areas include the entire Exclusive Economic Zones (EEZs) of the participating countries, and in some cases, such as the North-east Atlantic, adjacent areas of high seas. Countries within a UNEP-RSP region are linked either through a Convention or through a joint programme of work on marine and coastal conservation and management and are political, rather than ecological and geographical groupings.

[10] http://www.cbd.int/protected/pow.shtml

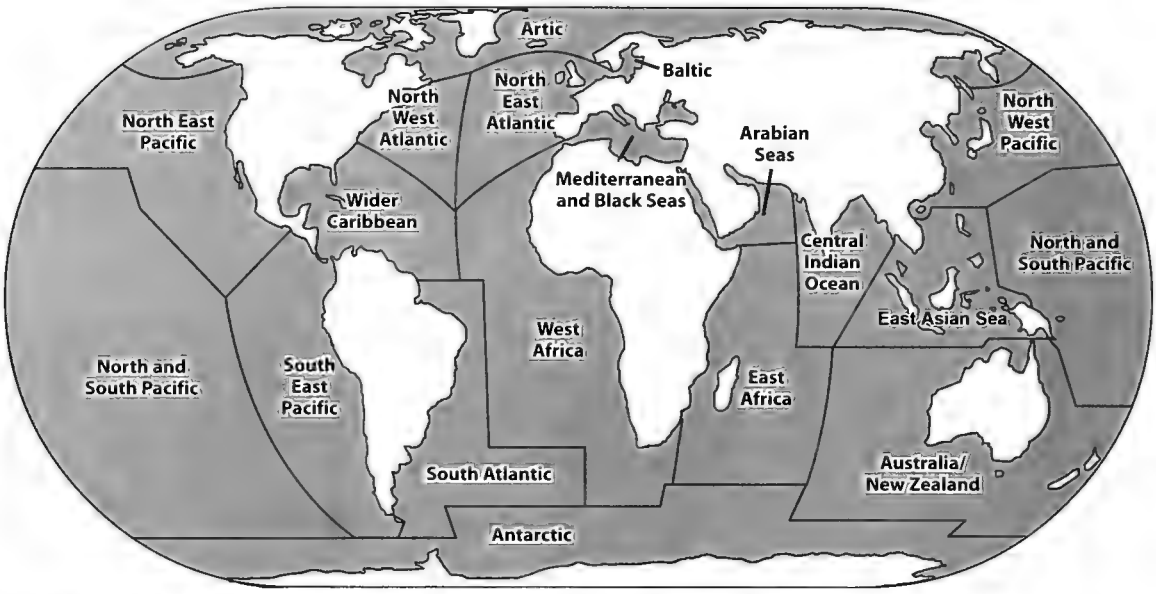


Figure 2: WCPA-Marine Regions. Source: WCPA-Marine
The 18 WCPA Marine Regions cover the entire ocean surface and take into account biogeographical and political considerations

The five independent partner programmes, which include the North-east Atlantic, Baltic, Caspian, Antarctic and Arctic, work with, but have not been established under the auspices of UNEP. They participate in the global meetings of the RSPs, share experiences and provide policy advice and support to the developing RSPs. A few countries are not part of either the UNEP-RSP programmes or the partner programmes, such as Brazil and Argentina.

The UNEP-RSP regions relate closely to the 18 WCPA-Marine regions (Figure 2) which are based primarily on bio-geographical criteria, but for practical reasons consider political boundaries. Unlike

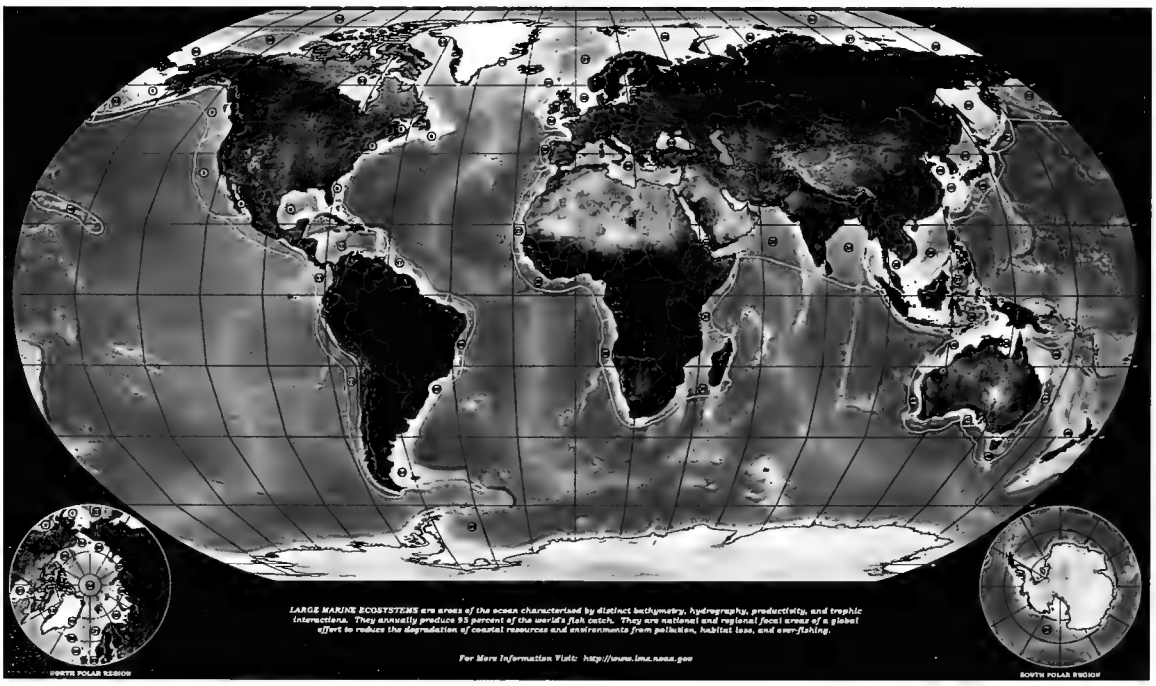


Figure 3: Large Marine Ecosystems (LMEs). Source: UNEP-WCMC
The 64 LMEs are split into 6 programmes: Atlantic East, Atlantic West, Indian Ocean, Pacific East, Pacific West; and Polar Oceans.

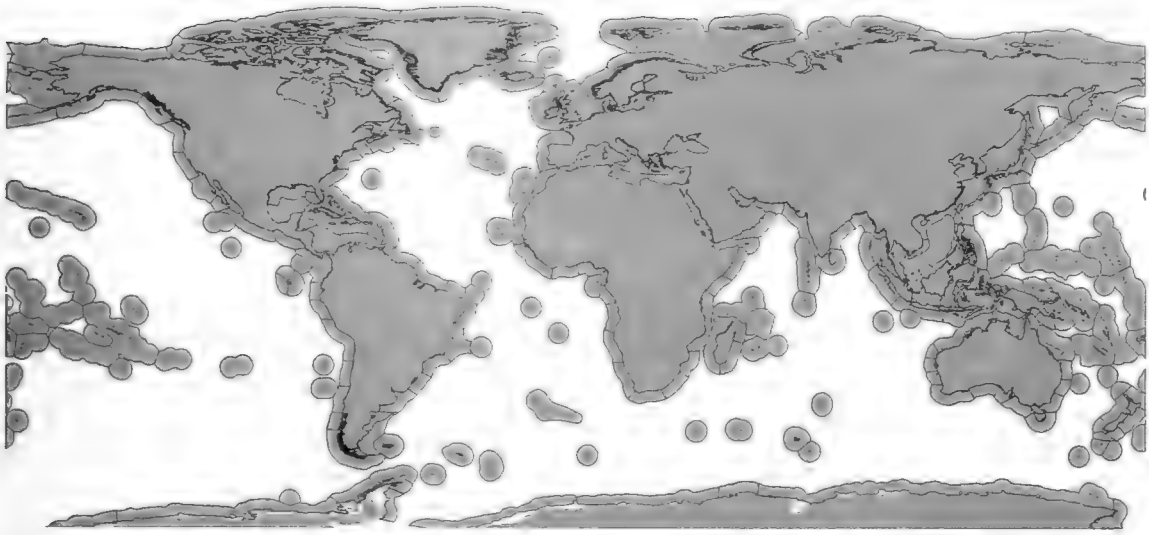


Figure 4: WWF Marine Ecoregions of the World. Source: UNEP-WCMC
The WWF Marine Ecoregions of the World (MEOW) incorporate a nested system of 12 realms, 62 provinces, and 232 ecoregions.

the UNEP-RSPs, WCPA-Marine regions cover the planet's entire ocean surface and consist not only of the national waters of the countries concerned but also the adjacent high seas. There is no formal management framework, but voluntary networks of MPA practitioners have, or are being, established within each region (Laffoley, 2008), and in some cases, such as South-East Asia, work programmes and strategies are in place or being developed.

Large Marine Ecosystems (LMEs) and World Wildlife Fund (WWF) Marine Ecoregions (Figures 3 and 4) are regions defined primarily on bio-geographical criteria and are not based on political boundaries. LMEs are large regions covering the continental shelf, characterised by distinct bathymetry, hydrography, productivity, and trophically dependent populations (Sherman, 1993). The boundaries are determined primarily by currents and large scale ocean processes. Although sound from a biological standpoint, LMEs can be difficult to apply to management issues, as national mandates, legislation and issues of sovereignty tend to over-ride the transboundary approach unless regional co-ordination mechanisms, such as the UNEP Regional Seas Conventions and Action Plans, are in place (Morgan, 1989; Dahl, 1993). Nevertheless, the LME concept has been adopted by the Global Environmental Facility (GEF) and some other organisations as a means of organising marine and coastal conservation activities and projects.

WWF's "ecoregions" are similar to LMEs but take into account biodiversity distribution. A marine ecoregion is defined by the major ecological processes that create and maintain biodiversity within an area, and addresses populations of species and ecological phenomena that require large-scale conservation (Olson and Dinerstein, 1998). WWF is supporting programmes aimed at developing MPA networks in several ecoregions, using a standard process that involves identifying the biological values of the Ecoregion and developing a vision and strategy for their conservation and sustainable management. Marine and coastal areas (or 'seascapes') of conservation importance are subsequently identified and classified according to whether they are considered to be globally outstanding or of ecoregional or sub-regional importance, so that priority sites for MPA establishment can be determined (Ward *et al.*, 1999). The EU also uses the term 'ecoregion' for smaller areas, and 11 ecoregions have been defined under the EU Marine Strategy of 2005 (ICES, 2005; Ehler and Douvere, 2007).

In a similar approach, Conservation International (CI) is working in three 'seascapes': the Eastern Tropical Pacific Seascape (in support of Corredor Marino or 'CMAR'), the Sulu-Sulawesi Seascape (in support of the Sulu-Sulawesi Marine Ecoregion (SSME)) and the Bird's Head Seascape in Indonesia, which are defined as large, multiple-use marine areas with seven key components as follows: an enabling legal framework; adequate institutions and capacity; networks of MPAs with effective planning, implementation, monitoring and evaluation; ecosystem-based management; private sector engagement; social and political support; and sustainable financing. Once the Global Marine Species Assessment[11] has been completed in 2012, a global marine hotspot (Myers *et al.*, 2000) analysis will identify the regions in most critical need for

[11] http://sci.odu.edu/gmsa/

marine conservation investment and a seascape approach to collaborative marine management will be introduced.

In addition to these programmatic regional approaches, which are described in more detail in the following chapters, there are numerous individual country groupings that have been set up to promote MPA establishment and that are taking a network approach. Many of these are also highlighted in subsequent chapters. The need to bring some form of harmonisation into the process, bearing in mind the development of new global bio-geographical classifications (see section 2.3.1.), is discussed in the conclusions.

2.2. RATIONALE FOR MPA NETWORKS

There is an extensive literature on the benefits of individual MPAs and their role as a tool for biodiversity conservation and marine resource management. Protected area networks have had a shorter history of application and their benefits are thus less well documented on the basis of practical experience. However, their theoretical rationale has been described for terrestrial (Bedward *et al.*, 1992; Pressey *et al.*, 1993; Margules *et al.*, 1994; Davey, 1998) and marine environments (Kelleher and Kenchington, 1992; Kelleher *et al.*, 1995; Salm *et al.*, 2000; Roberts *et al.*, 2003a and b). Essentially networks represent a 'scaling up' of conservation which should both help to accelerate progress, given the challenges to be met at the global scale, and also introduce the concept of resilience which is so urgently needed in the face of climate change. Adequate, comprehensive, representative MPA networks also provide a framework based on biodiversity priorities, around which development and management decisions can be taken without compromising ecosystem services and other essential aspects of sustainability.

The potential benefits of MPA networks can be summarised as follows:

- Ensuring that all types of biodiversity (both species and ecosystems) are protected;
- Helping to maintain the natural range of species;
- Ensuring that protection of unique, endemic, rare and threatened species is spread over a fragmented habitat;
- Enabling adequate mixing of the gene pool to maintain natural genetic characteristics of the population;
- Ensuring protection of ecological processes essential for ecosystem functioning, such as spawning and nursery habitats, and large-scale processes, such as gene flow, genetic variation and connectivity, that promote an ecosystem-based approach to management;
- Ensuring that social and economic connections between protected areas are addressed;
- Bringing sectoral agencies together, and helping conservationists, fishery managers and other stakeholders with diverse interests to find a common goal;
- Facilitating the sharing of information and lessons learned; and
- Allowing for a more efficient use of resources, through cost sharing.

There are additional benefits where national networks are linked into regional networks:

- Ensuring the protection of an ecosystem or species that cannot be adequately protected in one country, such as migratory species;
- Ensuring that transboundary protected areas are given adequate attention;
- Sharing effective conservation approaches across similar sites in different regions;
- Developing collaboration between neighbouring countries to address common challenges and issues;
- Strengthening capacity by sharing experiences and lessons learned, new technologies and management strategies, and by increasing access to relevant information.

There is a particular need for networks of protected areas in the marine environment. Marine ecosystems and species, as well as coastal communities, are more closely connected in a number of ways than those on land (Agardy, 2003; Carr *et al.*, 2003; Roberts *et al.*, 2001; National Research Council, 2001; and Ward *et al.*, 2002). This connection is caused by winds that drive water circulation and affect wave action, local climate, biological processes, human activities, oceanic and tidal currents, and freshwater inflow, all of which have a major influence on the dispersal of larvae, nutrients, pollutants and other biological and inorganic matter. Numerous species, including fish, turtles and marine mammals, are migratory and breed in one area and feed in others. For some of these, such as cetaceans, MPA networks can allow for 'conservation corridors' that will allow exchange of individuals between protected areas (Notarbartolo di Sciara, 2007).

Fisheries, tourism and other uses of marine and coastal resources also take place at a broad spatial scale and contribute to the need for MPA networks. For example, restrictions on fishing in one place may affect some sectors of society to the extent that fishers need to find employment opportunities or fish elsewhere. A 2005 decision by the Food and Agricultural Organization of the United Nations (FAO) Committee on Fisheries that the organisation should assist members in meeting the 2012 WSSD goal for representative MPA networks led to a workshop in June 2006 to prepare guidelines on the role of MPAs in fisheries management (FAO, 2007). In Germany, for example, thought is now being given to how the developing network of MPAs might also contribute to sustainable fisheries, with fisheries management plans being developed for certain sites and consideration being given to setting criteria for fishing activities within MPA networks (see section 7.1).

MPAs tend to be a magnet for tourists, and national tourism development plans must therefore be considered in the development of MPA networks. MPA networks allow both the benefits and costs of management - financing, technical input and staffing -- to be spread across sites. Harmonisation of management approaches to reflect national policy may also be simpler. In many countries, different government agencies such as Fisheries and Forestry Departments are responsible for different types of MPAs, and local communities and the private sector may be involved in management. A network approach can help to bring all the players together. This does not mean that all the components of the network will be managed or overseen by a single authority, but does require the establishment of a co-ordinating mechanism to provide guidance and ensure sharing of lessons learned and expertise.

Finally, in this era of climate change, MPA networks may play a vital role in conservation of species, communities and ecosystems, the individual sites within the network allowing for movement of both adults and young between sites, and for changes in the distribution of species and communities as conditions change in response to global warming.

2.3. PRINCIPLES FOR THE DESIGN OF MPA NETWORKS

The theoretical basis for MPA networks has been extensively discussed (Kelleher and Kenchington, 1992; Kelleher *et al.*, 1995; Agardy, 1997; Nilsson, 1998; Roberts *et al.*, 2003a and b; Ward *et al.*, 1999; Davey, 1998; ANZECC, 1998; Lubchenco *et al.*, 2003; Sala *et al.*, 2002) and there are numerous guidelines that lay out the principles involved (see section 2.4 for references). Much of the theory and experience in relation to the zoning of individual MPAs is also relevant to planning MPA networks (Villa *et al.*, 2002). Until recently, attempts to design an MPA network usually involved proposals by biologists for a suite of sites based on biodiversity priorities, such as presence of threatened species and perhaps representation, which were then reviewed and adjusted by stakeholders. Although some practitioners still consider that an ecological network of protected areas can be based on representativeness alone, for most, a key premise is that sites are linked either through dispersal and exchange of larvae, juveniles and adults, and/or through functional linkages between communities, ecosystems and ecological processes (Bennett, 2003). The approach of 'systematic conservation planning' (Margules and Pressey, 2000) is increasingly considered essential.

Several sets of criteria and principles have been developed to provide guidance on how to establish a protected area system or ecological network, and this section summarises some of the key references. No judgement is made as to the relative merits of the criteria; most include a mix of both 'ecological criteria' (e.g. representation, adequacy) and 'management approaches' (e.g. cost effectiveness, permanence/long term protection etc).

IUCN/WCPA characterises a protected area system as having five linked elements (Davey 1998; IUCN/WCPA, 2008b):

- Representativeness, comprehensiveness and balance;
- Adequacy;
- Coherence and complementarity;
- Consistency;
- Cost effectiveness, efficiency and equity.

These reflect the six guiding principles advocated by the CBD for carrying out gap analyses when setting up protected area systems (Dudley and Parish, 2006):

- Representation;
- Redundancy;
- Resilience;
- Consideration of representation, ecological and management gaps;
- Participatory approach; and
- Iterative approach.

For MPA networks, WCPA-Marine has identified five ecological guidelines based on the criteria defined by the CBD's *ad hoc* Technical Expert Group on Marine and Coastal Protected Areas (AHTEG) (AHTEG/MCPA, 2004), and those developed during a WCPA-Marine workshop held in 2005 (IUCN/WCPA, 2008a). An MPA network should:

- Include the full range of biodiversity present in the biogeographic region, i.e. address representation, replication and resilience;
- Ensure ecologically significant areas are incorporated, such as unique or vulnerable areas, foraging and breeding grounds, source populations;
- Maintain long-term protection (considered in this set of guidelines to mean no-take areas or appropriate periodic closures);
- Ensure ecological linkages, i.e. connectivity through adult and larval dispersal, and functional connections between ecosystems; and
- Ensure maximum contribution of individual MPAs to the network i.e. size, spacing, shape.

The Expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection, held in the Azores, Portugal in October 2007, developed scientific guidance for designing MPA networks, including in open ocean waters and deep-sea habitats, consistent with best practice as identified in other documentation. The criteria that were identified, listed in Annex II of the workshop report, were adopted by the COP9 in Bonn, Germany, in 2008. These criteria are likely to become the most widely used and are as follows:

- Ecologically and biologically significant areas;
- Representativity;
- Connectivity;
- Replicated ecological features; and
- Adequate and viable sites.

Roberts *et al.* (2003a) listed similar biological criteria for the evaluation of sites to be included in a 'marine reserve' network (i.e. a network of NTAs): biogeographic representation; habitat representation and heterogeneity; reduction of human and natural threats; connectivity; and adequacy of size. The Nature Conservancy (TNC) has also listed MPA selection criteria, based on work on the resilience of coral reefs (see section 2.3.2 below).

Given the similarity of these various sets of principles and criteria, the key aspects identified by them are discussed below under four headings:

- **Adequacy;**
- **Representativity;**
- **Resilience; and**
- **Connectivity.**

2.3.1. ADEQUACY

'Adequacy' describes the concept of ensuring that the individual components of a protected area network are of sufficient size, shape and appropriate spatial distribution to ensure the ecological viability and integrity of populations and species. MPA networks should be self-sustaining or *viable* in the sense that they must be able to maintain the persistence of populations and ecosystems through natural cycles of variation. This is similar to the concept of resilience, but focuses on the spatial and size aspects of an MPA system. The basic principle should be that the network is large enough to cover the full range of ecosystems or habitats in the area, preferably with multiple samples of each. However, although conservation goals suggest protection of a large area, socio-economic demands are likely to reduce this (Possingham *et al.*, 2000).

Viability is improved if the MPAs are independent, as far as possible, of activities in surrounding areas and if the criterion of 'permanence' is considered. An MPA network as a whole should be considered permanent, even if the units within it change. Protecting biodiversity, restoring and maintaining target populations, and/or protecting and restoring migratory species cannot be achieved instantaneously and requires long-term commitments. The time to accrue social, economic, and environmental benefits can vary from a few seasons to decades, depending on the life history of target species, the condition of the ecosystem at the time of implementation, the speed of development of the network, and the effectiveness of management outside it (IUCN/WCPA, 2008a).

Deciding how many MPAs are required and how large these should be is a major challenge, as we lack much of the knowledge needed. The theoretical basis for 'how much should be protected' is based largely on current understanding of the role of NTAs or exclusion areas in maintaining biodiversity and fishery biomass, and there is little consensus. The overall CBD target, that a minimum of 10% of each habitat or biome should be protected, is based on theory that indicates that this figure will ensure the

survival of 50-70% of the species within the area. However, for MPAs, it is recommended that 20% or more of all bio-geographic regions and habitats should be included in no-take areas, some studies having indicated that benefits from such areas are maximised when 20-50% of habitat is protected (Roberts *et al.*, 2003b). This is now the foundation for many of the MPA targets that have been set although some authors consider that further scientific evidence is required (Agardy *et al.*, 2003).

Rare habitats and ecosystems, including those that provide essential ecosystem services and those that are most vulnerable and 'sensitive', should have a higher proportion protected than those that are more common or 'persistent'. Ecosystems such as coral reefs and mangroves thus require a larger amount protected than for example sandy beaches, where the community structure changes more slowly.

The optimum size for the individual components of an MPA network is also much debated. IUCN/WCPA (2008a) recommends that, for greatest effectiveness and to ensure protection of a wider spectrum of species and more sustainable fisheries, the size of an MPA should be based on ecosystem-based bio-geographic units rather than smaller portions of a targeted area. This may not always be possible, however due to issues such as political boundaries and the cost of implementation and enforcement. Also, where MPAs are established to maintain fisheries, theory suggests that many small no-take areas should be better for the export of larvae and adults to fishing grounds because of the large edge-to-area ratio (Roberts *et al.*, 2003a). The disadvantages of small sites are that populations of some species need a large area to be sustainable, and such sites may only function if essential linkages to other habitats are maintained, and are more vulnerable to disturbance such as low tides and algal blooms. Some research has shown that benefits of no-take areas are independent of size (Gell and Roberts, 2003b; Roberts *et al.*, 2003a; Halpern, 2003), and will depend more on whether the species concerned are sedentary or mobile and, if mobile, how much they move. Halpern (2003) reviewed 89 no-take areas varying in size between 0.002 and 846 km² and found that the magnitude of increase in abundance, biomass, size and species diversity was independent of size. However, in a study of European sites, Claudet *et al.* (2008) found that increasing the size of NTAs leads to increased abundance of commercial fish species within the NTA compared to outside. Further research on this is clearly needed.

The size of an MPA also influences its management effectiveness. Smaller areas are often easier to set up, enforce, monitor, and engage stakeholders. Larger areas take longer to develop, will be more costly, and may require greater investment in developing relationships if they have more stakeholders.

2.3.2. REPRESENTATIVITY

A fully ecologically representative network requires one or more MPAs to be established for each example of the full range of biological diversity (from genes to ecosystems) and the associated oceanographic environment within the given area. The network should also aim to capture the differences in biodiversity across different depths as well as geographical areas (Roberts *et al.*, 2003a). The following should therefore be covered:

- All ecosystem/habitat types, including those that are rare or particularly vulnerable;
- All species and characteristic species communities;
- Critical habitat for threatened, restricted range or endemic species;
- Areas important for vulnerable life stages, such as spawning aggregations, breeding sites and migration routes.

A concept related to 'representativity' but often considered a separate principle is that of 'comprehensiveness', which means ensuring that the *full* range of ecosystems and species is included within the network, thus avoiding a system that is representative for only certain ecosystems or species. Australia uses the 'CAR' principle where systems should be Comprehensive, Adequate and Representative, whether at state or national level.

In order to determine whether an MPA system is ecologically representative, a bio-geographical classification is essential. Although there are several classifications for the terrestrial environment, comprehensive data on the distributions of marine species and ecosystems and a lack of knowledge of many other aspects of the oceans has hindered the production of marine classifications. Numerous initiatives are now underway at national and regional levels to develop biogeographic classifications[12]. A global classification is now available for the shelf areas (to 200 metres depth) (Spalding *et al.*, 2007) called the 'Marine Ecoregions of the World (MEOW)' classification (Figure 4), which is based on a detailed survey of relevant literature and studies, and builds on many of the existing regional initiatives. It has three nested tiers: 232 ecoregions (the smallest units, defined as large areas with distinct assemblages of species, communities and environmental conditions), 62 provinces and 12

[12] Report of the Expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection. Azores, Portugal, October 2007. UNEP/CBD/EWS.MPA/1/2

realms. The MEOW classification was circulated as an information document at the Eighth COP to the CBD in 2006, and the Ramsar Convention, TNC and WWF are currently exploring its potential for use in spatial planning. Work is also underway to develop a classification of the pelagic and deep water zones of the oceans, following an expert workshop in January 2007 in Mexico, as a joint initiative of UNESCO, Intergovernmental Oceanographic Commission (IOC), and IUCN, at which the draft Global Open Oceans and Deep Sea-habitats (GOODS) bioregionalisation was produced[13].

Ecoregions or biomes provide only a coarse description of the biodiversity within an area and thus only an estimate of the representativeness of a protected area network. Since they generally cover large areas, they are only useful for establishing representative systems at the global or regional level, or for countries with very large coastlines and EEZs, as many small countries lie entirely within a single ecoregion. Finer classifications to habitat level are thus required, and the information needed to prepare these is now becoming available. Distributions of some of the larger vertebrate species, such as marine turtles and seabirds, are relatively well known, as well as ecosystems such as coral reefs and mangroves. Even for deep sea and high sea ecosystems, there are now data sets for some areas for habitats such as sea mounts (Kitchingham and Lai, 2004), cold water corals (Freiwald *et al.*, 2004), hydrothermal vents, open pelagic systems, deep sea trenches, submarine canyons, and for species including high seas vertebrates and invertebrates (Cheung *et al.*, 2005). There are also country and regional level ecosystem classifications such as Connor *et al.* (1997) for the United Kingdom (UK) and north-west Europe, Holthus and Maragos (1995) for the Pacific and a number for the Caribbean. The Global Marine Species Assessment[14] once completed will allow for a species-based and data-driven analysis to identify marine hotspots and marine key biodiversity areas that will complement the the bio-geographical classifications.

2.3.3. RESILIENCE

Resilience is the term used to describe the ability of a system to survive natural catastrophes and major impacts, and to absorb shocks. Carpenter *et al.* (2001) describe ecological resilience as the "*ability of a system to undergo, absorb and respond to change and disturbance whilst maintaining its functions and controls*". Resilience can be increased through *replication* or *redundancy* - that is, the inclusion of multiple samples of habitat types, separated spatially, in a system to spread the risk of a large-scale event (e.g. an El Niño event, or a hurricane) destroying the only protected site of a certain habitat. Resilience, replication and redundancy are not mentioned in the CBD 2012 targets but are considered essential if MPA networks are to be fully effective, as they concern the need to ensure that an MPA network functions over the long term regardless of changes due to natural and human-induced events. Although the goal of representation could be met by having one MPA for each element of biodiversity in the network, more than one example for each biodiversity element is necessary to ensure that at least one will survive in the event of poor management or natural catastrophe (Allison *et al.*, 2003; Day and Roff, 2000). Resilience can also be increased by:

- Ensuring that a number of MPAs within a network are free from extractive uses, habitat-altering activities, and other unnecessary stresses. These will facilitate ecosystem recovery after a disturbance;
- Ensuring that genetic variability of the species and ecosystems involved in the MPA network is preserved, as this variability permits adaptation to both natural and human-caused changes;
- Paying particular attention to habitats and species that are especially vulnerable to disturbance and thus less resilient; such habitats (e.g. coral reefs and mangroves) are often dependent on biological or living structures, disturbance of which risks destroying entire communities.

Key principles for ensuring that resilience is taken into consideration when developing MPA networks are summarised in guidelines produced by TNC (Grimsditch and Salm, 2006) and WWF (Hansen, 2003) as follows:

- Spreading the risk of damage or extinction by ensuring, wherever possible, that habitat types are replicated in the network so that if one MPA is eliminated, others stay intact;
- Ensuring MPAs are effectively managed so that local threats are reduced or eliminated, ecosystems and populations are able to adapt to changing conditions, and recruitment and recovery are encouraged;
- Building in good connectivity (see below) between MPAs, so that sites that survive a particular impact can provide a source of replenishment for those that have been damaged;
- Ensuring that some sites are fully protected, so they are able to recover quickly from impacts such as coral bleaching. These should include

[13] http://www.ias.unu.edu/resource_centre/ocean%20bioregionalisation.pdf
[14] http://sci.odu.edu/gmsa/

critical areas such as refugia (see below) and key breeding and spawning sites such as spawning aggregations.

Coral reefs have been most studied in the context of 'resilience'. The extent to which they are affected by high sea surface temperatures is proving to be highly variable, and the intensity of bleaching, the species affected, the depth, and the extent of mortality all vary according to where a reef is located and the local conditions affecting it. The resilience of a reef to bleaching is defined as its ability to regenerate to its previous state through growth and reproduction of surviving corals and through successful larval recruitment from within the area or from adjacent areas. If these factors are understood, MPAs can be selected and designed to protect those reefs more likely to survive and most resilient and that act as 'thermal refuges' or 'refugia' (Obura, 2005; Riegl and Piller, 2003; Salm *et al.*, 2001; Salm and Coles, 2001; West and Salm, 2003). Coral refugia that are less subject to major increases in temperature during sea warming events include those located in or near strong currents, deep water, and upwellings, and those that are regularly shaded from the sun (such as on certain sides of an island), have high wave energy or are subject to high turbidity (Done, 2001).

A representative, replicated, and precautionary approach to creating an MPA network can help ecosystems cope with random disturbance events such as tsunamis, hurricanes, typhoons, spills or other accidents, disease outbreaks or coral bleaching events. Maintaining the resiliency and adaptability of species and ecosystems will become even more important over the coming decades of accelerated climate change.

2.3.4. CONNECTIVITY

Connectivity is a key issue to consider in the design of an MPA network. It refers to the linkages that exist as a result of the particular characteristics of marine organisms (such as larval dispersal, pelagic juveniles and adults and reproduction through spawning), and of the marine environment, including the mixing of waters through wind, currents, tides, and upwellings. Sediments, nutrients, plankton, animals, and pollution are re-distributed from their original sources up and down coastlines and across oceans, and different habitats are closely connected by the species that move between them. These linkages exist spatially, both in localised situations and basin-wide, and also temporally, in terms of genetic flows and generational time-scales. They also exist in the physical environment and include tidal fluxes, erosion and deposition processes.

An MPA network should maximise and enhance connectivity between individual MPAs, groups of MPAs within an area, and MPA networks in the same and/or different regions, in order to ensure that ecological functioning and system productivity is protected. It should consider:

- Exchange of offspring between populations through larval dispersal.
- Movement of juveniles and adults between the MPA and other sites.
- Ecosystem linkages through transfer of materials, such as organic carbon.

The rapid pace of research in this field means that MPA networks must be flexible and allow for new information becoming available. For example, techniques involving genetic analysis, mark-and-recapture (tagging), otolith[15] geochemistry and modelling of currents, gyres and upwellings, are providing a much greater understanding of the various aspects of connectivity in the marine environment. Modelling studies (e.g. Sanchirico, 2005) have demonstrated that different assumptions about connectivity and dispersal can lead to different conclusions about the most effective design of an MPA network, in particular in relation to distances between the individual components.

The extent to which larvae are exchanged between MPAs, or dispersed out of or into MPAs, depends on their dispersal distances, local oceanography (especially currents), and the distances between an MPA and other MPAs or sites relevant to the species life history. Information on larval dispersal is thus essential for determining the size of individual units within a network, and how far apart they should be spaced. However, for most species, there is no information on how fast or how far their larvae travel, whether they can swim, and how they are dependant on or are influenced by local hydrodynamics such as ocean currents. Research is showing that there is great variation and that an MPA network that might suit the dispersal of one species is unlikely to be suitable for all others (Roberts, 1998; Shanks *et al.*, 2003; Lockwood *et al.*, 2002; Grantham *et al.*, 2003).

Most work has been on reef species, and there is an emerging consensus that the larvae of many species disperse over much shorter distances than previously thought, often staying on their reefs of origin or recruiting to adjacent reefs. This means that there is less connectivity between individual reefs than previously predicted from ocean currents (Roberts, 1998), and in some cases there are demonstrated genetic differences between reefs and regions (Jones *et al.*, 1999; Swearer *et al.*, 1999; Thorrold *et al.*,

[15] Otoliths are fish ear bones, analysis of the chemical composition of which reveals information about the environment in which the fish was living.

2001; Barber *et al.*, 2002; Taylor and Hellberg, 2003). For example, distinct genetic differences have been found between populations of *Acropora palmata* on reefs in the Bahamas as close as 2 to 20 km, and all populations more than 500 km apart were distinct (Vollmer and Palumbi, 2007). There seems to be little genetic exchange between populations on reefs more than 50 to 100 km apart, and it is recommended that MPAs should be located with this maximum distance between them to ensure connectivity between the reefs. Cowen *et al.* (2006) found that larval dispersal for many reef fish in the Caribbean was between 10 to 100 km, also suggesting that populations may be more genetically isolated then previously thought. TNC (2008) recommends that MPAs within a network aimed at coral reef protection should be no more than 20 km apart. Shanks *et al.* (2003) recommend an inter-MPA distance of 10 to 20 km, and figures of between 20 and 150 km are inferred by Palumbi (2003) and Cowen *et al.* (2006). Larvae that survive for a long time do not necessarily travel long distances, although those that do so may play key roles in maintaining gene flow with populations at the extreme end of the species range. Isolated MPAs will benefit from larvae with a short dispersal range as they will be retained within the area. Wood *et al.* (in press) found that 56.3% of MPAs are located within 10 to 20 km of at least one other MPA, and 78.6% are within 20 to 150 km of another MPA. Many are 'connected' to up to ten MPAs.

Connectivity between reef and non-reef areas, such as mangroves and sea grass beds, is also starting to be understood (Cappo and Kelley, 2000; Mumby *et al.*, 2004). Certain reef fish, including snappers and emperors, as well as turtles require both seagrasses and reef habitats at different life stages. Transfer of nutrients between seagrasses, reefs, and mangroves is also extremely important. Small MPAs may only be sustainable if similar patches of habitat occur nearby, and on the level of protection of these patches. Mumby (2006) provides four algorithms for conservation planning in reef and mangrove ecosystems that take into account mangrove habitats as a nursery habitat for reef fish, reef connectivity with mangroves, and priority sites for mangrove restoration.

Adults of many marine species move on a cyclical basis between different areas for feeding, breeding and other key life stages, and these migration patterns must also be considered in MPA system design. At present, MPAs for such species tend to be predominantly focussed on breeding areas (such as turtle nesting beaches, sea bird and pinniped breeding colonies). Migration patterns of turtles and marine mammals are being studied through tagging and observation programmes, and techniques are now available for studying adult fish movements (Hooker and Gerber, 2004). Such species can cover 1000s of miles, spanning ocean basins and, if their routes are protected, have the potential to provide functional links between MPAs and other critical habitats (King and Beasley, 2005). A knowledge bank of migration route studies is now expanding through the use of satellite tracking technologies (e.g. Block *et al.*, 2005) and a number of projects, such as the Tagging of Pacific Predators (TOPP)[16] project, have been set up. Migratory patterns of fish are starting to be understood through mark-recapture studies and studies of the genetic structure of populations along geographical gradients may provide an indirect method to assess long-term connectivity.

2.4. METHODS FOR DESIGNING AND DEVELOPING MPA NETWORKS

The CBD and IUCN WCPA have produced a series of manuals on protected area system planning, including implementation of the CBD's requirements for establishing protected area systems (Dudley *et al.*, 2005), a gap analysis methodology for protected area systems (Dudley and Parish, 2006; Langhammer *et al.*, 2007), and a review of ecological networks and corridors (Bennet and Mulongoy, 2006). More specific guidance targeted for MPAs is also available, including WCPA-Marine's principles and guidance for MPA network establishment (IUCN/WCPA, 2008a) and the CBD's guidelines for developing national systems of marine and coastal protected areas (MCPAs) (SCBD, 2004). There are also a number of national guidelines, such as those produced for Canada[17]. Other guidelines to systematic conservation planning include Pressey *et al.* (1993), Davey (1998), Margules and Pressey (2000), and Leslie (2005). The December 2005 issue of *Conservation Biology* also provides valuable experiences, and the August 2008 issue of *MPA News*[18] carries a short discussion on this topic.

Methods range from the highly sophisticated, involving advanced computerised analytical techniques (see Box 1), to simpler approaches, but all the guidelines identify a similar approach, summarised by Ardron et al. (2008) as *eight key stages:*

1. **Identify and involve stakeholders:** From the onset of the planning process it is essential to ensure good communication with and the full involvement of all stakeholders, even if this may mean (as it invariably does) that the network can only be developed over a long time period;

[16] http://www.topp.org/
[17] http://www.dfo-mpo.gc.ca/csas/Csas/DocREC/2004/RES2004_082_e.pdf
[18] http://depts.washington.edu/mpanews/

2. **Identify goals and objectives:** For the network as a whole and for the individual components within it, identify both conservation (ecological), for biodiversity protection and restoration, and socio-economic goals to protect and enhance the social and economic interests of the area. The objectives must be in line with relevant protected area policies, legislation, obligations under regional and international environmental conventions, and any broader national or regional protected area system. Goals and objectives for an MPA network are sometimes defined in national legislation, and should be established using a participatory process to ensure that the views of all major interest groups are represented. They should be realistic, measurable and achievable;

3. **Compile data:** In order to design a network that embodies appropriate goals and objectives it is necessary to understand and map the *conservation features* to be conserved in the network, as well as human uses, threats and land tenure. The best available ecological, socio-economic and cultural data (including traditional and local knowledge) must be assembled and evaluated, gaps identified, and possibly new data collected to fill these gaps. MPA systems should be designed using the precautionary approach, which means using the best information available but not waiting in anticipation of better data being available later, since this may lead to further degradation. A suitable bio-geographical and/or habitat classification should be adopted. Some countries develop their own classifications, but there are generic global and regional classifications that can be adapted;

Box 1: Marxan and C-Plan

Marxan (Possingham *et al.*, 2000) and C-PLAN (Margules and Pressey, 2000) are software packages that can be used for planning and selection of protected areas, particularly for MPAs (SPOT is often used for terrestrial protected areas). The main difference between C-Plan and Marxan is the method of generating 'irreplaceability'. Marxan uses simulated annealing, whilst C-Plan uses a statistical method. Unlike C-Plan, Marxan can minimise cost and improve spatial reserve design, but C-Plan has a graphical user interface and GIS link, as well as a more powerful database system for building databases.

Marxan was developed by Ian Ball and Hugh Possingham when the re-zoning plan was being prepared for the Great Barrier Reef Marine Park. The name Marxan is derived from MARine, and SPEXAN, itself an acronym for SPatially EXplicit ANnealing. Marxan generates irreplaceability with simulated annealing by adding together the results from many different reserve configurations. A project area is divided into planning 'units' at a suitable scale. Small units give the best results, but only if the data are good. Different variables are then put into the dataset and the software selects options for the MPA network whilst ensuring that representation and the defined objectives can be met. Existing sites can be incorporated. The planning units that are 'selected' more than 50% of the time each time the software is run should be considered essential components for the MPA network. Marxan can thus quickly find different MPA configurations that meet the targets for biodiversity and other features whilst minimising cost. Marxan does not have a graphical user interface or database builder, but it can be used as a plug-in, including CLUZ, PANDA and C-Plan. It can be difficult to use if there is very little data (e.g. this was encountered in Belize). A Marxan 'Good Practices Manual' is available (Ardron *et al.*, 2008), and a range of other tools are under development, including the more advanced MarZone. For more information, see http://www.pacmara.org and http://www.uq.edu.au/marxan

C-Plan is an interactive decision support system with a GIS map interface and database builder, developed by Matt Watts and Bob Pressey. It uses a statistical method to create and explore alternative MPA configurations that meet targets for biodiversity features. It can support a stakeholder driven negotiation process or be used as a research or management tool with its graphical user interface. The user manuals are available from http://www.uq.edu.au/~uqmwatts/cplan.html

Further information is available on these and other related ecosystem-based management tools from:
http://www.ecology.uq.edu.au/index.html?page=33169&pid=20497
http://www.mosaic-conservation.org/cluz/
http://www.ebmtools.org

4. **Establish conservation targets and design principles:** Conservation targets specify how much of each conservation feature (such as species and habitat types) should be protected within the network, for example "20% of each bioregion" or "at least ten turtle nesting sites". Design principles influence the geographic configuration of the network, and address factors such as size, shape, number and connectivity of sites. Examples include "sites to be no smaller than 20km^2," "number of sites to be between seven and 12," or "edge to area ratio of the network to be kept low";
5. **Review existing protected areas:** Determine the extent to which existing protected areas already encompass conservation features, meet conservation targets, and contribute towards the network goals and identify gaps in the network (gap analysis);
6. **Select new protected areas:** A variety of options for the MPA network, meeting both conservation targets and design criteria, should be selected and from this range of configurations, suitable sites for new MPAs can be selected. Decision-support tools like Marxan are particularly helpful at this stage (Box 2.1). Ensuring representation ideally requires good knowledge of all the species and habitats within the area over which the MPA network will extend, but usually some kind of 'surrogate' approach will have to be used. A variety of techniques are being developed to deal with the lack of complete knowledge on species and habitat distributions, as well as computer-based methodologies that help with site selection (Leslie *et al.*, 2003; Rodrigues *et al.*, 2003; Edgar *et al.*, 2008b). Once sites have been identified, they should be ranked to establish priorities, since a staged and adaptive approach to implementation of a network is usually necessary. Adequate human and financial resources are rarely available for immediate implementation, and conditions may change and thus influence network design. For example, the South East Region MPA network in Australia has been designed to take into account future exploratory activities of the oil and gas industries;
7. **Implement the network:** This requires decisions on fine-scale boundaries, appropriate management measures, and other site-specific considerations. Where all sites in the network cannot be protected at once it may be necessary to implement interim protection;
8. **Maintain and monitor the protected area network:** Use 'adaptive management' to refine it, using the goals and objectives to evaluate whether management is effectively preserving ecological integrity, and whether each site makes a meaningful contribution to the network.

3 THE AMERICAS

This chapter provides case studies from countries in North and South America, and from the island states of the Caribbean. Regional divisions are complex as many countries participate in more than one UNEP RSP or regional initiative, and have coasts in both the Pacific and Atlantic Oceans. The chapter is therefore divided into three main sections (Wider Caribbean, South East and North East Pacific, and North America) with several sub-sections. Mexico features in all three major geographical divisions, and several Central American countries belong in both the Wider Caribbean and Eastern Pacific sections.

The Latin American countries consider themselves to be part of one broad geographical region in terms of MPA development. At the Second Latin American Congress on National Parks and Other Protected Areas in October 2007, sessions were held on regional and national MPA networks, with presentations on the experience and lessons learned in Latin America (IUCN/WCPA, 2007). At the Congress, under the Bariloche Declaration, the years 2008-2018 were declared to be the "*decade of Latin American MPAs*" and Latin American governments were urged to prioritise the establishment of national and regional MPA networks. MPAs cover around 0.5% of the marine area of Latin America, while nearly 20% of the continent's land area is protected. Most Latin American MPAs are multiple use, small in size, and do not extend far beyond the coastline (IUCN/WCPA, 2007). IUCN and WCPA-Marine will be hosting discussions to agree on common criteria for MPA networks, and a regional WCPA-Marine Plan of Action will be developed. A programme supported by TNC laid the groundwork for conservation planning for the coast and marine waters of six Latin American countries (Brazil, Chile, Colombia, Ecuador, Peru and Venezuela) (Chatwin, 2007).

3.1. WIDER CARIBBEAN REGIONAL SEAS PROGRAMME

The Wider Caribbean Region, with about 5.7 million km² of EEZs, comprises 38 very diverse countries and states, including insular independent nations, overseas territories of the UK, France, USA and the Netherlands, and mainland countries in Central and South America extending as far south as Guyana. The participating countries are also diverse in terms of level of development, geography, population size and many other characteristics. At the same time, there is a strong sense of regional identity, reflected in many regional marine conservation programmes.

The Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, known as the Cartagena Convention, was adopted in 1983, and the Protocol concerning Specially Protected Areas and Wildlife (SPAW Protocol) was ratified in 1990. They are supported by the UNEP-Caribbean Environment Programme (UNEP-CEP) and the Regional Activity Centre for SPAW established in 2000 in Guadeloupe, both of which contribute to implementation of the SPAW Programme (UNEP-CEP, 2000 and 2003)[19]. Activities relating to MPAs that are underway through the Cartagena Convention include:

- Establishing a regional network and forum of MPA Managers (CaMPAM) - see below;
- Establishing a Training of Trainers Programme for MPAs;
- Establishing a small grants programme to provide technical assistance to MPAs in the region;
- Strengthening MPA management;
- Promoting the *Guidelines for Protected Area Management* and development of a regional database on MPAs.

CaMPAM was launched in 2004 with a secretariat within UNEP-CEP and is an important social network[20]. CaMPAM supports information exchange, and capacity building and training activities (Bustamante *et al.*, 2005). In addition to MPA managers and personnel from the Wider Caribbean, members include UNEP-CEP, TNC, Environmental Defense, World Resource Institute, the University of Puerto Rico, IUCN-WCPA, and the U.S. Government (National Oceanic and Atmospheric Administration (NOAA)). CaMPAM meets annually, often in association with Gulf and Caribbean Fisheries Institute's (GCFI) annual meeting and an internet server has been set up for regular communications

[19] http://www.cep.unep.org
[20] http://www.gcfi.org/campam/CaMPAM.htm

between the MPAs in the region. A draft 5-year strategic plan (2005-2009) has been prepared (GCFI, 2005).

A GEF project *Organization of Eastern Caribbean States Protected Areas and Associated Sustainable Livelihoods*, approved in 2004, is helping to strengthen existing protected areas and create new ones. Other organisations that have been involved in MPA research, planning and capacity building include the Caribbean Conservation Association (CCA), WCPA-Marine which supported the production of a *Marine Reserves Regional Enhancement Plan for the Wider Caribbean* in 2003 (Bustamante, 2003), the Wildlife Conservation Society (WCS), Environmental Defense, and CI. TNC's Learning Center[21] facilitates communication and provides training to conservation professionals, local decision makers and community leaders.

At the national level, MPAs have been a major focus of attention for the Wider Caribbean since the 1980s and there are now over 500, although a much smaller number are effectively managed. At least a dozen countries have designed or are designing MPA networks. The Inter-American Biodiversity Network (IABIN)[22] is supporting gap analyses for the island nations, using the 'Caribbean Decision Support System' developed by TNC[23] and marine gap assessments have been completed for the Bahamas, Jamaica, Dominican Republic, Grenada and St Vincent, with St Lucia and St Kitts and Nevis underway.

In terms of representation, coral reefs are relatively well represented, but other habitats less so (Geoghehan *et al.*, 2001). A number of studies have been carried out to look at how currents and larval dispersal might be used in the design of MPA systems within the region (e.g. Roberts, 1998; Cowen *et al.*, 2006). The Caribbean Sea is partially enclosed, with its circulation dominated by the northern branch of the Atlantic Equatorial Current massed with the Orinoco River drainage which flows north-west to form the Caribbean current, and the southern branch that flows along the outer side of the Lesser Antilles and Bahamian Archipelago forming the Antilles Current. Local gyres generate retaining systems that disrupt the biological connectivity in the region but these have not yet been fully defined (Bustamante *et al.*, 2005). Cowen *et al.* (2006) analysed movement of reef fish larvae and identified sites that are potentially recruitment limited, meaning that they lack a source of larvae upstream within appropriate distances. Such areas include the Windward Islands and the Yucatán Peninsula. The west and east parts of the Caribbean were found to be relatively isolated, with the north-east Caribbean isolated from the rest of the Eastern Caribbean. The Leeward Islands appear to be largely self-recruiting, acting as a sink. Similar patterns were found using the genetics and morphology of two species (the coral *Acropora palmata* and the goby *Elactinas evelynae*) to model connectivity. This work is being followed up through a project led by the UN University International Network on Water, Environment and Health (UNU INWEH) on *Connectivity and Large Scale Ecological Processes* (2004-2009) under the GEF funded "*Coral Reef Targeted Research and Capacity Building for Management*"[24]. This involves quantifying connectivity between populations of selected coral reef organisms (fish corals and lobster) on the basis of larval dispersal, initially in the Mesoamerican Caribbean.

The Caribbean Challenge[25] - to protect at least 20% of marine and coastal habitats by 2020 - was launched in May 2008 at COP9 of the CBD. To date, the Bahamas, Grenada, Dominican Republic, Jamaica and St Vincent and the Grenadines have signed up to this and other countries are considering joining. TNC has pledged funding to support its implementation. Two sub-regional initiatives in the Caribbean to establish MPA networks are described below: the Mesoamerican Barrier Reef, and the recent proposal for Islands in the Stream, a network of MPAs in the Gulf of Mexico. Examples of national MPA network initiatives are then described for six countries.

3.1.1. MESOAMERICAN BARRIER REEF

The Mesoamerican Barrier Reef stretches the length of the Caribbean coast of Mexico, Belize, Guatemala and Honduras. Through the 1997 Tulum Declaration, the four countries committed to the *Mesoamerican Caribbean Coral Reef Systems Initiative*, which is being implemented with GEF and bilateral donor support through the *Conservation and Sustainable Use of the Mesoamerican Barrier Reef System* Project involving a number of organisations. In 2002, WWF produced a 'blueprint for Ecoregional Conservation Planning' for the Mesoamerican Reef that identifies key sites for MPA establishment (Kramer and Richards-Kramer, 2002).

TNC's Mesoamerican Reef (MAR) Programme is undertaking conservation assessments, research on replication and resilience, and policy work aimed at the creation of a 'resilient network of well-managed mutually replenishing MPAs'. Spawning aggregations are being studied and monitored in all four countries and have been protected in Belize (Heyman and Requena, 2005) (see below); and sites resistant to coral bleaching will be identified and monitored. The initial focus is on four 'platform' sites: Sian Ka'an

[21] www.tncmar.net
[22] www.iabin.net
[23] http://www.conserveonline.org/workspaces/Caribbean.conservation
[24] http:// www.gefcoral.org/Portals/25/publications/posters/lgi.pdf
[25] http://www.nature.org/initiatives/protectedareas/features/art24943.html

Biosphere Reserve, Mexico; Gladden Spit Marine Reserve, Belize; Punta Manabique National Park, Guatemala; and Cayos Cochinos Natural Monument, Honduras.

3.1.2. GULF OF MEXICO 'ISLANDS IN THE STREAM'

There are a number of ecologically vital, enormously productive, and scientifically important sites in the Gulf of Mexico that are interconnected by ocean and currents and are dependent upon one another for biological recruitment and replenishment. The Gulf is strongly linked "upstream" to the Caribbean and "downstream" to the Atlantic by the Loop Current, Florida Current and the Gulf Stream, and is one of the most scientifically studied ocean areas. A Scientific Forum held in January 2008 analysed the biophysical background of the Gulf of Mexico and concluded that there was sufficient science to support the implementation of an MPA network that would extend from the Florida Keys to Belize, provisionally termed the 'Islands in the Stream'. Some sites have already been designated as marine sanctuaries or identified as areas of critical habitat and most are afforded some degree of protection by different management entities. An MPA network would lead to a comprehensive management approach that recognises the interdependence of these sites across the entire Gulf of Mexico and its broader connections with the Caribbean Sea and Atlantic Ocean (Richie and Keller, 2008). The concept has been proposed to the U.S. Administration for consideration for possible Presidential action.

3.1.3. BAHAMAS - PROPOSED NATIONAL NETWORK OF NO-TAKE MPAS

In 2000, the Bahamas pledged to protect 20% of its marine ecosystems as NTAs for fisheries replenishment, reinforced through its participation in the Caribbean Challenge, but going significantly further in stating that the areas would be closed. A major research and planning exercise is underway to develop this network, led by the Bahamas Fisheries Department and the Bahamas Reef Environment Education Foundation (BREEF). Goals for the network have been agreed as follows:

- Enhanced support for fisheries production and management efforts;
- Protection of marine biodiversity;
- Protection of healthy marine ecosystem structure and function.

A team of US scientists has identified 30 candidate sites for the network using a ranking system which took into account the potential for fishing displacement, the presence of a nearby supportive community, the existence at the location of more than one critical habitat, such as reefs and sea grasses, and the significance of the site as a potential source of fish larvae *(MPA News 10(2), August 2009)*. The network is to include existing MPAs if these are appropriate, and newly designated sites as needed. Five high scoring sites were proposed to initiate the network: North Bimini; Berry Islands; South Eleuthera; Southern Exuma Cays; and Northern Abaco Cays. These will undergo extensive consultation, modification and finally designation as part of the network. According to MPAGlobal and the WDPA, there are already 31 MPAs in the Bahamas. Exuma Cays Land and Sea Park (ECLSP) is the largest (456 km² marine area) and is entirely no-take and will be included in the network but other MPAs are not being included.

The Bahamas Biocomplexity Project (BBP), a collaborative initiative of the American Museum of Natural History's CBC, the University of Exeter in UK, and other institutions, with original funding from the U.S. National Science Foundation, is undertaking research to inform the network design and establishment (Brumbaugh *et al.*, 2008). An interdisciplinary research team has been established that includes several working groups:

- Habitat Working Group: Field surveys and remote sensing to understand spatial variation in relationships between habitat types and species assemblages; detailed analysis of the ECLSP as an exemplar of reserve ecological function within the Bahamas (Mumby *et al.*, 2006, 2007, 2008; Harborne *et al.*, 2008); and the development of new algorithms that can incorporate a wider range of ecological and human factors into MPA network design (Brumbaugh, 2008). For example, work is underway to select sites that may be most resistant to thermal stress (Mumby *et al.*, in press).
- Connectivity Working Group: Research on hydrological circulation and genetic population structure to determine population connectivity within the Bahamas and between the archipelago and surrounding parts of the Caribbean. Analysis of *Acropora cervicornis* DNA has revealed genetically distinct populations on reefs as close as 2-20 km, and all reefs more than 500 km apart were genetically distinct (Vollmer and Palumbi, 2007). It is therefore recommended that MPAs are sited every 50-100 km for efficient seeding of one reef by another. Similar genetic analysis of conch *Strombus gigas*, lobster *Panulirus argus*, and bonefish *Albula vulpes* is underway. Circulation models are also being used to simulate the potential

dispersal of these and other coral and fish species, with genetic analyses serving to help validate these models (Galindo *et al.*, 2006). Waters within the Bahamas appear to be relatively isolated from the rest of the Caribbean, with origination mainly from the North Atlantic sub-tropical gyre to the east, and limited mixing from the West Caribbean and Straits of Florida.

- Social Working Group: Assessing patterns of resource use and attitudes about resource conservation among stakeholders, as well as the potential socio-economic and cultural impacts of the establishment of MPAs (e.g. fishing and job displacement, increased tourism).
- Geographical Information System (GIS) Working Group: Looking at spatial integration of human dimensions with bio-physical patterns and processes, and developing the Bahamas Online Digital Map Atlas.

There is also a modelling working group and an educational and capacity building programme, involving Bahamian institutions and CBC, which has produced an exhibit on MPAs, primary school and college curricula in marine conservation science, and community outreach programmes.

3.1.4. BELIZE - NATIONAL MPA SYSTEM

The Belize National Protected Areas Policy and System Plan (NPAPSP) (Meerman, 2005) was launched in January 2006, having been prepared with the support of the United Nations Development Programme (UNDP), TNC, WWF, WCS, as well as national institutions and Non-governmental Organisations (NGOs). Preparation of the NPAPSP and associated consultations took nearly two years. A protected areas task force was established in 2003 to oversee the process, and a project co-ordinator was hired. The guiding principle for the NPAPSP was that the potential contribution of the protected areas system to national development and poverty alleviation should be maximised. CI has since been undertaking supporting research through its Marine Management Area Science Programme.

The initial step was an ecosystem and socio-economic assessment covering natural resources, existing protected areas, cultural assets, critical habitats, watersheds, land suitability, use and ownership, vulnerability to natural and climate change, threats and identification of sites suitable for new protected areas and biological corridors. The available marine habitat map was at finer scale, but less accurate, than the terrestrial maps available, and so habitats were clustered and the results redigitised (polygons were a minimum size of one hectare). The marine habitats were categorised according to seven bioregions, 14 marine classes and six mangrove classes (compared with 65 terrestrial classes). The result was a Belize Ecosystems Map at a scale of 1:100,000.

Priority sites for conservation were selected using Marxan. In the absence of information giving guidance on optimum sizes for NTAs, it was agreed that where an MPA is large enough, two or more NTAs, each as large as possible, should be included. The NPAPSP a scoring system was then used to rank the existing protected areas using several criteria such as level of management (Meerman, 2005). The MPA component of the plan, which covers the entire EEZ, thus builds on existing MPAs that were established ad hoc, starting in 1982. MPAs are gazetted under two pieces of primary legislation: the Fisheries Act for Marine Reserves; and the National Parks Systems Act for National Parks, Wildlife Sanctuaries, Natural Monuments, and Nature Reserves. Marine Reserves are zoned, and have one or more NTAs. National Parks, Wildlife Sanctuaries, Natural Monuments, and Spawning Aggregation Marine Reserves are strictly no-take. There are 25 MPAs, incuding eight Marine Reserves, two Natural Monuments, two National Parks, two Wildlife Sanctuaries, and 11 Spawning Aggregation Marine Reserves (Gibson *et al.*, 2004; Heyman and Requena, 2005). Seven sites lie within the Belize Barrier Reef World Heritage Site. The MPA network is also an integral part of the national Integrated Coastal Zone Plan, the MPAs in effect representing different zones within this broader, national level plan (see Figure 5).

The following targets for representation were set under the NPAPSP, although some are considered to be low and in need of revision (Meerman, 2005):

- Bioregions: 20%;
- Reefs: 30%;
- Turtle nesting sites: 60%;
- Manatee distribution: 30%;
- American crocodile nesting: 60%;
- Spawning aggregations: 80%.

The current total area of the MPA network is about 2,387 km². NTAs cover about 190 km², representing about 8% of the entire MPA system, or about 4% of the estimated 5,000 km² of reef and sea grass habitats, and about 1% of Belize's territorial waters. According to Gibson *et al.* (2004), the current MPA network probably includes all the 'main and unique habitats' as recommended in the original 1995 National Protected Areas System Plan, apart from Turneffe Atoll.

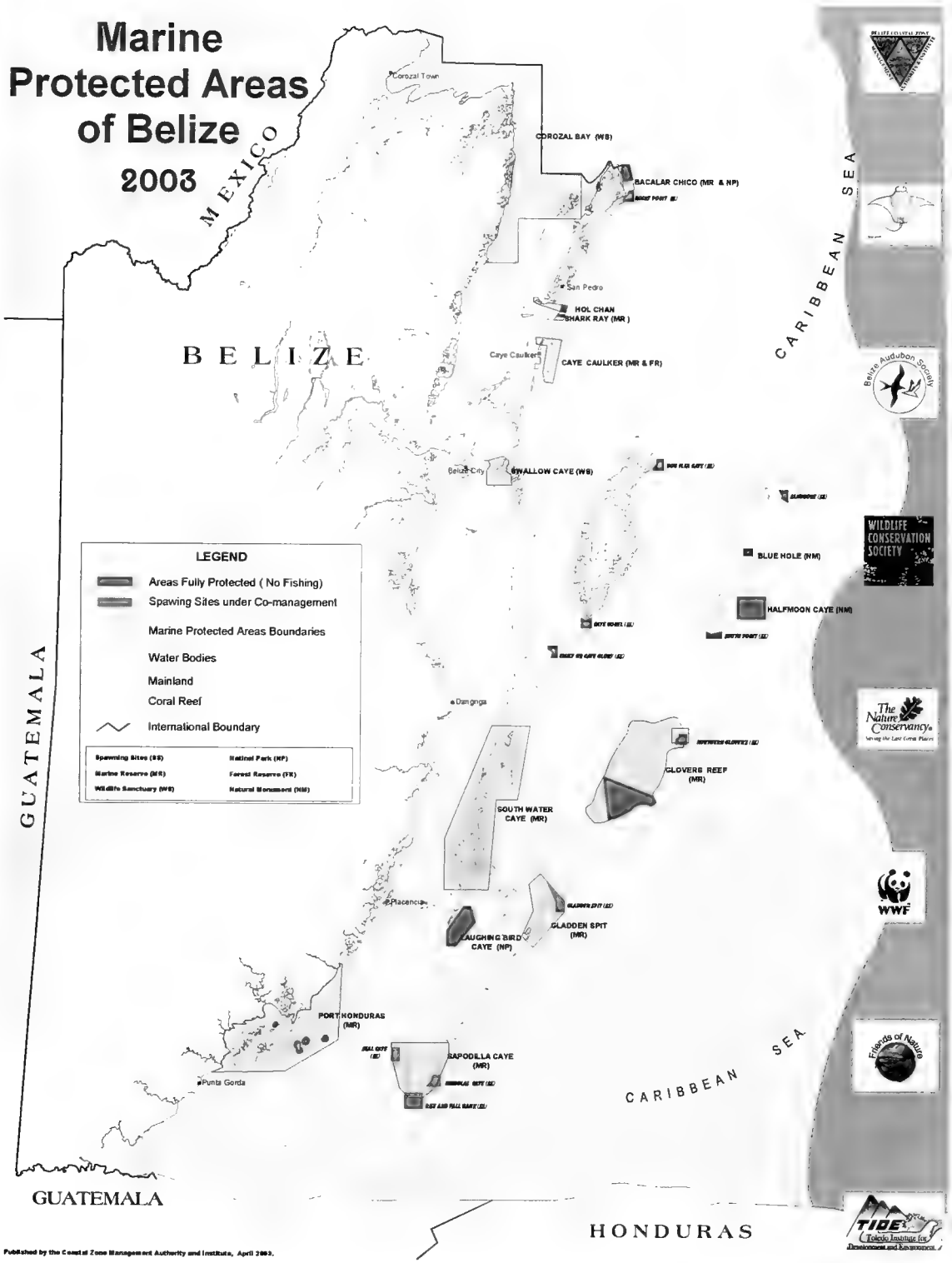


Figure 5: Belize MPA System. Source: Healthy Reefs for Healthy People Initiative
The MPA system of Belize comprises 25 MPAs, including eight Marine Reserves, two Natural Monuments, two National Parks, two Wildlife Sanctuaries, and 11 Spawning Aggregation Marine Reserves.

Resilience is being studied through the MAR programme, but adequacy and connectivity have not yet been addressed as there is insufficient information. Connectivity is a recognised area for research in Belize and a target was set in the NPAPSP that critical inter-connected regions, such as mangroves, sea grass and coral reef habitats, should be within 2.5 km of each other.

All existing MPAs have an IUCN category, but these were not used in designing the system, and are said to need revision. In terms of the IUCN governance matrix, there are two governance types in place: Government only, and Government/co-management, where the government has delegated management to an NGO or other association. Details are given in Gibson *et al.* (2004).

The NPAPSP resulted in a number of recommendations that if implemented would result in a merging of current protected areas to reduce the number of "management units". For example, several of the protected spawning aggregations overlap with other marine reserve designations. The plan demonstrates the need for an individual, rather than a "one size fits all", approach to the different biodiversity components: for example, conservation of the endangered manatee is considered to be well served by current MPA arrangements. The process of preparing the plan also demonstrated the need for improved biodiversity monitoring in order to identify priorities and trends, and for better (geo-referenced) data, particularly in the marine sector. The deep water ecosystems of Belize have received little, if any, attention, and consequently little is known about them and the software could not map areas of high importance. Potential sources of further information include data from whale shark research and interviews with sports fishermen (Meerman, 2005).

3.1.5. COLOMBIA - PROPOSED CARIBBEAN COMPONENT OF THE NATIONAL SYSTEM, AND SEAFLOWER MPA, SAN ANDRES ARCHIPELAGO

Colombia has a vast EEZ (988,000 km²), with coasts on both the Pacific Ocean and Caribbean Sea. The National System of Protected Areas currently includes 11 coastal-marine sites, seven in the Caribbean and four in the Pacific, most of which are terrestrial national parks with marine components. Work was initiated in 2005 to identify the priority sites that would be necessary for the creation of a

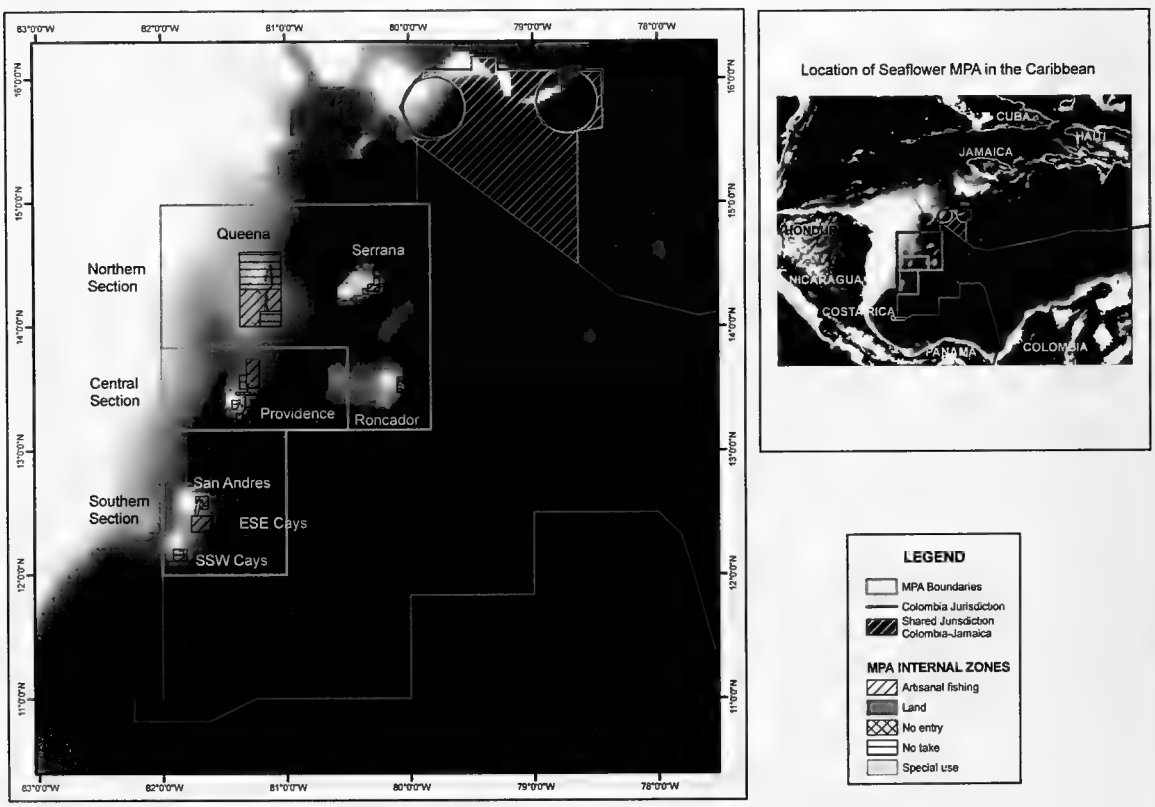


Figure 6: Seaflower MPA System. Source: Brandeis University and CORALINA
The Seaflower sub-national MPA system in the San Andrés Archipelago, comprises three adjoining, multiple-use MPAs.

representative MPA network using the TNC methodology and Marxan (Chatwin, 2007). Priority areas on the Pacific coast are being determined through the CMAR initiative (see below). For the Caribbean, three national workshops were held to define 37 conservation targets. Conservation goals have been defined: 30%, 60% or 100% depending on the target. 100 new priority sites were identified, covering 12.2% of the Caribbean continental platform which, with the existing MPAs, would provide 22.4% coverage if implemented (Chatwin, 2007).

The TNC analysis excluded the Seaflower MPA, which is a sub-national system in the San Andrés Archipelago, western Caribbean, comprising three adjoining multiple-use MPAs, totalling about 65,000 km² (Northern Section 37,522 km², Central Section 12,716 km², and Southern Section 14,780 km²). The archipelago as a whole is a UNESCO Biosphere Reserve, designated in 2000 and comprising 300,000 km² of marine waters, and the three Seaflower MPA sections are the country's first fully marine sites (see Figure 6). The MPAs were established by CORALINA, an autonomous regional government agency responsible for natural resource management and sustainable development in the San Andres Archipelago, through a five year World Bank/GEF project involving participatory mapping and zoning with fishers, dive tourism operators and other stakeholder groups. Technical partners included The Ocean Conservancy, Island Resources Foundation, Florida Keys National Marine Sanctuary, UNESCO-Coastal Regions and Small Islands Portal and UNEP (Friedlander *et al.*, 2003).

The Seaflower Biosphere Reserve and MPA are managed by CORALINA. The marine area of the Old Providence McBean Lagoon National Park, which is managed by the national park office, is included in the Central Section. CORALINA's Old Providence office and the local branch of national parks work together on managing this section of the system. Three regional parks are found in the Southern Section, each managed by a different team within CORALINA's San Andrés office. A co-management structure that includes stakeholder advisory committees for each section has been set up for day-to-day management.

The overall MPA objectives, developed in collaboration with stakeholders, are:

1. Preservation, recovery, and long-term maintenance of species, biodiversity, ecosystems, and other natural values including special habitats;
2. Promotion of sound management practices to ensure long-term sustainable use of coastal and marine resources;
3. Equitable distribution of economic and social benefits to enhance local development.
4. Protection of rights pertaining to historical use;
5. Education to promote stewardship and active community involvement in management.

All three sections are zoned. The zoning criteria included representativeness, connectivity, key habitats, ease of demarcation, likelihood to foster compliance, and potential to effectively meet the overall objectives. Based on the criteria and overall objectives, the specific zoning objectives are:

- **Species protection:** Protect biodiversity and species of special concern;
- **Habitat protection:** Protect representative habitats and those that are critical to the survival of species of special concern and to the maintenance of ecosystem functioning, taking into account habitat connectivity;
- **Recovery:** Allow for regeneration of degraded benthic communities and/or overexploited populations of fish and other marine species;
- **Socioeconomic impacts:** Minimise adverse socio-economic impacts;
- **Sustainable use:** Ensure sustainability of consumptive and non-consumptive uses of the resources;
- **Conflict resolution:** Eliminate or minimise incompatible uses and conflicts between users;
- **Equity and tenure:** Guarantee equitable distribution of economic and social benefits, and protect historical/traditional rights; and
- **Implementation:** Consider ease of demarcation for management, compliance, and enforcement.

Five zone types were defined, based on the zoning objectives:

1. No-entry, with use restricted to research and monitoring;
2. No-take, allowing a variety of non-extractive uses;
3. Artisanal fishing, for use by traditional fishers only;
4. Special use, for specific uses like shipping lanes, large-vessel anchorage, ports, and marinas or uses with the potential to generate conflict like heavily used water sports areas;
5. General use, where restrictions apply to preserve water quality and promote marine conservation.

Table 3.1. Seaflower MPA system: zone coverage

Zone type	Primary purpose	Size km²	% total area
No-entry	Preservation/conservation	116	0.18
No-take	Conservation	2,214	3.41
Artisanal fishing	Sustainable use	2,015	3.10
Special use	Sustainable use	68	0.10
General use	Buffer (allow sustainable use and protect conservation areas)	60,587	93.21
	Total	65,000	100

Each section was zoned separately in collaboration with the respective users and other stakeholders including institutions, and the communities made the final decisions. The same criteria, objectives and zone types were applied throughout the system. The initial target was to protect a minimum of 2,000 km² of significant marine ecosystems within the three MPAs. Each of the five zone types is found in each of the three sections (Table 3.1)[26]. Just over 3.5% of the area is no-take (no-entry + no-take).

Ecosystem and habitat representation is good (Table 3.2). Mangroves are fully protected, as well as over 50% of coral reefs, seagrass beds and algal beds. Examples of all coastal and marine habitats and ecosystems found in the San Andrés Archipelago (and in the Caribbean region) are included: coral reefs (e.g. atolls, barrier and fringing reefs, coral heads and patches, lagoons), mangroves, seagrass and algal beds, soft and hard bottoms, beaches, and open ocean, as well as habitat of endangered species like sea turtles, and sea bird colonies. Spawning aggregation sites are being mapped and their zoning status reviewed to ensure adequate protection.

Resilience has also been addressed. Multiple coral, benthic, beach, algal and pelagic sites occur in each MPA section while mangroves and seagrass beds are found in two (Southern and Central). Planning took into account replication to improve resilience. However, decisions were based on theory, given that resilience has not been studied in the archipelago. Entire ecosystems are protected in every section and conservation zones are sizeable and dispersed to maximise resilience. It is hoped that monitoring will gather information to help determine effectiveness.

Recognising the need to protect large areas of ocean, each MPA includes tidal, sub-tidal, and other nearshore waters; off-shore reefs, banks, cays, and atolls; and the open ocean connecting them, in order to ensure 'adequacy' of the network. The three sections are contiguous to minimise impacts from fragmentation and "edge effect". The entire Seaflower MPA system and the external boundaries were enacted at the national level in 2005 and thus have permanent legal status. Internal zoning and divisions between the three sections were legally declared by CORALINA at the regional level and are supported by an umbrella regulation that defines uses and actions permitted in each type of zone. Regulations are consistent for zone types throughout the system except for special use zones, where uses and regulations are zone-specific and are not yet enacted. CORALINA and user groups are currently working together to define these.

Table 3.2. Seaflower MPA system: ecosystem/habitat in no-entry and no-take zones

Ecosystem /Habitat	Southern%	Central%	Northern%	System total (3 sections)%
Corals	51	35	72	53
Mangroves	100	100	0	100
Seagrass beds	74	48	0	61
Algal beds	52	26	81	53

[26] http://whc.unesco.org/en/tentativelists/5166/

Each MPA section is linked and ecosystems within each section are connected. Conservation zones include integrated ecosystems, for example, a section of barrier reef along with its corresponding lagoon, seagrass beds, and mangroves in a single no-take zone. Again, design was based on theory as information on aspects relevant to connectivity like larval dispersal, movement of juveniles, and transfer of materials between ecosystems in a single section or between the larger sites of the MPA system's sections is unavailable.

3.1.6. CUBA - NATIONAL MPA SYSTEM

Cuba's MPA network, the Subsistema de Áreas Marinas Protegidas (SAMP), is a sub-system within the National System of Protected Areas (SNAP or Sistema Nacional de Áreas Protegidas)[27] (Estrada *et al.*, 2004). Under Environmental Law 81 of 1997, the SNAP is defined as an integrated marine-terrestrial system. The 1999 Decree Law 201 for the National System of Protected Areas provided the primary legal framework and established eight management categories that are equivalent to the IUCN categories (Table 3.3).

An additional category is the 'Special Regions of Sustainable Development' (REDS) that are designed for areas with high economic and conservation interest, and that include the two largest archipelagos (Sabana-Camaguey and Canarreos) and the largest wetland in the insular Caribbean (Ciénaga de Zapata).

Table 3.3. Management categories for protected areas within SNAP (Estrada *et al.*, 2004)

	Category	Local Abbreviation	IUCN Category
1.	Natural Reserve	RN	IUCN Cat I
2.	National Park	PN	IUCN Cat II
3.	Ecological Reserve	RE	IUCN Cat II
4.	Outstanding Natural Element	RED	IUCN Cat III
5.	Managed Floral Reserve	RFM	IUCN Cat. IV
6.	Faunal Refuge	RF	IUCN Cat IV
7.	Protected Natural Landscape	PNP	IUCN Cat V
8.	Protected Area for Managed Resources	APRM	IUCN Cat VI

Recommendations for a Cuban MPA system date from the 1960s and 1970s. The planning process for SAMP was finally started in 1995 by the National Center for Protected Areas (CNAP) as part of planning for the 2003-2008 SNAP (CNAP, 2002). MPAs in Cuba are defined as protected areas with a marine or coastal component and include coastal wetlands, sub-tidal waters from high water line to 200 m depth, and offshore keys. Terrestrial MPAs adjacent to the shoreline are also considered part of the SAMP. The goals for the SAMP are for representation of at least:

- 15% of the Cuban insular shelf;
- 25% of coral reef areas;
- 25% of each sub-type of wetland for each wetland region.

Additional goals were identified during the gap analysis as follows:

- To protect outstanding land- and sea-scapes and representative samples of marine-coastal biodiversity;
- To contribute to the sustainable management of fisheries;
- To represent the most outstanding geographical features of the marine and coastal zone of Cuba, as well as historical and cultural values.

An initial gap analysis for the SAMP was completed in 2003, led by the Institute of Oceanology (IDO) and the CNAP, with support from WWF Canada and Environmental Defense. The gap analysis involved many scientific institutions and protected area managers, and included ecoregional planning, cross-shelf habitat classification, Geographic Information System (GIS), remote sensing, digital cartography, and decision support systems. The 2003-2008 SNAP plan proposes a network of 85 MPAs (containing marine surface waters), covering 21.9% of the Cuban insular shelf, of which 44 will be of national importance and will cover 20.2% of the insular shelf (Table 3.4).

The first 18 MPAs were declared in 2001 through Agreement 4262 and covered 3.5% of the insular shelf. An additional three MPAs have been declared through other legal instruments bringing the total to 21 approved, and 13 further MPAs were being prepared for approval in 2004. The system also includes a number of MPAs that have international designations as follows:

- Two World Heritage Sites: Desembarco del Granma National Park and Alejandro de Humboldt National Park;

[27] http://www.snap.cu/categorias.htm

- Six Ramsar Sites: Ciénaga de Zapata, Río Máximo Faunal Refuge, Gran Humedal del Norte de Ciego de Ávila, Ciénaga de Lanier y Sur de la Isla de Júventud, and Humedal Buenavista;
- Five Biosphere Reserves: Ciénaga de Zapata, Buenavista, Guanahacabibes, Cuchillas del Toa and Baconao.

In terms of representation, well-conserved reef sites are included in the more highly protected MPAs (categories 1-IV), as well as sites critical to significant populations of important species. Uncommon features such as blue holes and banks off the shelf have also been taken into account. In many cases, MPAs were extensions of existing or proposed terrestrial protected areas. Connectivity in terms of larval dispersal was also considered, as well as information on the locations of spawning aggregations of certain fish (Claro and Lindeman, 2003; Paris *et al.*, in press).

Cuba is thus well on its way to meeting it target in terms of MPA coverage, although it is recognised that none of the existing MPAs are adequately managed. Many sites have programmes in place to support management, with international funding and technical assistance from a range of organisations.

Table 3.4. Status of Cuban MPA system, March 2004 (Estrada *et al.*, 2004)

		Insular Shelf km²	Offshelf km²	Total km²	National significance	Local significance
Approved	18	1,989.34	70.95	2,060.29	10	8
In process of approval	12	4,046.73	686.10	4,732.83	11	1
Proposed	55	6,463.64	1,421.66	7,885.30	23	32
TOTAL	85	12,499.71	2,178.71	14,678.42	44	41

3.1.7. JAMAICA

In 2007, Jamaica had six national marine parks, two fish sanctuaries and six coastal fishing reserves that covered more than 10% of the marine shelf but provided insufficient representation, particularly in the east (Corrigan *et al.*, 2007). A gap assessment was therefore carried out with the assistance of TNC for inclusion in the master plan for a national protected areas system. Data had been collected for Jamaica's eco-regional plan, a comprehensive mapping exercise of the country's ecological features, which identified 12 'coarse-filter' conservation features (including rocky and sandy shores, sea grass beds, and coral reefs) and one fine-filter feature (the West Indian Manatee). These features were stratified among four distinct island 'units' determined according to oceanographic, geophysical and environmental characteristics. The TNC survey added additional biodiversity features. For the assessment, a goal of 10% minimum protection for each biodiversity feature was set, with higher goals for features with ecologically significant roles. Gaps in protection were identified by using a GIS overlay of conservation targets with existing MPAs. In addition to poor representation of the eastern unit, offshore bank areas have no protection, and the existing protected areas are too small or spatially disconnected except for the Portland Bight Protected Area (Corrigan *et al.*, 2007). In May 2008, Jamaica signed up to the Caribbean Challenge and committed to protecting 20% of its marine and coastal habitats by 2020.

3.1.8. GRENADA

In 1988, Grenada (which includes the islands of Carriacou and Petit Martinique) developed its first protected area system plan. In 2005, with technical support from TNC and financial assistance from the United States Agency for International Development (USAID), an ecological gap assessment was undertaken, as an integrated initiative for terrestrial, freshwater and marine biodiversity (Corrigan *et al.*, 2007). Largely as a result of this work, in 2007, the government committed to having 25% of the nearshore marine ecosystems under effective conservation by 2020, with goals for individual biodiversity features ranging from 10 to 60%. In 2008 Grenada signed up to the the Caribbean Challenge to protect 20% of its marine waters by 2020. Just over 2% of essential marine habitat was protected in two MPAs designated in 2001, and a third site (Sandy Island and Oyster Bay MPA - SIOBMPA) was designated in 2008. A further two

sites are proposed which will take coverage to 12%. Current efforts are now being supported through the Caribbean Challenge.

3.1.9. BRITISH VIRGIN ISLANDS (BVI)

The preparation of a protected area system plan for the BVI is mandated by section 10 of the National Parks Act 2006, but this approach dates back to 1981 when the first system plan for parks and protected areas was prepared for the Ministry of Natural Resources and Labour with the assistance of the Eastern Caribbean Natural Areas Management Programme (ECNAMP). Since then, it has been revised four times, with the most recent revision the result of a three year project (2004-2007) conducted by the Island Resources Foundation (IRF) and the BVI National Parks Trust (Gardner, 2007). Stakeholders from relevant Government departments and industry representatives were involved, and the Protected Areas System Plan was approved by the Cabinet in January 2008. The overall goal for the System Plan is "*To manage important natural and historical resources in ways that will contribute to animprovement of the quality of life of BVI residents*".

The specific objectives are to:

1. Maintain vital natural areas that are:
    i. Important to the productivity of commercial species and other valuable wildlife;
    ii. Essential to the protection of endangered species, such as turtles, and to the life patterns of other critical species, such as seabirds;
    iii. Important to retaining representativeness and diversity of the Territory's natural heritage.
2. Maintain areas that are physiographically, geologically or otherwise aesthetically unique as sources of attraction, recreation, education and research;
3. Maintain and utilise historical resources, such as wrecks, for recreation and study;
4. Maintain, where possible, economic uses such as fishing and tourism under the guidance of proper resource management;
5. Provide for the continued growth of economic and recreational opportunities in a manner that can be sustained by available resources;
6. Encourage public understanding and enjoyment of the resources contained within protected areas.

The marine component of the system includes a range of designated areas throughout the 60 islands and cays of the BVI. It includes existing MPAs (e.g. the Wreck of the Rhone Marine Park and 14 fisheries protected areas declared by the Fisheries Regulations of 2003) as well as some 70 dive sites and other sites that had previously been managed for other activities without formal protection. It represents a total marine area of 82,759 km^2. The identification of marine benthic communities to be protected was based on the location of turtle nesting beaches, important seagrass areas, mangrove stands, coral reefs (particularly areas with *Montastrea* and *Acropora* species) and existing Fisheries Protected Areas and MPAs. The proportion of marine area under formal protection under either the National Parks or Fisheries Act of 1997 increased from 17.4% to 33% within the inshore and nearshore zones after the approval of the System Plan.

The scientific basis for developing the MPA component of the Plan was the two-year Marine Assessment Project (2004 - 2006), undertaken as part of the Overseas Territories Environment Programme (OTEP). A target was set that at least 30% of important habitats, such as coral reefs and mangroves should be protected, a gap analysis undertaken, and Marxan was used. Resilience was addressed by dividing the total area into three parts and ensuring that the targets were met in each part. Two main stakeholder groups were consulted: dive and charter industry users and fishermen, and meetings were held on all four major islands in order to ensure representation and equity. The feedback was incorporated into the system planning exercises during the latter part of 2006. New boundaries were formulated and presented to stakeholders, and opportunities were afforded for additional feedback. System plan meetings were held at the same communities during the month of January 2007. In addition, the meetings were preceded by a radio interview to inform the community both about the consultations and the broad objectives of the plan. Three scenarios were presented to the stakeholders, who came out in favour of a network of fewer, larger MPAs.

The BVI claims, in addition to a three mile marine zone extending from each island along the perimeter, the 200 mile EEZ as the northernmost chain of islands along the Eastern Caribbean. The deeps and shelf comprise the greater proportion of the marine area whilst the inshore and nearshore are less than 0.5%. The inshore, nearshore and shelf areas are used for recreation and fishing, which is also where the target marine habitats (coral reefs, sea grass beds and mangroves) are found and there is very

little use of the deeps. A management plan is now under preparation for the entire MPA network, and further attention will be given to the deeps. The IUCN management categories have been adopted as the official framework for protected areas management in the BVI, with nine categories of protected areas described in the BVI National Parks Act 2006. Each area has therefore been assigned a management category using the information gathered from the stakeholders and the assessment of conservation value attached to the area. For instance, in areas where pre-existing uses included fishing or diving, a management category of protected landscape/seascape may have been prescribed so that multiple uses may be managed along with the protection of the natural resource.

3.1.10. VENEZUELA

Priorities for marine conservation have been identified with assistance from TNC, usig the ecoregional assessment methodology (Chatwin, 2007). 20 sites were identified representing 37% of shallow maritime territory to 200 m depth and these will be used for planning the future designation of MPAs. Special emphasis is being placed on establishing zoning that takes into account offshore oil and gas exploitation. The existing National System of Protected Areas (NSPA) includes 13 National Parks and four National Monuments with marine habitat, but MPAGlobal identifies some additional protected areas with marine habitat.

3.2. SOUTH-EAST & NORTH-EAST PACIFIC REGIONAL SEAS PROGRAMMES

The South-East and North-East Pacific UNEP RSPs are discussed together as their jurisdictions overlap. The North-East Pacific Region as defined under the UNEP-RSP covers a narrow range of latitude (Mexico south to Colombia) and is predominantly tropical, with the exception of sub-tropical areas in northern Mexico. The South-East Pacific Region (Panama south to Peru) extends from the tropical ecosystems of Colombia and Panama south to the polar areas of southernmost Chile. It is dominated by the Humboldt Current, which is very productive, cold, and rich in nutrients with many upwellings and gyres. This results in some of the most productive fisheries in the world off Peru and Chile. The region is also characterised by periodic El Niños and La Niñas. Two LMEs, the Humboldt Current LME and the Pacific Central-American Coastal LME, dominate these two regions, but the North-east Pacific Region also overlaps with two other LMEs: the California Current and the Gulf of California. The CMAR initiative straddles the two regions (see section 3.2.1).

The Convention for Cooperation in the Protection and Sustainable Development of the Marine and Coastal Environment of the North-East Pacific (Antigua Convention) and the Action Plan were adopted in 2002. There is no MPA protocol. The Central America Marine Transport Commission (Comisíon Centramerica de Transporte Marítimo or COCATRAM) serves as Secretariat. WWF, NOAA, and local partners have been campaigning to raise awareness about the benefits of fully protected MPAs to fisheries, and to gain support for establishment of a regional MPA network, a proposal for which was presented by COCATRAM to the Third Intergovernmental Meeting of the North-East Pacific region in November 2005.

The Convention for the Protection of the Marine Environment and Coastal Areas of the South-East Pacific (Lima Convention), with the South East Pacific Action Plan, was adopted in 1981. A Protocol for the Conservation and Management of Protected Marine and Coastal Areas was adopted in 1989. The Action Plan is implemented through an inter-agency body known as the Permanent Commission on the Exploitation and Conservation of the Marine Resources of the South Pacific (Comisíon Permanente de Pacifico Sur or CPPS)[28] and involves numerous partner organisations. A proposed network (Regional Network of Protected Coastal and Marine Areas in the South-East Pacific) for implementing the Protocol, with guidelines and principles, was approved at the Fifth Inter-governmental Meeting of the Plan of Action in 1992, and amended in 2004. This is a social network, comprising the participating countries and relevant agencies and individuals, with the objective of promoting the exchange of experiences and information. The aim is to strengthen the management of existing MCPAs, and significantly increase their coverage by 2012 by establishing an ecological network that will include both MPAs and protected areas that lie on the coast, but do not have marine habitat.

At the Fourth Meeting of the *ad hoc* Group of Experts on Marine and Coastal Protected Areas of the South East Pacific Region, in August 2004 in Guayaquil, Ecuador, it was concluded that, although there has been an increase in numbers of MPAs since 1999, the representation of marine and coastal ecosystems at national and regional levels and connectivity between protected areas is still limited. The following needs were identified:

- Development of supportive national and regional policies relating to MCPA systems and MCPA establishment that promote baseline studies;
- Removal of overlapping responsibilities between

[28] http://www.cpps-int.org/init.htm

national institutions in charge of the administration, management and control of MCPAs;

- Increased funding for relevant scientific research, environmental awareness and community participation programmes;
- Development of clear definitions and a standardised nomenclature for concepts such as MCPAs, MPAs and networks. Both the North-East and South-East Pacific Regions are using the CBD approach and terminology and are developing networks of '*MCPAs*', and thus include both MPAs with sub-tidal and inter-tidal components and coastal protected areas without sub-tidal or inter-tidal habitat;
- Development of strategies for international cooperation;
- Promotion of the establishment of marine biological corridors to connect MCPAs and act as buffer zones;
- Establishment of a regional database with information on experts and protected areas in a standardised form.

At the Fifth Meeting of the Group (February 2008, Guayaquil, Ecuador), a permanent working group was established and a work plan was prepared.

3.2.1. TROPICAL EASTERN PACIFIC MARINE CORRIDOR NETWORK (CMAR - OR CORREDOR MARINO)

The CMAR covers a total area of 2,110,000 km², including portions of the EEZs of Colombia, Costa Rica, Panama and Ecuador (thus lying in both the North-East and the South-East RSPs), as well as an area of high seas between them, and is known as the 'Eastern Tropical Pacific Seascape (ETPS)' by CI. In April 2004, the four countries signed the San José Declaration agreeing to establish a network that comprises five existing MPAs, each with an associated terrestrial national park. Four are WHSs: Galapagos Marine Reserve (Ecuador), Coiba (Panama), Cocos Island (Costa Rica) and Malpelo (Colombia); and the fifth site is Gorgona, also in Colombia. A sixth site, an adjacent coastal area, Baulas de Guanacaste National Park, in Costa Rica has more recently been added.The CMAR is being modelled on CaMPAM (see above). There is a rotating secretariat (the Technical Secretariat Pro-Tempore), currently based in Costa Rica, to oversee the initiative and to co-ordinate the individual country work plans. A draft Action Plan has been prepared. The CMAR Secretariat also produces annual workplans that are reviewed by a technical committee and approved by an Interministerial Commission with representation of each CMAR country.

An important initial focus is on improving management of the existing MPAs as a network. Several NGOs, led by CI in partnership with the UN Foundation and the UNESCO World Heritage Centre, are helping to improve management at each site, by supporting training of personnel and encouraging networking between the sites. There is thus a range of work at national and regional levels to support the development of integrated marine strategies, strengthen marine management institutions, generate research to support management, develop sustainable financing mechanisms and work with the private sector to reduce impacts and reward responsible resource stewardship. Four large projects managed by CI have been prepared through the involvement and consultations of all relevant sectors. An important result over the past years that provides part of the ecological underpinning to the CMAR is the demonstration of shark migratory routes linking the WHSs through research supported by CI.

There is also a proposal to establish a 'whale corridor' to protect whales during their migration along the South-East Pacific coast (Hoyt, 2005; Cheung *et al.*, 2005) which would increase connectivity. The highest diversity of marine mammals occurs in the South-East Pacific and cetacean protection has therefore been a very important focus for the region. In 2005, Panama declared the waters within its jurisdiction as a marine corridor to protect marine mammals.

3.2.2. CHILE

Chile, through its 2003 National Biodiversity Strategy, has set a target to protect at least 10 % of 'relevant' national ecosystems by 2010 and to develop a 'national marine network' of conservation and management sites by 2015. A potential network of priority coastal and marine sites along the 4,500 km coastline was identified through a series of workshops in each of the 13 administrative regions, with the support of TNC, and 55 marine priority sites were identified in addition to the existing protected areas. The Comisión Nacional del Medio Ambiente (CONAMA), the lead agency, is working with TNC to evaluate the contribution of each site to the 10% goal and to identify the gaps (Fernandez and Castilla, 2005; Chatwin, 2007). The network will comprise multiple use MCPAs, incorporating existing and new protected areas under a range of designations, and its implementation is being supported by the GEF MARINO project (Conservation of Globally Significant Biodiversity on the Coast of Chile).

There are currently 11 coastal natural sanctuaries and 11 no-take MPAs. There is also a system of Management and Exploitation Areas for Benthic Resources (MEABRs), within which registered artisanal fishing groups have exclusive diving rights to the seabed (shellfish collection is a central component of the Chilean artisanal fishery). As of May 2005, 547 MEABRs had been decreed although these may only be implemented if they have an approved benthic resource management plan. Three recently gazetted government administered multiple-use MCPAs attempt to integrate these various management tools, and allow for inclusion of marine reserves (sustainable fisheries allowed), NTAs (marine parks and concessions), ecotourism areas and MEABRs (Fernandez and Castilla, 2005; World Bank, 2006). At the regional level, Chile participates in the bi-national Humboldt project and also the regional network proposed by the CPPS (Anon, 2008).

3.2.3. ECUADOR

Only eight protected areas in Ecuador include coastal or marine habitat (two offshore areas, and six covering mangroves and associated estuarine habitats). Since 2000, mangrove areas can be given to community groups as ten year concessions under which the communities must protect and maintain the forest in return for the use of other resources such as shellfish, fish and tourism, according to an agreed management plan (Ministerio del Ambiente, 2000). 29 such agreements have been drawn up and have been assessed (Anon, 2008; Coello *et al.*, 2007; Coello *et al.*, in press).

A sub-system of MPAs is now being constructed through an incremental strategy (Villegas *et al.*, 2005), as part of the SNAP. For the mainland coast, a first step was a marine ecological gap assessment undertaken as part of a more general protected areas gap assessment, as a joint initiative of several organisations, with the assistance of TNC and CI, and led by the Instituto de Investigaciones Marinas Nazca (Benitez, 2007; Chatwin, 2007; Corrigan *et al.*, 2007). Information came from the Equatorial Pacific Ecoregional Assessment led by TNC, which covered 80% of the coast of Ecuador, so only 20% remained to be assessed, which was undertaken through three expert workshops. The conservation targets identified were 12 inter-tidal systems, 27 sub-tidal systems, and 59 target species in eight taxonomic groups, and a minimum conservation goal of 20% was set for each. The decision support tool SITES was used to identify marine sites. Only 13% of the eight highest priority sites are currently protected and only 8% of the conservation targets, although mangroves exceed the protection goals. Five priority sites were identified, and should be incorporated into the SNAP as the MPA sub-system. Several coastal protected areas were created in 2008 including El Morro Wildlife Refuge, the Pacoche Wildlife Refuge, and the Santa Elena Peninsula Wildlife Refuge. A social MPA network, the Grupo Nacional de Trabajo sobre Biodiversidad Marina (Marine Biodiversity Working Group), has also been established to facilitate exchange of experiences and advise the Ministry of Environment.

This analysis did not include the Galápagos. The Galápagos Marine Reserve (GMR), initially gazetted in 1996 and expanded in 1998 to include waters out to 74 km (40 nautical miles (n. mi)) offshore, is one of the largest MPAs in world covering some 135,000 km^2. It is one of the most comprehensively studied MPAs, with detailed physical and ecological information available that would allow for effective planning. However, it has a complex social, political and economic context that has made implementation difficult, demonstrating the importance of taking socio-political factors into account when developing an MPA system. The GMR is managed by a Participatory Management Board. Through the 1999 Management Plan, a zonation plan, out to two n. mi. (3.7 km) from shore, has been put in place under which a total of 17% is no-take (6% is no-take and no-entry; and 11% is no-take but tourism is permitted), 77% is fishing using artisanal methods, and 5% has yet to be allocated and will be for multiple use. (Edgar *et al.*, 2008a). The location of the zones was decided on the basis of representation, so that examples of all major habitat types in recognisable biogeographic zones are protected. All offshore areas are open to artisanal fishing by the local fleet of about 400 small boats and all industrial fishing is prohibited.

The zonation plan is considered preliminary and is to be revised and made permanent once sufficient data on biodiversity and natural resources are available. At least two schemes have been proposed for revising the zoning scheme. CI has undertaken a study to identify Key Biodiversity Areas (KBAs), by applying the KBA criteria (vulnerability and irreplaceability) to 41 threatened and/or endemic species found in the GMR. All available data on the selected species was collated and some additional field work undertaken (Edgar *et al.*, 2008a). 38 KBAs were identified, of which 27 have some form of statutory protection (i.e. lie in a no-take zone). Seven KBAs are in zones where fishing is still permitted, and it is estimated that if the current scheme was amended to provide total protection for these, the total area available for fishing would be reduced by only 1.9%, but the length of coastline protected would be increased by 26 km. Four KBAs are in locations as yet unallocated to zones and could be designated as no-take tourism zones. Additional

refinements of the boundaries of the existing zones are also proposed under this scheme.

An ecosystem-based management framework by Dight (2005) proposes three partially overlapping management regions, each with unique biophysical characteristics and management implications, and reflected in the MEOW classification (Spalding *et al.* 2006):

- Western Management Region (western side of Isabela Island and Fernandina Island): Characterised by relatively cold water and high primary productivity. The many endemic species found here indicate limited dispersal capabilities and the area may be largely self-seeding, and thus very important for recruitment. This region may thus require a high level of protection, with good replication of NTAs that will provide refuges during periods of extreme disturbance such as El Niño events.
- Northern Management Region (Darwin, Wolf, Pinta, Marchena and Genovesa Islands): Characterised by warmer water and lower primary productivity, the Panama Current being the dominant influence. There is high species diversity, with many species that have a wide distribution and are probably recruited outside the area and/or disperse widely. The protection of this region will thus depend on effective management at the regional ecosystem scale, particularly the CMAR initiative, as well as reduction of direct impacts such as anchoring in sensitive coral sites and overfishing.
- Central Management Region: Characterised by more variable spatial and temporal oceanic conditions in terms of temperature and primary productivity, as it is influenced by three currents: the Panama and Peru currents, and the Equatorial Undercurrent. The fauna and flora are similar to the Western Management Region but are less abundant, and in some cases occur as isolated local populations. Management of this area will require fully protected zones at the appropriate scale for the species involved and further work to identify critical source populations and other key habitats.

3.2.4. PERU

The National Institute for Natural Resources (INRENA), a decentralised arm of the Ministry of Agriculture, is responsible for the establishment and management of protected areas in Peru and administers the National System for Protected Areas (SINANPE). At present, only four of the 60 protected areas in the system are marine and coastal (covering 1.86% of the area), with the Paracas National Reserve as the flagship MPA. TNC and INRENA, with USAID funding, have undertaken a marine ecoregional assessment (Chatwin, 2007) and Peru has now committed to establishing a representative system of MPAs by 2015. A first step is likely to be the establishment of a system of reserves for the guano islands and peninsulas that host spectacular aggregations of seabirds; this would increase protection of the coast to 2.91% (Anon, 2008; Birdlife International, 2008).

3.2.5. PANAMA

The National System for Protected Areas (SINAP) of Panama comprises 65 protected areas, of which 29 are MCPAs with eight on the Caribbean Sea and 21 on the Pacific coast. In 2006, the Authority for Aquatic Resources in Panama (ARAP) was created to combine the management of marine and coastal resources with the fisheries and fish-farming sectors. ARAP has established two forms of MPAs: Reserve Zones, aimed at the conservation of areas necessary for reproduction, recruitment and repopulation by various species, and Special Marine and Coastal Management Zones, which are areas with fragile marine and coastal ecosystems, such as coral reefs, wetlands, and nesting and nursery sites, that require integrated coastal management' (Anon, 2008).

3.3. BRAZIL

Brazil is not part of the UNEP-RSPs, but is included in the WCPA-Marine South Atlantic region. It has been making important advances in developing a national MPA network. A federal law in 2000 established the Sistema Nacional de Unidades de Conservação da Naureza (SNUC), or National System of Conservation Unit. There are two types of Conservation Unit (World Bank, 2006):

1. Absolutely Protected Areas or Indirect-Use Conservation Units: these include ecological stations, biological reserves, parks, natural monuments, and wildlife refuges. The offshore marine parks such as Atol das Rocas, Parque Nacional dos Abrolhos and its buffer zone, and Fernando de Noronha fall into this type.
2. Sustainable Use Areas or Direct-Use Conservation Units: these include environmental protection areas, areas of significant ecological interest, national forests, extractive reserves, fauna reserves, sustainable development reserves, and private reserves of natural heritage. This type of protected area includes the Marine Reserves for Sustainable Development MRSD) and the Marine Extractive Reserves (MERs) which are community-based

artisanal fishery management areas often with zoning including no-take areas. There are 28 MERs, such as Canavieiras MER and Cassuruba MER, with a further 68 proposed.

A National Plan of Protected Areas, including the coast and marine waters, was legally adopted in 2006. It defines principles, objectives and strategies for establishing a representative and effectively managed system of terrestrial protected areas by 2010 and MPAs by 2012 (Chatwin, 2007). The Plan mandates that MPAs must be created and managed for both the conservation of biodiversity and the recovery of fishery resources.

A total of 145 coastal (covering 148,412 km²) and 22 marine (196,332 km²) candidate sites were identified through an initiative of TNC, Brazil's Ministry of Environment and the national Environmental and Natural Resources Institute (IBAMA) which included a series of workshops involving over 300 national coastal and marine experts. The TNC/WWF ecoregional assessment methodology (described in Chatwin, 2007) was applied, using C-Plan to produce the maps. 239 conservation targets were identified including 85 coastal ecosystems, 55 marine ecosystems, and 99 coastal/marine species and taxa; for each of these goals for the amount to be protected were set (ranging from 30-100%). Over 80% of the country's mapped shallow reefs are already in MPAs. The final system will consist of the existing MPAs mentioned above (both direct and indirect-use conservation units) and the candidate sites which will be given appropriate designations.

3.4. NORTH AMERICA

NAMPAN[29], a social network involving the USA, Canada and Mexico, came into being as a result of a tri-national, multi-disciplinary workshop in November 1999 with support from the Conservation of Biodiversity Program of the Commission for Environmental Co-operation (CEC) of North America. The goal of NAMPAN is to establish an effective system of North American MPA networks. Specifically, it will:

- Enhance collaboration among the three countries to address common challenges and jointly prioritize conservation actions;
- Develop effective approaches and cross-cutting initiatives to help conserve critical marine and coastal habitats and North American biodiversity, and recognise ecological, economic, social, and cultural issues;
- Build regional, national, and international capacity to manage, conserve, and monitor the status of critical marine and coastal habitats by sharing effective conservation approaches, lessons learned, new technologies and management strategies, as well as by increasing access to and synthesis of relevant information;
- Facilitate the strategic design and establishment of a global system of MPAs throughout North America and the world.

The NAMPAN partnership has produced several tri-national technical products and conducted technical workshops and symposia, including *Institutional Options for Integrated Management of a North American Marine Protected Areas Network* (2002), *North American MPA Practitioners Exchange* (2002), *North American Action Plan Framework* (2004), and *Marine Ecological Regions of North America* (2007) and a range of activities relating to marine species conservation. A map of marine and terrestrial protected areas of North America is to be produced in cooperation with the CEC's Ecological Information Program. NAMPAN works particularly closely with the Baja California to Bering Sea (B2B) initiative (see below). The tri-national partnership is currently determining future actions including how to expand efforts in the Atlantic, Gulf of Mexico, Caribbean, and Arctic regions. Although NAMPAN does not necessarily have an impact on national MPA network activities, it is useful in providing the overall context for national efforts and ensures that transboundary issues are considered.

Sub-regional networks are being set up on both the Pacific and Atlantic coasts of North America, and each of the three countries is developing a national MPA network, as described below.

3.4.1. BAJA CALIFORNIA TO THE BERING SEA (B2B)

On the Pacific coast, CEC, with the Marine Conservation Biology Institute (MCBI), has developed a 3-level hierarchical classification for the area extending south from the Bering Sea to Baja California (Morgan *et al.*, 2005; Wilkinson *et al.*, in prep). This defined a series of Marine Ecological Regions that can be used for developing representative MPA systems and identified 28 key sites for protection. A number of other products have been produced through the initiative including: *An Inventory of MPA Inclusive Monitoring Programs for the Baja to Bering* (2006) and an *Ecological Scorecard Framework for MPAs in the B2B Region* (2007).

[29] http://www.nampan.org/default.cfm?page=2678

3.4.2. SCOTIAN SHELF/GULF OF MAINE

On the east coast of North America, a systematic planning exercise has been undertaken for the area of 277,388 km² covering New England (USA) and Maritime Canada, encompassing the Gulf of Maine, Georges Bank and the Scotian Shelf. This has indentified a range of network options designed to represent all habitat types, and including both biologically distinctive areas and biogeographic representation (CLF-USA/WWF Canada, 2007). Marxan was used, and resulted in the selection of 30 priority areas for conservation, comprising seven areas that include portions of the Georges Bank, 11 areas in the Gulf of Maine and 16 areas on the Scotian Shelf. Such a network would cover 62,449 km² or 22% of the entire area. Several sites coincide with previously recognised areas of ecological importance, such as cod spawning sites on Stellwagen Bank and areas for whales on the Scotian Shelf, and existing management areas (such as the Stellwagen National Marine Sanctuary, The Gully, the Lophelia Coral Conservation Area, the Haddock Box and several whale conservation areas and fishery closed areas). The network would encompass the full range of seafloor types, depths, water conditions and biological attributes. Information about connectivity was not specifically included but it is thought that the known ocean currents will contribute to this, but further information is needed on dispersal patterns before this can be addressed fully. Full details of the method used are given in CLF-USA/WWF Canada (2007). It is hoped that the information from this analysis will be used in further development of the MPA systems for Canada and USA.

3.4.3. MEXICO - NATIONAL MPA SYSTEM AND SUB-NATIONAL GULF OF CALIFORNIA MPA SYSTEM

MPAs in Mexico are the result of several independent initiatives, involving various federal and state agencies with jurisdiction over different sectors including fisheries, wildlife, forestry and the environment. There are 61 marine and coastal protected areas gazetted at federal level, of which 30 contain marine ecosystems, and eight MPAs gazetted at state level. The total marine area protected is 43,461 km² (45,040 km² federal, and 2,379 km² state). Federal protection represents the equivalent of 22.68% of Mexico's territorial waters, 12.02% of its continental shelf and 1.51% of its EEZ.

The current sites are considered to provide the key strategic elements that will lead eventually to a full national comprehensive and representative system. Steps are being taken to implement this through two subnational programmes, one for the Caribbean coast and one for the Gulf of California and Pacific coast, both of which have produced conservation plans based on expert workshops (Bezaury-Creel, 2005). A national MPA gap analysis was undertaken through a partnership of government institutions (National Commission for Protected Areas or CONANP and National Commission for the Knowledge and Use of Biodiversity or CONABIO), an international NGO (TNC) and a national NGO (PRONATURA) as a component of the CBD´s Global Programme of Work on Protected Areas (CONABIO *et al.*, 2007).

The Mexican Caribbean MPA network is part of the Mesoamerican Caribbean Coral Reef Initiative and includes all previously established protected areas on the Mexican portion of the coast, as well as three new ones. The total new area to be incorporated is 568 km² (Bezaury-Creel, 2005).

The CEC/MCBI approach (section 3.4.1.) is being used for the Pacific coast, where there are currently 16 MPAs covering a total area of 28,807 km² or 1.2% of the Pacific coast EEZ (Bezaury-Creel in litt., Sept 2006). The Gulf of California is a particularly high priority on account of its endemism (with approximately 770 species) and high species diversity (Roberts *et al.*, 2002). In 2001 a workshop was organised by the Gulf of California Sustainability Coalition to identify key priority sites using a set of databases on species distribution, physical oceanography, social and economic data, and mapping the information on a GIS in relation to fisheries, shrimp trawling and other factors (Carvajal *et al.*, 2005; Enriquez-Andrade *et al.*, 2005). Over 180 national and international experts contributed information and knowledge to identify and define key sites. The results of a project to determine a system of sites for reef fish habitat protection were also included (Sala *et al.*, 2002). The outcome was a list of 'especially important areas for coastal and marine biodiversity'.

There are already nine protected areas in the Gulf of California containing marine habitat covering 14,925 km², or 4% of the Gulf's surface area. Four MPAs have no take zones covering a total of 979 km², or 0.26% of the Gulf's surface area, and there are also some community-based no-take areas. The current MPAs occur in five of the nine level CEC III ecological regions, and so are not fully representative. Existing and new MPAs, plus the 'especially important areas' if placed under special management regimes, would cover 15% of the Gulf's surface area and would be representative of all habitats including coastal wetlands, mangroves, islands, coral and rocky reefs, seagrass beds and hydrothermal vents (Carvajal *et al.*, 2005). The Communidad y Biodiversidad (COBI) and TNC have used Marxan to optimize site selection

(Ulloa *et al.*, 2006), and in addition to the habitats addressed previously included benthic complexity, important ecological processes such as upwelling and primary productivity and pelagic species. This resulted in a network of 54 sites that represent 24% of the area.

3.4.4 USA - NATIONAL MPA SYSTEM

Presidential Executive Order 13158 of 2000 provided authority for the development of a National System of MPAs within the EEZ of the three oceans that border the USA (Pacific, Atlantic, Arctic) and the Great Lakes. The National Marine Protected Areas Center (MPA Center) is responsible for its implementation. The USA currently has some 2000 MPAs according to the IUCN definition, but these are not representative, do not form a ecologically representative network and only a small proportion (less than 1%) of the total area is no-take (such as in Buck Island Reef and Virgin Islands Coral Reef National Monuments, Channel Island National Park, and Dry Tortugas National Park).

MPAs are designated through several mechanisms (Uravitch, 2005). Designations at Federal level include:

- National Estuarine Research Reserves.
- National Marine Sanctuaries (NMS): Multiple use MPAs established under the 1972 National Marine Sanctuaries Act to protect areas of special national significance, and administered by the Sanctuary and Reserves Division of NOAA. 13 NMSs have been designated as well as the Northwest Hawaiian Islands Coral Reef Ecosystem Reserve, the second largest MPA in the world.
- National Park System: Currently includes about 70 sites with marine/coastal habitat with many designations including National Monument, National Seashore, National Recreational Area, National Historical Park, and Preserves.
- National Wildlife Refuges.
- Sites under the National Marine Fisheries Service.

A similar complexity is found at state, territorial, commonwealth and tribal levels, all of which have some authority to establish MPAs.

In 2004, the MPA Center started a participatory process to obtain input from the many stakeholders on the development of the national system, and a 30 member MPA Federal Advisory Committee (FAC) was established, representing industrial sectors, non-federal governments, environmental organisations and academia. The recommendations of the Committee are available in MPA FAC (2005 and 2008). Consensus was reached in June 2005 on the goal and objectives of the national MPA system. As a result of public comment on the 2006 *Draft Framework for the Development of a National System of MPAs*, the initial goals and objectives were expanded significantly and priorities established in April 2007 (MPA FAC, 2008) (Table 3.5, following page).

A process for establishing the system, with eligibility criteria for designating sites (including both areas that allow fishing and those closed to all uses), has been agreed. Existing or new MPAs will not be recognised as part of the national system if they do not meet these criteria[30]. The MPA Center has identified some 1500 sites, managed by over 100 agencies, that would likely qualify for inclusion in the national system. Most of these were established after 1970, allow multiple uses, and are managed by state agencies. A Revised Draft Framework for the National System of Marine Protected Areas was published for public comment in spring 2008. The final Framework will put in place the administrative structure to establish the U.S. national system. Existing MPAs from all levels of government, federal, state, territorial, and tribal, will be nominated throughout the rest of 2008 and 2009 based on the identification of which sites address at least one of conservation goals and priority objectives of the national system. There has been no national gap analysis and instead this is being done at sub-region or state level, as described in the examples below of California and Florida.

California

The California state legislature passed the Marine Life Protection Act (MLPA) in 1999 aimed at redesigning and strengthening the state's MPA system, but little progress was made at first. In 2004, the process was revived with funding from private foundations and the appointment of a special task force to spearhead the planning[31]. The aim now is to implement a state network of MPAs along the mainland coast by 2011. A *California MLPA Master Plan for Marine Protected Areas*[32] was approved in 2008 and guides the adoption and implementation of the MLPA. A regional approach is being taken and the coast has been divided into five regions. For each region, a Blue Ribbon Task Force (BRTF) composed of respected public policy leaders is established to oversee the public involvement process and recommend alternative MPA proposals to the Commission, and a regional stakeholder group provides detailed input and develops draft proposals.

[30] www.MPA.gov
[31] www.dfg.ca.gov/mlpa
[32] http://www.dfg.ca.gov/mlpa/masterplan.asp

Table 3.5. Goals and Objectives of US national MPA system

Goal 1: Advance comprehensive conservation of the nation's biological communities, habitats, ecosystems, and processes, and the ecological services, uses, and values they provide to this and future generations through ecosystem-based MPA approaches

Priority Conservation Objectives: To conserve:

Near term	Key reproduction areas and nursery grounds Key biogenic habitats Areas of high species and/or habitat diversity Ecologically important geological features and enduring/recurring oceanographic features critical habitat of threatened and endangered species
Mid-term	Unique or rare species, habitats and associated communities Key areas for migratory species
Long-term	Linked areas important to life histories Key areas that provide compatible opportunities for education and research

Goal 2: Advance comprehensive conservation of cultural resources that reflect the nation's maritime history and traditional cultural connections to the sea, as well as the uses and values they provide to this and future generations through ecosystem-based MPA approaches.

Priority Conservation Objectives: To conserve

Near term	Key cultural and historic resources listed on the National Register of Historic Places (NRHP) Key cultural historic resources determined eligible for the NRHP or listed on a State Register Key cultural sites that are paramount to a culture's identity and/or survival
Mid-term	Key cultural and historic sites that may be threatened Key cultural and historic sites that can be utilised for heritage tourism
Long term	Key cultural and historic sites that are under-represented

Goal 3: Advance comprehensive conservation of the nation's renewable living resources and their habitats, including, but not limited to, spawning, mating, and nursery grounds, and areas established to minimise incidental by-catch of species, that are important to the nation's social, economic, and cultural well-being through ecosystem-based MPA approaches

Priority Conservation Objectives: To conserve

Near-term	Key reproduction areas, including larval sources and nursery grounds Key areas that sustain or restore high priority fishing grounds
Mid term	Key areas for maintaining natural age/sex structure of important harvestable species Key foraging grounds Key areas that mitigate the impacts of bycatch
Long term	Key areas that provide compatible opportunities for education and research

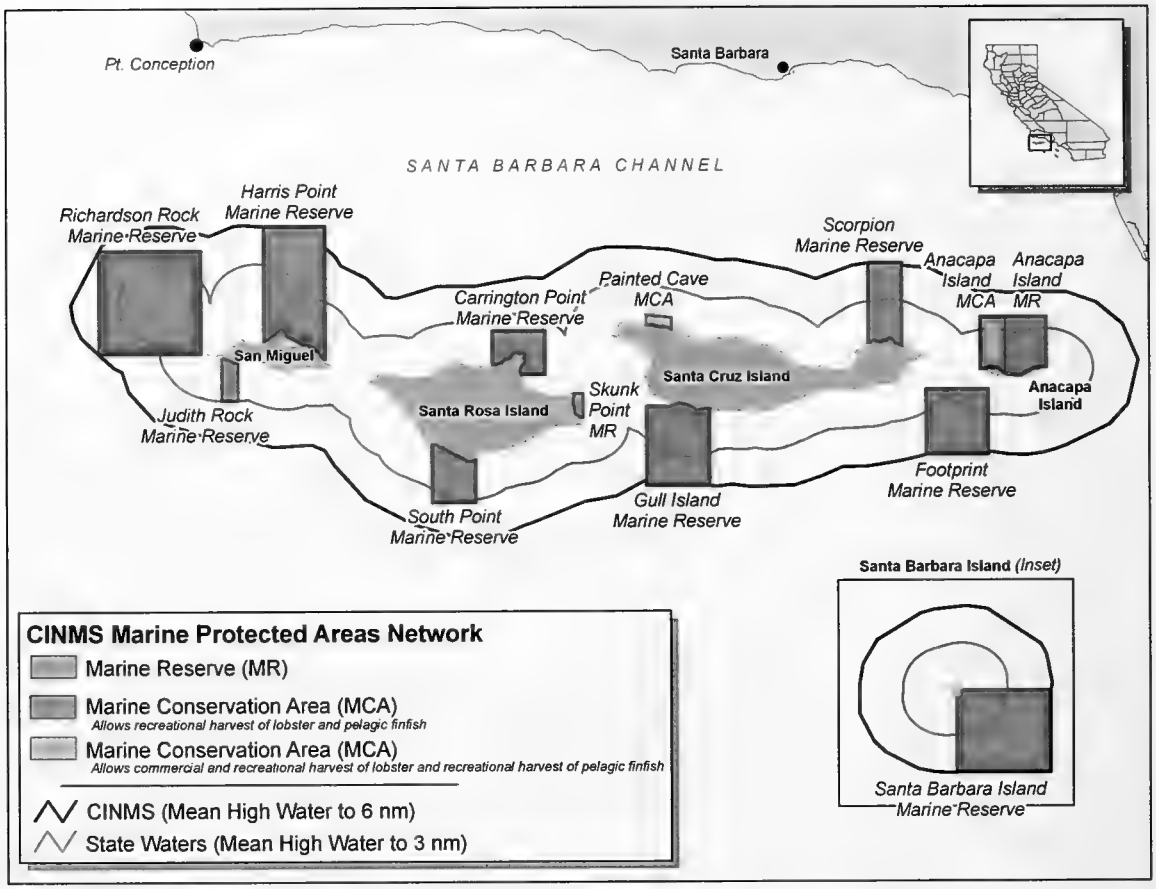


Figure 7: Channel Islands National Marine Sanctuary (CINMS) MPA Network. Source: NOAA
The CINMS MPA Network incorporates closed areas (red) and includes representative samples of all marine habitats.

The state's central coast was used as the pilot, and a network of 29 MPAs was finalised in 2007 covering about 528 km² or about 18% of state waters between Pigeon Point and Point Conception. Each MPA extends seaward for three n mi (5.6 km), the outer boundary of state waters. 13 MPAs are no-take State Marine Reserves (SMRs) covering about 220 km² or 7.5% of the total area. Other designations are State Marine Parks and State Marine Conservation Areas that allow limited recreational or commercial fishing (MLPA Initiative, 2007).

The second study region covers the north central coast (Alder Creek in Mendocino County to Pigeon Point in San Mateo County) and this network should be adopted by the end of 2008. A specific timetable for the remaining study regions has yet to be established. For 2008-2010 the MLPA Inititiative will focus on developing alternative MPA proposals in the south coast study region from Point Conception southward to the U.S./Mexico border. Final recommendations will be made to the Commission near the end of 2009, after which the north coast process will begin (Alder Creek north to the California border with Oregon), followed by the San Francisco Bay process (from the Golden Gate Bridge northeast to the Carquinez Bridge).

California also has two NMSs managed at the federal level: Monterrey Bay NMS and the Channel Islands NMS (Figure 7). The latter is a multiple-use MPA of over 4000 km² in which there is now a system of no-take MPAs, established through a well-documented participatory process (Airame *et al.*, 2003). In 1999, the Sanctuary Marine Advisory Council and the California Department of Fish and Game developed a joint federal and state process to consider marine reserves in the Channel Islands based on the agencies' overlapping and complementary jurisdictions: the State has jurisdiction up to three n.mi. from shore, and the federal government has jurisdiction over waters from three to six n.mi.from shore. The process took some four years, and involved the establishment of a Marine Reserves Working Group comprising representatives of all the main stakeholders, and two advisory panels, one on

science and one on socio-economics. Advanced computer-based modelling was used to help identify where to site the MPAs and to determine optimum sizes (Leslie *et al.*, 2003; Possingham *et al.*, 2000). The resulting system comprises a network of closed areas, covering 10% of the total area and including representative samples of all marine habitats. The closed areas in state waters, as well as two marine conservation areas that allow for limited harvest, were implemented in 2003 (Hastings *et al.*, 2005). In 2006, the US NMS Program released the plan for the remainder of the system, in federal waters, and following a 60-day public comment period, the regulations were passed in 2007. This means that a total of 19% of the sanctuary, or 802 km², is no-take; there is also be a marine conservation area allowing limited take. This demonstrates the length of time overall that may be required to develop a system. There is still some disagreement between the ecologists and fisheries scientists over the progress, since larval transport between the reserves is not yet fully understood, and the optimum size of a reserve is still not known[33] (Mize, 2006; MPA News 9(1) July 2007).

Florida

In Florida, the entire Keys area is gazetted as the multiple use Florida Keys NMS within which there is a network of 24 NTAs, covering 6% of the total area, in the form of ecological reserves, sanctuary preservation areas and special use areas, and including the Tortugas Ecological Reserve of 151 n. mi² (279.7 km²). Resilience is being addressed through the TNC supported Florida Reef Resilience Program (FRRP). Rather than taking a scientific, quantitative approach, the initial step to identification of resilient reefs was interviews with experts (including academics, dive operators, and others with long-term knowledge of the area) backed by existing information from broad-scale surveys. The experts were asked to identify reefs or hard bottom areas that they believed had maintained their functional integrity given the various disturbances that have impacted the reefs of the Florida Keys in recent decades. This process identified 43 reefs in the NMS that are considered to be particularly resilient.

3.4.5. CANADA - NATIONAL MPA NETWORK

Canada has the world's longest coastline (over 243,000 km²), the second largest EEZ and its waters support an immense diversity and abundance of marine life. Three oceans border the country: the Arctic, Atlantic and Pacific. Three federal MPA programmes administered by different agencies, with separate legislation, give rise to three types of MPA as follows:

- National Marine Conservation Areas (NMCAs): Established under the *Canada National Marine Conservation Areas Act* (2002) to protect representative examples of Canada's natural and cultural marine heritage and provide opportunities for public education and enjoyment. NMCAs are the responsibility of Parks Canada and are managed for ecologically sustainable use and include zones of high protection as well as zones where sustainable uses are permitted, but mining, oil and gas exploration and development, and ocean dumping are prohibited. NMCAs can be designated anywhere within Canada's internal waters, territorial sea, or EEZ. An NMCA Policy was released in 1994, followed by an NMCA System Plan *(Sea to Sea to Sea)* in 1995. No NMCAs have yet been established under the enabling legislation but Parks Canada operates two sites: Saguenay-St. Lawrence Marine Park (established under separate legislation in 1998) and Fathom Five National Marine Park in the Great Lakes. There are four proposals for NMCAs: Gwaii Haanas and Southern Strait of Georgia on the Pacific Coast, Lake Superior in the Great Lakes and Îles de la Madeleine in the Gulf of St. Lawrence.
- Marine Wildlife Areas (MWAs): Established by regulation under the *Canada Wildlife Act* (1994) to protect nationally significant habitats for a range of wildlife with a special emphasis on migratory birds and species at risk, and managed by Environment Canada. MWAs may be established in the EEZ, whereas National Wildlife Areas include only territorial waters (see below). No MWAs have yet been established but several candidate sites are under consideration.
- MPAs: Established by regulation under the *Oceans Act* (1997) by Fisheries and Oceans Canada to protect important fish and marine mammal habitats, endangered marine species, unique features and areas of high biological productivity or biodiversity. MPAs may be designated out to the 200 n. mi limit (370 km). There are six MPAs: Endeavour Hydrothermal Vents in the Pacific, The Gully, Gilbert Bay, Eastport Peninsula, Basin Head in the Atlantic, and Musquash Estuary. Several other sites are being considered for designation including inshore and estuarine areas that are important fishery nursery areas.

Other federally designated sites with a marine component (and thus qualifying as MPAs under the IUCN definition) are Migratory Bird Sanctuaries (51 of 92 sites) and National Wildlife Areas (13 of 51 sites) managed by Environment Canada, and

[33] www.channelislands.noaa.gov/marineres/main.html

National Parks (11 of 42 sites) managed by Parks Canada. In addition, several provinces and territories have established MPAs or protected areas with marine components and are considering a network approach (Ardron *et al.*, 2002). The various designations differ in size, scope, design and governance structure, ranging from NMCAs that have minimum protection standards and are established in perpetuity, to more voluntary community-based initiatives. It is also recognised that for some areas, management measures other than MPA designations may be more appropriate, such as seasonal or permanent fisheries closure areas (Day and Roff, 2000; Hanson *et al.*, 2000).

In 2005, as part of the Oceans Action Plan, the three federal programmes released the *Federal Marine Protected Areas Strategy* (Government of Canada, 2005) which helps set the foundation for developing the federal network. The Strategy describes how the network will be developed and proposes, as a first step, a mechanism by which the three federal agencies (Parks Canada, Environment Canada and Fisheries and Oceans Canada) can work together. The second step would involve the important contributions to be brought by the provinces and territories and others in establishing a broader, truly national MPA network.

The Federal Strategy uses the IUCN definition for the term MPA, and defines a network as:

> *A set of complementary and ecologically linked MPAs, consisting of a broad spectrum of MPAs, established and managed within a sustainable ocean management planning framework and linked to transboundary, global and terrestrial protected area networks.*

It lays out a goal, four objectives and a set of principles (Box 2). The federal MPA network will be built in two ways. Sites that have been previously identified as candidate MPAs will be designated by the appropriate agencies. At the same time, within the context of integrated oceans management planning, collective efforts will be undertaken to identify additional sites to fill gaps, protect biologically and ecologically significant sites and ensure representation and connectivity.

WWF Canada is playing an active role in the development of the national MPA network, having produced policy recommendations (Smith *et al.*, 2006) and, in January 2008, hosted with Fisheries and Oceans Canada a meeting[34] to identify ecological criteria for the network and to begin elaborating a hierarchical process for site selection. Parks Canada has categorised Canada's oceanic waters into 24 marine regions, with a further five regions in the Great Lakes, for planning of NMCAs. Environment Canada, with Fisheries and Oceans Canada, have identified 17 marine ecoregions to be used for MPA planning. Spatial planning activities are also under way to identify potential sub-national networks of MPAs. Stakeholders in the Eastern Scotian Shelf area are working to develop an action plan for spatial conservation planning in this area of 325,000 km² off Nova Scotia. WWF has assisted with the development of a framework, methodology and map of priority areas, based on mapping of representative habitats and using Marxan.

British Columbia, on the Pacific coast, has the most sites of all the provinces. The British Columbia Marine Conservation Analysis (BCMCA)[35] is developing an *Atlas of Known Ecological Values and Human Uses* and will use this data to undertake a Marxan spatial analysis to identify areas of high conservation value and other potential sites for protection, using marine reserve design principles (e.g. maximising connectivity, minimising edge to area ratio). A provincial system of MPAs is being planned, supported by provincial policies and land use planning processes that will build on the existing 104 sites that qualify as MPAs at provincial level (Dunham *et al.*, 2002). The Project Team was established in 2006 and comprises representatives from the Canadian government, the British Columbia government, First Nations, academia and environmental organisations.

Although all the differently designated sites, with their various levels of protection and enforcement, legitimately contribute to Canada's MPA network, there are varying levels of marine representation in each (from strictly sub-tidal areas to beaches with an inter-tidal component to migratory bird habitats). Currently there is a relatively low number (less than ten sites) of federally established and managed, strictly marine (inter-tidal and sub-tidal only) MPAs, and only 0.56% of the total Canadian ocean area is under federal protection (Gardner *et al.*, 2008). However, Canada is one of the few countries to have protected offshore, deep sea habitats (hydrothermal vents and a deepsea canyon).

There are some concerns about the length of time it is taking for the national MPA system to be established, expressed in a report by the Canadian Parks and Wilderness Society (CPAW)[36] which recommends that a 'network approach' should be taken, rather than the current site-by-site approach (Gardner *et al.*, 2008; Jessen, 2008).

[34] http://www.wwf.ca/MPAworkshop/
[35] www.bcmca.ca
[36] http://cpaws.org/files/report_mythandmadness.PDF

Box 2: Goals, objectives and principles of the national MPA network for Canada

Goal: The establishment of a network of MPAs, established and managed within an integrated ocean management framework, that contributes to the health of Canada's oceans and marine environments.

Objectives:

- Establish a more systematic approach to MPA planning and establishment;
- Enhance collaboration for management and monitoring of MPAs;
- Increase awareness, understanding and participation of Canadians in the MPA network;
- Link Canada's network of MPAs to continental and global networks.

Guiding principles:

- Integrated management;
- Ecosystem approach;
- Precautionary principle;
- Respecting aboriginal peoples;
- Knowledge based;
- Consultation and collaboration;
- Public awareness, education and stewardship;
- Management effectiveness;
- Adaptive management.

4 AFRICA & MIDDLE EAST

The African Protected Areas Initiative (APAI) is mainly oriented towards terrestrial sites but is nonetheless relevant to MPAs. Under the auspices of the New Partnership for African Development (NEPAD), APAI has been established to promote protected area establishment and management in line with obligations under international treaties.

4.1. EASTERN AFRICA REGIONAL SEAS PROGRAMME

The Eastern Africa Region has ten participating states (Somalia, Kenya, Tanzania, Mozambique, South Africa, Madagascar, Mauritius, Seychelles, the Comores, and France (Réunion and Mayotte). The Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (known as the Nairobi Convention) was adopted in 1985. The Protocol concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region was adopted at the same time and, in 2002, a Group of Experts on Marine Protected Areas in Eastern Africa (GEMPA-EA) was set up, hosted by UNEP and the Western Indian Ocean Marine Science Association (WIOMSA), to oversee implementation.

There are a number of sub-regional programmes supporting the development of MPA networks and these and the regional activities undertaken through the Nairobi Convention have contributed to awareness in this region of the 'system' approach to MPA establishment and management. The Eastern African Marine Ecoregion programme is described below. The Western Indian Ocean Marine Ecoregion (WIOMER) covers the Western Indian Ocean (WIO) island states, and the development of an MPA network within this sub-region is being supported through the *Réseau des Aires Protégées des Pays de la COI* project, a collaborative effort of the Indian Ocean Commission (COI), WWF, and CI, with funding from Fonds Français pour l'Environnement Mondial (FFEM) project, to strengthen the network of MPAs[37]. The first steps involve data gathering in order to identify an 'ecological network' and prepare a strategy.

There is also a relevant regional project in the two LMEs that border the mainland coast: the Somali Current LME that extends from the Arabian Gulf southward along the East African coast to an area just north of Tanzania's border with Mozambique; and the Agulhas Current LME that extends from Mozambique down to the tip of South Africa. The Agulhas-Somali Current LME (ASCLME) project, supported by UNDP/GEF, is focusing on assessing ecological and socio-economic characteristics of the region. The EU-funded project "Transboundary Networks of Marine Protected Areas for Integrated Conservation and Sustainable Development: Biophysical, Socio-Economic and Governance Assessment in East Africa" (TRANSMAP) involved research to develop scientific knowledge for the creation of transboundary networks of MPAs between Tanzania and Mozambique and Mozambique and South Africa and has led to discussions between these countries on a transboundary network approach.

National-level processes have been initiated in Seychelles, Tanzania, South Africa, Madagascar and Rodrigues (Mauritius) to establish protected area systems (see below) and initiatives are also under way in the French dependencies of Mayotte and Réunion. Progress has also been particularly rapid in Mozambique, which has some of the largest MPAs in the region. There is a now a need to share experiences and, where appropriate, harmonise methods in order to develop a region-wide biogeographic and habitat classification. A social network of MPA managers is being established by WIOMSA, as part of a new programme to certify MPA practitioners as 'professionals'; the network will act as a mechanism for information exchange and experience sharing.

4.1.1. EAST AFRICAN MARINE ECOREGION (EAME) PROGRAMME

This programme covers the mainland from southern Somalia down to the northern coast of South Africa and WWF has set a target 10% of each country's "sea" to be protected as MPAs (WWF-EAME, 2004a and b). Individual country commitments have been made by South Africa and Tanzania (WWF EAME, 2004b) (see below). These targets are somewhat

[37] http://www.amp-coi.org

ambiguous as there is no clear statement as to what areas of ocean the percentage targets relate to (such as an EEZ or territorial sea).

The relative importance of different locations has been assessed using four key habitats/community groups: coral communities and associated fauna; mangrove communities; seagrass, algae and sponge communities; and wetlands, coastal lakes, inland pools, sandy shores and dunes. A total of 21 marine and coastal areas (or 'seascapes') of conservation importance were identified: Eight are considered to be globally outstanding; seven are ecoregionally important; and six are of sub-regional importance. There is good correspondence between existing MPAs and the seascapes. Only one MPA (Dar es Salaam Marine Reserve System) does not fall in a seascape, and this was established mainly for tourism and recreation, rather than biodiversity protection. This suggests that existing MPAs may form a good starting point for the development of a representative regional MPA system.

In terms of the continental shelf to a depth of 200m, MPA coverage is 8.7% in Kenya, 7.9% in Tanzania and 4.0% in Mozambique. In terms of ecosystem representation, there is a clear bias towards protection of coral reefs, which are found in most MPAs (WWF EAME, 2004b; Wells *et al.*, 2006), although the area of reef protected is still not known. Mangroves are included in Forest Reserves, but are less well represented in formal protected areas. As with coral reefs, data are not readily available to estimate area coverage. For other habitats, data are not available to assess representation. Areas important for seabirds and coastal wetland birds are also well represented, with very close correlation between MPAs and areas designated as Important Bird Areas (IBA).

In relation to 'adequacy', early MPAs were small at less than 10 km², and focused on individual species or habitats, such as turtle nesting beaches and attractive reefs. By the 1990s, larger, zoned, multiple-use MPAs were being seen designated (such as the over 200 km² in Bazaruto in Mozambique and Mafia Island Marine Park in Tanzania). Within the last five years, very large areas have been declared, with the largest sub-tidal areas in the newest MPAs in Mozambique, where Quirimbas and Bazaruto Archipelago National Parks both include over 1,400 km² of sub-tidal water (Francis *et al.*, 2002).

There are insufficient data to incorporate resilience and replication into the system planning. However, there is some information on the location of reef refugia, such as reefs off Stone Town in Zanzibar and in Chole Bay in Mafia Marine Park, Tanzania, which largely escaped bleaching in the 1997-98 El Niño event. A training workshop on resilience and MPAs, with special reference to coral reefs and spawning aggregations, was held for the region by TNC in 2006 and is expected to lead to improved analysis of existing and proposed MPAs in terms of resilience.

Data on some aspects of connectivity are becoming available for the region (WWF EAME, 2004b). For example, it is possible that Mnazi Bay and the Mafia/Songo Songo areas in Tanzania are important source areas for larvae, as these are the points where, depending on the monsoon, the East African Coastal Current divides and flows north. Preliminary data on turtles, cetaceans and fish are available but scattered. Tags have been recovered in several areas of Tanzania from turtles that nested in Kenya, Seychelles, Comoros and South Africa. The French Research Institute for the Exploitation of the Sea (IFREMER) Regional Satellite Tagging Project for green turtles in Réunion has been finding that turtle movements are linked with gyres, and combining this information with genetic analysis, has determined that there are two populations of this species in the region, one in the north and one in the south. Tagged sharks have been known to travel long distances in the WIO, and there is also some data on billfish and tuna migration routes, and migratory patterns of fish are being researched through mark-recapture studies.

4.1.2. TANZANIA - PROPOSED NATIONAL MPA SYSTEM

Tanzania declared its intention to increase protection of its seas to 10% by 2012 and 20% by 2025 at the Fifth World Parks Congress in Durban in 2003. This led to preliminary steps being taken under the World Bank funded Marine and Coastal Environment Management Project (MACEMP) to develop a national MPA system (Ruitenbeek *et al.*, 2005). A very simple process was used to assess priority sites for inclusion. Biodiversity information was available for coral reefs, mangroves, birds (IBAs), dugong, and turtle nesting, as was information on uses of the coastal and marine environment. The Tourism Master Plan for the mainland and the Tourism Zoning Plan for Zanzibar were also taken into account since coastal areas have been identified as priorities for tourism development and the mainland plan emphasises the role that MPAs might play in the expansion of the tourism industry. The location of important hydrocarbon and mineral resources was mapped. Mariculture (including seaweed farming) and salt production which are important sources of revenue for coastal villages were not mapped as data were not available, but these activities would have been included in a more detailed assessment.

The information was collated onto very simple maps, using a GIS, but without sophisticated software programmes, given the lack of precise data. Other initiatives were taken into consideration, including the National Integrated Coastal Marine (ICM) strategy, which addresses mainly mainland Tanzania, and recommends planning at different spatial levels. These include District ICM Action Plans, which might cover the full District and territorial waters, or smaller areas within the District, such as a village or a bay. Also included are SAMPs which can cover a single District, several Districts or an area within a District, and are developed in a partnership arrangement between central government, local government and local communities.

Six areas were identified for potential development of sub-national MPA systems, all of which had previously been recognised as priorities for biodiversity conservation through WWF's East African Marine Ecoregion (EAME) analysis (EAME, 2004):

- Tanga Region: A system of collaborative fishery management areas with closed reefs is already in place on the northernmost mainland coast.
- Pemba Island: Entire west coast, now gazetted as the Pemba Channel Conservation Area, and one pre-existing MPA around Misali Island.
- Unguja Island: Existing MPAs at Menai Bay, Chumbe, Mnemba, and Jozani-Chwaka Bay.
- Dar es Salaam-Bagamoyo: Existing Dar-es-Salaam Marine Reserves and a District level ICM programme in place.
- Rufiji-Mafia-Kilwa-Songo Songo complex: This comprises three Districts and covers over 9,000 km², with some 140,000 people. It is planned as a network of management areas that are being developed and implemented with the support of the WWF EAME programme in collaboration with Kilwa, Mafia and Rufiji Districts. This would include the existing Mafia Island Marine Park, a community-managed MPA in Kilwa area; a Ramsar site in the Rufiji Delta; and protection of part of the Songo-Songo Archipelago, with the individual sites linked through a Biosphere Reserve approach.
- Mtwara District: Largely covered by Mnazi Bay-Ruvuma Estuary Marine Park, and potentially to be developed as a transboundary conservation area with Mozambique.

The proposal for the system has been published in the form of a book (Ruitenbeek *et al.*, 2005), aimed at policy makers and written in a popular fashion. Implementation of sub-national MPA systems for the Pemba and Rufiji-Mafia-Kilwa-Songo Songo areas have been identified as priorities and work is being supported through MACEMP for the former, and a WWF programme with several donors for the latter.

4.1.3. SEYCHELLES - PROPOSED INTEGRATED MPA SYSTEM

The National Biodiversity Strategy and Action Plan (NBSAP) of 1997 (Shah *et al.*, 1997) recognised that there are a multiplicity of protected areas and statutory authorities that need harmonisation in the Seychelles. It also identified a need for clear policy on the selection and objectives for protected areas to create an appropriate balance between conservation and exploitation, and for more public involvement in selection and management of protected areas. An Integrated Marine Protected Areas Systems Plan (IMPASP) (Seychelles Gov, 2005; Beaver, 2004) was therefore developed as one output of the GEF funded Seychelles Marine Ecosystem Management Project (SEYMEMP). This is a preliminary document, reviewing the current status and outlining the steps that would need to be taken to develop a system.

Seychelles has 17 MPAs, developed over a long period of time (Cousin Island was designated in 1968, nearly 40 years ago) but in a largely piecemeal and often reactive manner. The sites have varied roles and functions, differing administrative structures, diverse legislative support and different degrees of management and enforcement. They are managed by six separate organisations, two of which are NGOs, and fall under the mandates of three ministerial portfolios. There are five designation types: Special Reserves (three sites), Marine National Parks (six sites), Shell Reserves (four sites, which include no inter-tidal habitat but are considered by the Seychelles as MPAs), Fisheries Reserves (three sites) and Protected Areas (one site). There is relatively good information on coral reefs and mangroves, which are well represented, most MPAs having originally been selected on the basis of the location of coral reefs that are important for tourism as well as biodiversity protection. However, no overall assessment of the extent to which the current MPAs are ecologically representative has been undertaken.

The IMPASP proposes that, in the first instance, the national MPA systems plan should cover inter-tidal and sub-tidal habitats in nearshore waters only, and not open ocean, pelagic or deep water benthic habitats. A detailed study of the inner granitic islands was carried out; ultimately a full gap analysis is needed to include the outer coralline islands. Selection criteria have been identified. There are good data for coral reefs, and so priority sites, or coral 'refugia', in the granitic islands were identified,

using criteria of: high hard coral diversity (coral 'hot spots' that may function as seed areas for other reefs); high levels of coral and fish recruitment; and resilience to coral bleaching. Priority sites are:

- Anse Petit Cour reefs, already in Curieuse Marine National Park, a coral hot-spot;
- Conception Island, a coral hot-spot with high levels of coral recruitment;
- Reefs in north-west Mahe, a coral hot-spot;
- Marianne Reef with high levels of coral recruitment and resilience to coral bleaching;
- North Island Reefs, demonstrating resilience to coral bleaching.

The IMPASP proposes a co-ordinating mechanism, in the form of an 'association' that would be representative of all users of the MPAs as well as relevant government agencies, NGOs and the private sector. The plan has not yet been adopted by the government and there are currently no specific proposals or resources for its implementation. However, some of the recommendations are being acted on as a result of individual activities by various agencies, such as private owners or NGOs that are taking a greater role in management. Spawning aggregations, for example, are being considered for protection.

4.1.4. MAURITIUS - PROPOSED MPA NETWORK FOR RODRIGUES

Under the Fisheries and Marine Resources Act 1998, three types of MPAs can be gazetted:

- Marine Parks: Multiple use MPAs with zoning plans that allow for strict conservation zones in which fishing is prohibited, as well as zones for swimming and other regulated permissible activities; the objectives are primarily conservation through regulation of activities, public appreciation and enjoyment, and research;
- Fishing Reserves: Areas where net fishing is prohibited; there is no zoning; these are primarily aimed at protection of fish breeding and nursery areas;
- Marine Reserves: MPAs in which all extraction is prohibited; this includes fishing as well as searching, extracting or drilling for oils or minerals.

On Rodrigues, an autonomous dependency of Mauritius, five Fisheries Reserved Areas, in which seine net fishing is banned, were gazetted in 1984 under the previous fisheries legislation. In 2007, four Marine Reserves were gazetted under the new legislation covering larger areas of the reef on the northern side of the island, following technical and consultation work supported through a donor-funded initiative led by the NGO Shoals Rodrigues. Three of these are still to be demarcated and are not yet enforced; implementation work is underway in the fourth. In addition, the South-east MPA (SEMPA) is being established through a UNDP/GEF project, as a zoned multiple use Marine Park on the south coast and will cover an estimated 62 km² (42 km² marine - or 17% of the lagoon - and 20 km² terrestrial) (Figure 8).

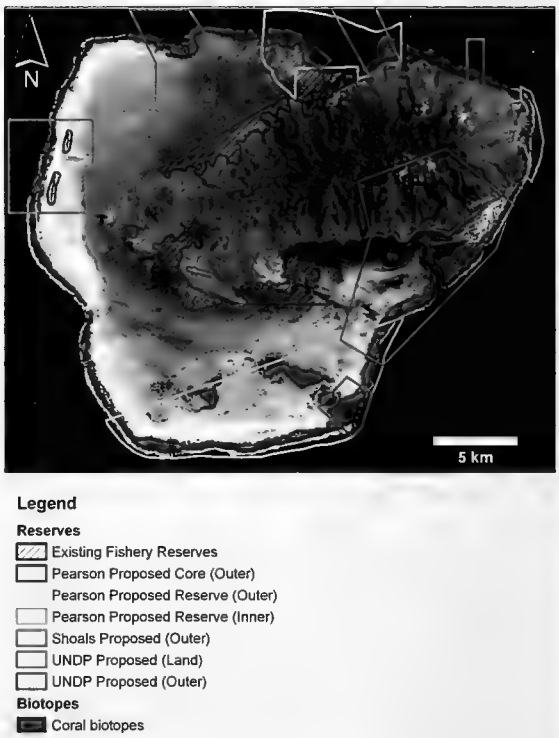


Figure 8: Rodrigues MPA network. Source: University of Wales - Bangor

During the process to establish the Marine Reserves, a GIS was developed to integrate the wide range of data needed for MPA planning. Field surveys were undertaken at 183 sites to ground-truth the image. 42 biotopes[38] were described in four habitat groups (coral, sand and rubble with mixed vegetation, lagoon muds and consolidated limestone) and a biotope map layer was produced. The GIS and maps were used to assess the ecological representation of the existing Fishery Reserved Areas, and the improvement that would be achieved once the Marine Reserves were established (Chapman and Turner, 2004) (Table 4.1). Habitat coverage of the proposed SEMPA is being surveyed and will allow a fuller analysis of progress being made in establishing the island MPA network. Rodrigues may act as a

[38] An area of uniform environmental conditions providing a living place for a specific biological community.

Table 4.1. Ecological representation of fishing and marine reserves in Rodrigues (data from Chapman and Turner, 2004)

	Existing Fisheries Reserves km²	Marine Reserves km²
Coral habitat	0.9	13.4
Sand, rubble, marine vegetation	8.9	30.3
Consolidated limestone	0.2	1.1
Lagoon muds	2.3	0.0
Intertidal sand	1.5	
Deep water	1.0	17.0
Lagoon channels		0.1
Land	0.4	
Total	16.0	58.0

source of larvae for Mauritius and Reunion, since the South Equatorial Current transports water in a west-south-westerly direction (Turner and Klaus, 2005). This would need to be considered in overall national MPA planning.

4.1.5. MADAGASCAR

Madagascar has a coastline of over 5000 km, and more than 250 offshore islets. Mangroves and coral reefs cover some 3,400 km² and 2,000 km² respectively and there are a wide range of other marine and coastal ecosystems. The level of attention paid to MPAs has recently increased. During the 2003 World Parks Congress in Durban, South Africa, the President of Madagascar announced a new commitment to triple the coverage of protected areas from 1.7 to 6 million hectares, including one million hectares of new marine sites, by 2012. This would involve establishing at least three new MPAs. A number of expert workshops have been held, with the support of NGOs such as WCS and WWF, and potential sites are in the process of being identified, particularly as a fisheries management tool and to address coral reef resilience to climate change. IUCN categories are being used to develop the system with much focus on Category VI (multiple use).

MPAs that are part of the national protected areas systems plan, the *Plan de Gestion du Réseau National des Aires Protégées (Plan GRAP)*, are the responsibility of the Association Nationale pour la Gestion des Aires Protégées (ANGAP), and include National Parks and Biosphere Reserves. As the objectives of the new MPAs evolve, the involvement of the fisheries department (Direction de la Peche et des Ressources Halieutiques) is expected to increase. In addition, there are a growing number of MPAs being established by NGOs and local communities, sometimes using customary laws (dina) that will also contribute to the overall national network.

The most recent example is that of the Velondriake MPA, in the south-west of the country, which is being developed by local communities - the Vezo people - with the support of WCS and a British NGO, Blue Ventures, following a series of conservation initiatives including the establishment of several NTAs for octopus (Harris, 2007). Convinced by the success of these NTAs, the villagers themselves asked that they be made permanent within the framework of an MPA. In 2005 a comprehensive ecological assessment of the area was undertaken by WCS and Blue Ventures (Harding *et al.*, 2006). In 2006, representatives of 23 coastal villages came together with facilitators from WCS and Blue Ventures, and agreed to the protection of the following: eight lagoon patch and fringing reefs areas for permanent closure as marine reserves; 16 reef flat zones for temporary closure as octopus NTAs; three mangrove protected areas; one intertidal lagoon zone with restrictions on seine fishing for the protection of seagrass habitat; one special management area for aquaculture trials near Andavadoaka; one special management area for ecotourism in Andavadoaka; and three terrestrial areas for protection of baobab trees *Adansonia grandidieri* within selected areas of dry forest habitat (Figure 9). The whole MPA covers an area of 823 km² along 40 km of coast, encompassing all of these special zones within which regulations governing resource use and access would apply. The MPA was named 'Velondriake', which means 'to live with the Sea'.

Special management areas cover 20.06 km² (2.44% of the total management area), of which: 12.56 km² (approximately 15.61% of the total 80.47 km² of reef flat) are for seasonal NTAs for octopus fishing; 3.75 km² are for permanent coral reef NTAs; 2.67 km² are for permanent mangrove protected areas; 0.55 km² are for permanent terrestrial forest protected areas; and 0.23 km² and 0.27 km² are for special management areas for marine aquaculture and ecotourism development respectively. The respective areas were suggested and ultimately agreed by the stakeholders themselves, reflecting a truly bottom-up approach.

Figure 9: Velondriake MPA. Source: Blue Ventures
The Velondriake MPA in Madagascar is being developed by the local community with NGO support, and includes a series of NTAs for octopus (green).

Three committees, made up of representatives from the relevant villages, have been established to oversee management of the northern, central and southern regions of the MPA. A goal and objectives for the MPA have been developed and a preliminary management plan prepared. The objectives include: developing the capacity of Velondriake's local and regional management committees for self - management; promoting communication, solidarity and coordinated environmental management planning between villages; and diversifying local economies through the promotion of ecotourism and the development of mariculture as an alternative income source in Velondriake villages.

4.2. SOUTH AFRICA

Planning for a national system of MPAs started in the 1990s, when Hockey and Branch (1997) developed some initial criteria for development of a system. Lemm and Attwood (2003) reviewed the status of MPAs nationally, and WWF identified targets for marine conservation at the national level which include (1) identification of priority habitats, species and marine systems requiring special conservation attention, and (2) establishment and implementation of a network of effectively managed, ecologically representative MPAs. By 2005, there were 23 MPAs with subtidal water.

The National Spatial Biodiversity Assessment Programme (NSBAP) started in 2005 was developed with input from a wide range of scientists and managers. The marine component of the NSBAP (Lombard *et al.*, 2005) covers the entire EEZ apart from the Prince Edward Islands (see below). The broad initial assessment of marine biodiversity (Driver *et al.*, 2005) was based on selected species and habitats, excluding mobile species, biodiversity

processes, and estuaries (which are covered in a separate assessment). It is acknowledged that a more complete analysis of fish species would be necessary to provide a full gap analysis. The success of this approach led to the NBSAP methods being adopted for the Benguela Current Large Marine Ecosystem (BCLME) marine conservation planning projects on the Atlantic side of Africa.

The assessment found that 23% of the coastline lies within MPAs and 9% in NTAs, but that the existing network is far from representative. For example, there were no MPAs in the entire Namaqua bioregion on the west coast, but in the Delagoa bio-region in the north-east, 20% of the coast is in NTAs due to the presence of the St. Lucia protected area complex. Less than 1% of the EEZ lies within an MPA and of this only 0.16% is no-take. Inter-tidal habitats are under-represented but further work is needed to see how well species are studied. Proclamation of the proposed new Namaqualand MPA will more than double the sea surface area under protection

More detailed spatial planning exercises are underway for the different bioregions within the EEZ:

- **Prince Edward Islands:** The area of EEZ around these islands in the Antarctic is covered by a separate planning initiative to design an MPA network using SCP methods and C-Plan software. Three zones have been delineated comprising (1) four IUCN Category 1a reserves (13% of the area); (2) two conservation zones (21% of the area); and (3) three Category IV reserves (the remainder of the area).
- **Kwazulu-Natal (KZN):** A fine-scale study (SEAPLAN) for the 640 km coastline of this east coast province, out to the limits of the EEZ, was initiated in 2001 (Harris *et al.*, 2005). The conservation status of biodiversity features (patterns and processes) is being assessed and GIS-based C-Plan software developed by Margules and Pressey (2000) has been adapted. The project has collated fine-scale data on biodiversity patterns (through field mapping and the use of satellite imagery and bathymetry to define offshore habitats), and distribution of marine resource use and threats. Workshops were held to introduce the project and invite participation, to identify important biodiversity features and processes, and to assess data availability. Two of the main gaps identified were (1) the difficulty of defining and mapping biodiversity processes, and (2) the difficulty of mapping and incorporating threats. Data poor environments were identified, including sandy shores and reefs. The project is now entering an analytical phase.
- **Agulhas Bioregion:** A marine conservation plan has been prepared for the area around the Cape, using Marxan (Clark and Lombard, 2007). A total of 19 priority areas were identified that would allow most habitat conservation targets of 20% and/or 30% to be achieved.
- **Offshore:** A network of offshore MPAs in the EEZ is being developed by the South African National Biodiversity Institute and Department of Environmental Affairs, in consultation with the fishing and mining industries. At present, offshore areas are very under-represented, and of the 34 biozones identified, 23 have poor protection (Sink *et al.*, 2007).

4.3. WESTERN AFRICA REGIONAL SEAS PROGRAMME

The West and Central Africa RSP has 22 participating states: Angola, Benin, Cameroon, Cape Verde, Congo, Democratic Republic of Cameroon, Côte d'Ivoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mauritania, Namibia, Nigeria, São Tomé and Príncipe, Senegal, Sierra Leone, South Africa, and Togo. The Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the West and Central African Region (known as the Abidjan Convention) was signed in 1981. There is no MPA related protocol.

In 2002, a Regional Strategy for MPAs was developed with the support of IUCN, the Fondation Internationale du Banc d'Arguin (FIBA), WWF and Wetlands international, for a subset of six countries in this region: Mauritania, Senegal, Gambia, Guinea-Bissau, Guinea, and Cape Verde, covering over 3,200 km of coast and based on the WWF West African Ecoregion (WAMER) (WWF, 2003). The 'vision' for this network is to create: *An effective network of MPAs in West Africa with participatory management, led by strong institutions contributing to the sustainable development of the region by enhancing natural and cultural diversity.*

Three main ecosystem types were identified:

- Senegalo-Mauritanian system characterised by upwellings;
- Cape Verdian system, which is mainly rocky islands;
- Guinea and Guinea-Bissau, mostly estuarine-mangrove.

Sites in the region are connected by the Canary Island and Guinea upwellings, as well as through the movement of migratory species. More sites are to be included in the network for better representativeness and connectivity.

To implement the strategy, a five-year Regional Conservation Programme for the Coastal and Marine Zone of West Africa (PRCM) was developed with the assistance of IUCN, WWF, FIBA, Wetlands International, UNESCO, and 47 other partners (both governmental and NGOs), including the Commission Sous-Régionale des Pêches (SFC/CSRP) (WWF, 2005; Kimball, 2003). A seventh country, Sierra Leone, was included in the regional programme after joining the CSRP. The CSRP member States gave strong political support to the regional MPA strategy by signing a general policy declaration in 2003.

A three-year EU-funded project *Coherence of Conservation and Development Policies on Coastal and Marine Protected Areas in West Africa (CONSDEV)* was initiated in 2002 to develop options for improving MPA management in three countries (Mauritania, Senegal and Guinea-Bissau) and involved a range of agencies. Recommendations were made in relation to improving integration of MPA site management with regional and national policies, more clearly defining the role of governments in MPAs, recognising rights-of-use by stakeholders, and developing ecotourism[39].

The Regional Network of MPAs in West Africa (RAMPAO)[40] was formally launched in April 2007 and comprises 23 MPAs in six countries, including 15 MPAs in four countries (Mauritania, Senegal, the Gambia and Guinea Bissau) that were listed in the

Figure 10: West Africa MPAs. Source: IUCN
Figure 10 illustrates the location and variety of MPAs off the coast of West Africa, including Biosphere Reserves, National Parks, Community-based MPAs, Protected Areas in project, as well as other forms of PA.

[39] www.resed.org/consdev
[40] http://www.rampao.org/en/index.php

Regional Strategy (ten national parks, four reserves and a community-based MPA). The goal of the RAMPAO is to ensure, at the scale of the eco-region, *'the preservation of a coherent set of critical habitats... for the regeneration of natural resources and the conservation of biodiversity to the benefit of the societies'*. This is to be achieved through the conservation of representative samples of critical habitats and viable population of threatened species, the contribution to sustainable fisheries resources management and the reinforcement of the capacities of MPAs managers and local key actors. A secretariat has been set up, which facilitates and coordinates the network's activities, with technical assistance from PRCM and financial support from international partners.

In 2001, Senegal announced its intention to establish a national MPA network. Five MPAs, covering a total of 82,000 ha, have been established as the first step[41].

4.4. RED SEA AND GULF OF ADEN REGIONAL SEAS PROGRAMME

The Red Sea and Gulf of Aden (RSGA) region has seven participating states: Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan and Yemen. The Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (known as the Jeddah Convention) was signed in 1982. The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) was established in September 1995, as a Secretariat for the Convention and comprises a Regional Coordinating Committee and the Regional MPA Activity Centre in Jeddah, Saudi Arabia. The Protocol Concerning the Conservation of Biological Diversity and the Establishment of a Network of Protected Areas in the Red Sea and Gulf of Aden was signed by PERSGA member states in December 2005.

PERSGA assists with implementation of the Convention and is involved in the development and implementation of regional programmes for the conservation of the marine environment, including the Strategic Action Plan (SAP) for the Red Sea and Gulf of Aden. This is aimed at safeguarding the coastal and marine environments of the RSGA and ensuring sustainable use of its resources (Gladstone *et al.*, 2003).

A Regional Master Plan for an MPA network (PERSGA, 2002a) and a design for the proposed MPAs (PERSGA, 2002b) have been produced. Seven MPAs have been declared and a further five are proposed as part of this. The existing and proposed MPAs are at different stages of declaration, site-

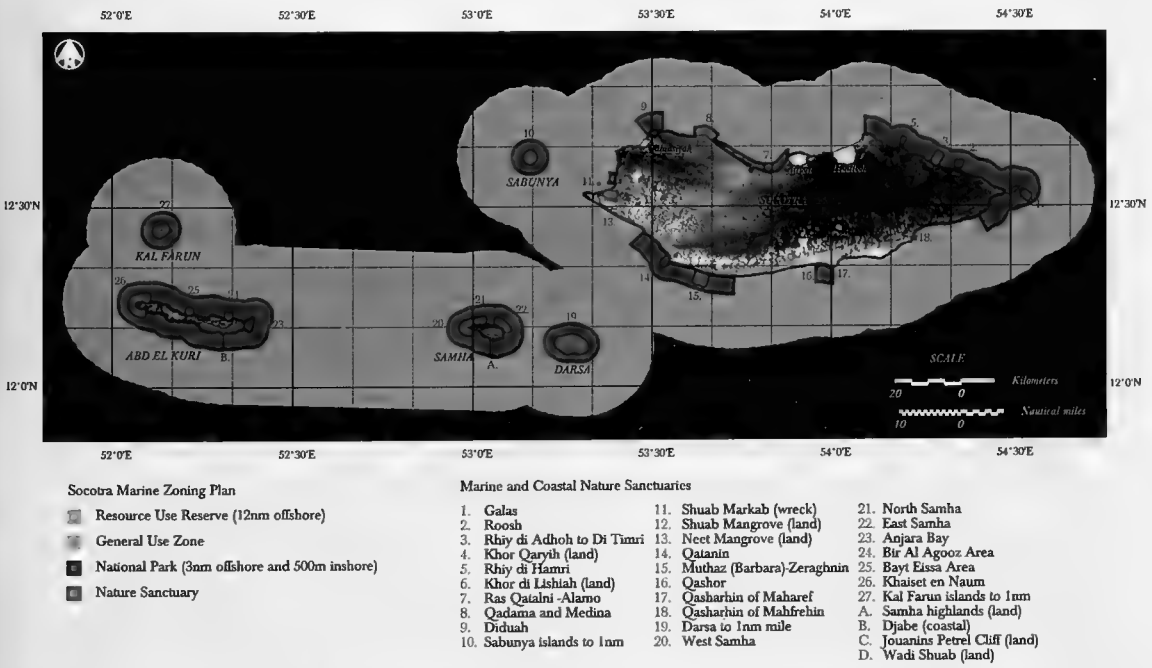


Figure 11: Socotra MPA Network. Source: Klaus, R. and Turner, J.R. (2004) The marine biotopes of the Socotra Archipelago. Fauna of Arabia 20: 45-115

The Socotra Marine Zoning Plan comprises a system of protected areas, within a larger managed area, and includes General Use areas, National Parks and Nature Sanctuaries.

[41] http://assets.panda.org/downloads/senegalmpa.pdf

specific surveys, development of master and management plans, training, infrastructure, and equipment (PERSGA, 2004).

In a separate initiative, the Regional Action Plan for the Conservation of Reefs in the Red Sea and Gulf of Aden, developed in 2003 (PERSGA, 2003) and subsequent National Action Plans (in press), call for the establishment of a biologically interconnected network of MPAs, for the long-term maintenance of reef ecosystems and the viability of populations of endemic, rare, threatened or endangered, and harvested species (Kotb *et al.*, 2004).

Eritrea lies within the region geographically but is not part of the RSP. Planning is underway in this country to designate a network of MPAs, through a UNDP/GEF coastal management project.

4.4.1. YEMEN - SOCOTRA MARINE ZONING PLAN

The Socotra Archipelago, which is part of Yemen, comprises four islands and two rocky outcrops and lies at the junction between the Indian Ocean, Gulf of Aden and Arabian Sea. The islands and marine waters have been recognised for several decades as a priority for protection. Through UNDP/GEF funding, a Conservation Zoning Plan[42] was prepared (Krupp and Klaus, 2000; Klaus and Turner, 2004; and Cheung and DeVantier, 2006) and legally gazetted by Presidential Decree 275 in 2000 (Republic of Yemen, 2000). In addition, the entire archipelago was designated a Biosphere Reserve in 2003, and was made a WHS in 2008.

The Zoning Plan, essentially a system of protected areas within a larger managed area, covers all the islands and the surrounding sea, encompassing a total area of about 21,450 km², with 17,720 km² of marine area (EPA/SCDP GIS Unit, 2006; Cheung and DeVantier, 2006). The territorial sea (out to 12 n.mi) and about a quarter of the total land area are designated as a Resource Use Reserve where traditional and other natural resources uses that do not damage the environment are permitted. Within this large area, there are three zone types:

- General Use: Several small areas where a significant level of habitat modification has occurred in the interest of essential infrastructure and economic development.
- National Parks: Most of the coastline (500 m inshore) extending up to 3 n. mi offshore. These include about three quarters of the total land area and buffer the Nature Sanctuaries;
- Nature Sanctuaries: Areas in natural to near pristine condition; highly protected and varying in size from 0.27 to 45.0 km².

Development of the zoning plan was a progressive process, involving:

- Local team building, training and awareness programmes to enable the participation of the Socotrans in the process and hence ownership of the Plan. Training was provided to the local team and extension officers in areas ranging from English and computer literacy to basic taxonomy, ecology and survey techniques;
- Collation of all information from previous studies, with biotope and biodiversity surveys and mapping by technical experts, using the trained local team, to fill gaps in knowledge;
- Resource use surveys and monitoring by technical experts and local extension officers;
- Drafting of zoning plan and activity guidelines involving technical experts, local team and government representatives;
- Broad-based consultations across the islands;
- Revision and finalisation of the zoning plan and activity guidelines.

Implementation of the plan is occurring in a phased manner in relation to available management capacity.

The surveys and mapping of biodiversity and resource use involved over 60 national and international scientists from a large number of institutions, and covered terrestrial and marine environments of all the islands and rock outcrops of the archipelago. The Socotran extension officers collected a substantial amount of information on the state of the environment, plant use and fisheries.

The criteria used to select marine nature sanctuaries included the diversity, richness and/or representativeness of biotopes, algae and seagrass, coral, fish and other faunal groups, and the presence of important seabirds, nesting turtles, lobster stocks and mangroves. Aesthetic beauty or tourism potential was also considered in the zoning process. Sites proposed by local communities were rated highly in the selection process. Coastal villages around the archipelago have a traditional system of NTAs and four of the five such sites proposed by the local communities agreed with the findings of the scientific assessments.

Further consultations and negotiation with community leaders were undertaken to refine the zoning system. The boundaries of the Nature Sanctuary MPAs were subsequently mapped in the presence of local community members using hand-held global positioning systems (GPS). The officers

[42] www.socotraisland.org/plan/plan.html

also held village meetings on a regular basis, to facilitate understanding and provide feedback and inputs into the formulation of the Plan. Provisional activity guides for the different zones were also developed. In July 1999, a technical review workshop was held by the project in Sana'a (on the mainland), attended by community leaders, relevant ministries, scientists, EU representatives, tour operators and an ecotourism expert, at which a first draft Zoning Plan was developed, building on the draft proposal. Subsequently, extensive consultation efforts to review the Plan began, through many large meetings held across the islands, involving some 500 community leaders and local government representatives.

The Zoning Plan was developed in order to ensure good representation of all biotopes, and of coral, fish, algal and seagrass communities within the MPA system. Socotra is located at the intersection of several distinct bio-geochemical and bio-geographical faunal sub-provinces, and is also at the junction of three LMEs: Somali Coastal Current; Arabian Sea; and Red Sea. The surrounding waters were divided into four bio-geographical areas for the purpose of the Zoning Plan.

Resilience was partially addressed in that sites that were not affected or were recovering from the major coral bleaching event in 1998 were rated highly in the selection process and designated as Nature Sanctuaries. Sites with significantly higher biomass of fishes, lobsters and/or rich coral communities were rated highly and incorporated into the Nature Sanctuaries. Size and shape of individual MPAs were selected largely based on convenience and following negotiations with local communities to minimise loss of local livelihoods. Connectivity was not addressed, although there is a good understanding of current patterns around Socotra (Klaus and Turner, 2004).

4.5. REGIONAL ORGANIZATION FOR THE PROTECTION OF THE MARINE ENVIRONMENT (ROPME) REGION

The ROPME Region has eight participating States: Kingdom of Bahrain, Islamic Republic of Iran, Republic of Iraq, State of Kuwait, Sultanate of Oman, State of Qatar, Kingdom of Saudi Arabia, and the United Arab Emirates. The Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution (known as the Kuwait Convention) was adopted in 1978 and the Member States have agreed to develop a Protocol concerning the Conservation of Biological Diversity and the Establishment of Protected Areas.

There are eight parks and reserves on the coast and over 85 sites have been recommended for protection according to ROPME (2003) but the WDPA lists a total of 27 MPAs for this region. Some of these sites have international designations including the Harra Biosphere Reserve in Iran, protected for its mangroves, and four Ramsar Sites: the Shadegan marshes and mudflats of Khore Al-Amaya; the Khuran Straits; the deltas of Rud-e-Shur; and the deltas of Rud-e-Gaz. In Iraq, most of the important marine and coastal conservation areas are unprotected although many have been recommended for future protection. In the United Arab Emirates, many MPAs are under major threat from construction activities and coastal development.

4.6. CASPIAN INDEPENDENT PARTNER PROGRAMME

The Caspian Region, the only entirely inland sea associated with the UNEP-RSP, has five participating states: Azerbaijan, Islamic Republic of Iran, Kazakhstan, the Russia Federation and Turkmenistan. The Convention for the Protection of the Marine Environment of the Caspian Sea (known as the Teheran Convention), and the Caspian Strategic Action Programme, were approved and signed in 2003. The Caspian Environmental Programme (CEP) is encouraging the development of special programmes for integrated management of coastal areas and MPAs, and the draft Biodiversity Strategy and Action Plan (July 2002) provides for establishment of a protected areas network (Kimball, 2003). The third Caspian regional workshop was held in September 2001, and discussed the creation of a regional network of protected areas, analysed existing and planned protected areas, and examined their status in the Caspian states. Work has started to develop a regional network and improve each participating country's protected area legislation, with the support of a GEF project 'Towards a Convention and Action Programme for the Protection of the Caspian Sea Environment'.

5 ASIA

5.1. SOUTH ASIA REGIONAL SEAS PROGRAMME

The South Asia RSP has five participating states: India, Bangladesh, the Maldives, Pakistan and Sri Lanka. The Chagos Archipelago (known as the British Indian Ocean Territory or BIOT) and Myanmar are bio-geographically part of the region and are included in the equivalent WCPA-Marine region. With 12,049 kilometres of coastline, the region encompasses ten and six per cent of the world's mangrove and coral reef areas respectively, two of the world's largest estuaries (the Ganges and the Indus), large areas of sand dune and seagrass bed and numerous globally threatened marine species. The Northern Indian Ocean, encompassing Maldives, Chagos and the Lakshadweep islands, together with Sri Lanka, has been collectively identified as one of the ten global priority areas for coral reef conservation (Roberts *et al.*, 2002). 70 coastal sites have been designated as IBAs by Birdlife International (Perera, 2005).

The South Asia Co-operative Environment Programme (SACEP)[43], an inter-governmental organisation established in 1982 to promote and support protection, management and enhancement of the environment in the region, is the main regional body promoting MPA establishment. It covers a broader area than the RSP, including three non-coastal states (Afghanistan, Bhutan, and Nepal). There is no convention addressing management of marine and coastal resources and no protocol on MPAs for the region, but a South Asian Seas Action Plan (SASAP) was developed under the UNEP-RSP. SACEP is responsible for promoting the implemention of the SASAP, which aims to protect and manage the marine environment and related coastal ecosystems of the region (SACEP/UNEP, 1995).

An EU-funded project[44], coordinated by the International Coral Reef Action Network (ICRAN) and SACEP, facilitated the establishment of a South Asia Coral Reef Task Force (SACRTF) in 2007 with representation of all five nations in the region. SACRTF is responsible for promoting regional cooperation and is leading the development of strategy for a regional network of marine and coastal protected areas. The need for an initiative to establish a regional network of MPAs, given the importance of this area for marine biodiversity, has long been recognised (Pernetta, 1993; Kelleher *et al.*, 1995). Some of the actions required to meet the 2012 MPA targets are outlined in Perera (2005), including improving ecological representation, improving legislation, linking MPAs to ICM, improving data collection on MPAs, and including transboundary MPAs in any future network. Within each country, existing information on marine biodiversity distribution should be collated, a gap analysis undertaken, and a process set in motion to design appropriate national MPA networks that will contribute to the regional network.

The status of MPAs in the South Asia region has been reviewed a number of times (Pernetta, 1993; Wells *et al.*, 1995; Perera, 2005). Perera (2005) found that MPAs are far from being fully ecologically representative or comprehensive since most were declared before the importance of these concepts was fully understood. Some 60% of MPAs lie in the Maldives and the Andaman and Nicobar Islands, most of which are very small sites (Spalding *et al.*, 2007). India has two large MPAs (the Gulf of Mannar and Gulf of Kuchch) and numerous small sanctuaries and protected areas covering lagoons and mangroves. In the Andaman and Nicobar Union Territory, 96 of the 306 islands are designated as wildlife sanctuaries and six are national parks, and are thought to have some sub-tidal and/or inter-tidal habitat although the extent of this is not known. Many key sites in India, are still unprotected: for example, Gahirmatha Marine Sanctuary was declared in 1997 to protect nesting Olive Ridley turtles, but other key nesting habitats such as the Devi and Rusikulya river mouths are not protected. The Maldives has 25 small protected dive sites, and two MPAs established to protect mangroves.

Sri Lanka has 13 protected areas with sub-tidal and inter-tidal habitat, but only a few are fully marine and they tend to be poorly enforced. Six Fishery Management Areas have also been declared including two coral reef ecosystems and four lagoon systems, and there are 19 Ramsar sites (or 64.4% of the total area designated under Ramsar in this region) covering coastal lagoons, inter-tidal

[43] http://www.sacep.org/
[44] Institutional Strengthening and Capacity Development for the Long Term Management and Conservation of Marine and Coastal Resources in South Asia

mangrove forests and mud flats, estuarine waters and sandy shores (Perera, 2005). and mud flats, estuarine waters, and sandy shores (Perera, 2005). MPAs in Sri Lanka are part of a broader ICM framework that includes other management designations under the national Coastal Zone Management Plan.

In Bangladesh, four marine reserves were designated in 2000 covering 698 km² of fishing ground in the Bay of Bengal. Several MPAs, including international designations such as WHS and Biosphere Reserves, contribute to the protection of the Sundarbans mangroves and tidal areas, which is the pre-eminent MPA in the region. Pakistan has a number of MPAs including 19 Ramsar Sites designated for the protection of coastal areas, marine mammals, turtle nesting grounds, and mangrove habitats[45].

5.2. EAST ASIAN SEAS REGION

The East Asian Seas (EAS) Region, as recognised by the UNEP-RSP, is focused on the five member countries of the Association of South-East Asian Nations (ASEAN), namely Indonesia, Philippines, Singapore, Thailand and Malaysia, which adopted the East Asian Seas Action Plan (EASAP) in 1981. The Plan was revised in 1994, when Australia, Cambodia, the People's Republic of China, the Republic of Korea and Vietnam also became members. The Coordinating Body on the Seas of East Asia (COBSEA), through its Bangkok-based Secretariat oversees the implementation of EASAP. The Plan includes a range of activities, many of which relate to MPA management, as well as two regional COBSEA projects, initiated in 2002, that contribute directly to the implementation of MPAs:

- The ICRAN Demonstration-Target Sites Project: Involved the exchange of experiences on management of coral reefs under three themes: MPAs, community-based management and sustainable tourism;
- The UNEP/GEF Project "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand": Includes a component on establishing fisheries refugia to preserve critical habitats such as mangrove forests, seagrass beds and coral reefs.

In 2002, the ASEAN Environment Ministers adopted two sets of criteria for MPAs[46], one for nationally important MPAs and one for ASEAN Marine Heritage Areas[47] or regionally important sites, which had been prepared by the ASEAN Working Group on the Coastal and Marine Environment in collaboration with COBSEA. The aim of the criteria is to promote a co-ordinated and harmonised approach to the establishment and management of MPA networks in the region, and the criteria were subsequently incorporated in the Vientiane Action Programme 2004-2010[48] that was adopted and endorsed at the tenth ASEAN Summit in Vientiane, Lao PDR in 2004. A further regional programme, Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) also contributes to strengthening the enabling environment for MPA networks. For example, the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA), endorsed at the Intergovernmental Meeting of PEMSEA in 2002 and launched at the East Asia Seas Congress in 2003 has a target of implementation of ICM programmes in at least 20% of the Region's coast by 2015, and MPA networks will be discussed at the 2009 East Asia Seas Congress.

The waters of the East Asian Seas Region are closely linked with the South-west Pacific, particularly in the area of the 'Coral Triangle' which covers some 5.7 million km² and includes the waters of Indonesia, Malaysia, Philippines, Timor-Leste, Papua New Guinea, and Solomon Islands. This region has the richest marine biodiversity in the world, with over 600 coral species (more than 75% of all known coral species), 53% of the world's coral reefs, 3,000 fish species, and the greatest extent of mangrove forests of any region in the world. The Coral Triangle also serves as the spawning and juvenile growth areas for the largest tuna fishery in the world. In December 2007, the six countries of the region agreed on a plan of action to implement a programme known as the Coral Triangle Initiative (CTI) that is aimed at developing sustainable marine resource use, and will include support for several of the developing MPA networks described below. The Tri-National Governmental Partnership for Western Pacific Leatherback Turtles, signed by Indonesia, Papua New Guinea and Solomon Islands in August 2006, is aimed at the development of an MPA network for the conservation of the critically endangered and migratory Leatherback Turtle. The network design will include other conservation features, such as coral reefs and other important coastal habitats, and even pelagic, high seas MPAs, and will use a similar process to that developed for the SSME (WWF-SSME Program, 2004).

There are numerous initiatives underway to establish MPA networks in this region, many of which address the four LMEs that it encompasses - the Gulf of Thailand, South China Sea, Sulu-Celebes Sea, and the Indonesia LME.

[45] http://www.ramsar.org/key_sitelist.htm
[46] http://www.aseansec.org/cme/ASEAN%20Criteria%20for%20National%20MPAs.pdf
[47] http://www.aseansec.org/cme/ASEAN%20Criteria%20for%20Marine%20Heritage%20Areas.pdf
[48] http://www.aseansec.org/VAP-10th%20ASEAN%20Summit.pdf

5.2.1. SOUTHEAST ASIA MPA NETWORK

In 2002, the then IUCN WCPA South-east Asia Marine Working Group (WCPA SEA Marine)[49] developed a *Regional Action Plan to Strengthen a Resilient Network of Effective MPAs in Southeast Asia 2002-2012* (RAP) (Fortes *et al.*, undated) (Box 3) to help co-ordinate, guide and implement the various MPA networks. The initial portfolio included 15 projects, three from each of five themes: planning and design, adaptive management, co-ordination and enforcement, community awareness and development, and sustainable financing. TNC set up a South East Asia Center for MPAs (SEACMPA) in Bali to assist with the establishment of regional networks of MPAs in South-east Asia, undertake training and other capacity building activities, and co-ordinate the implementation of the RAP. In 2008, the SEACMPA in Bali was changed to the Coral Triangle Center (CTC) but maintains the same general functions as intended for the SEACMPA. Activities directed at developing a regional MPA network for Southeast Asia will now evolve with the CTI as this develops.

Box 3: IUCN WCPA Regional Action Plan for an MPA network in Southeast Asia - key components

Vision: A region with an effective, self-sufficient and resilient representative network of MPAs, sustaining biodiversity and human uses, designed to adapt to local and global environmental change, managed by an empowered, responsible citizenry.

Goal: To establish an effective, functional representative network of MPAs by 2012, that is officially recognised and actively supported at all levels by governments in Southeast Asia, and implemented by a regional national, national and/or local management authority.

The South-east Asian MPA network should:

- Be representative of all coastal and oceanic habitats, and the regions biodiversity of residential and migratory marine species;
- Include replicated sites in order to build resistance and resilience;
- Integrate biological connectivity and manage critical processes such as larval dispersal and re-seeding, and migratory corridors of large marine life (such as cetaceans and turtles);
- Be large enough to be self-sustaining in the long-term;
- Be based on the latest ecoregional planning principles incorporating mitigation strategies;
- Develop innovative financing mechanisms;
- Facilitate sharing of management technical assistance across the network;
- Provide an opportunity for testing high technology distance learning.

5.2.2. SULU-SULAWESI MARINE ECOREGION/SEASCAPE MPA NETWORK

At the apex of the Coral Triangle, the SSME or Sulu-Sulawesi Seascape (SSS) an area of nearly one million km², covers the Sulu-Celebes Sea LME and includes parts of the EEZs of Indonesia, Malaysia and the Philippines (Figure 12, overleaf). From 1999-2001, biophysical and socio-economic assessments were carried out under the WWF SSME Programme (e.g. WWF, 2003 for the Philippines). In 2003, the ecosystems within the broader region were mapped by TNC and ecoregions were defined. A Framework for a Network of Marine Protected Areas in the Sulu-Sulawesi Marine Ecoregion was developed by WWF (WWF-SSME Program, 2004). In 2004, an MOU was signed between the governments of Indonesia, Malaysia and the Philippines to adopt a Conservation Plan for the SSME, and a tri-national Committee has been established to oversee this. The SSS Project of CI, with the involvement of some 30 partners, is now working in this area, with a focus on four corridors - the Trinational Sea Turtle Corridor, the Cagayan Ridge, the Balabac Strait, and the Verde Island Passage.

The *Framework* was developed through a series of workshops, with expertise shared through three working groups, each of which developed a separate framework based on information available for the particular issue: Species of Special Concern; Coastal and Marine Ecosystems; and Fisheries. Draft frameworks were prepared in the initial planning process separately for each issue. Subsequently the biophysical and socio-economic matrices were combined into a general framework, using the decision support approach used to design the MPA network for the Great Barrier Reef in Australia. A similar approach was taken for developing the actions required to create, plan and implement the network with three groups established for different

[49] WCPA-Marine now has an East Asian regional group

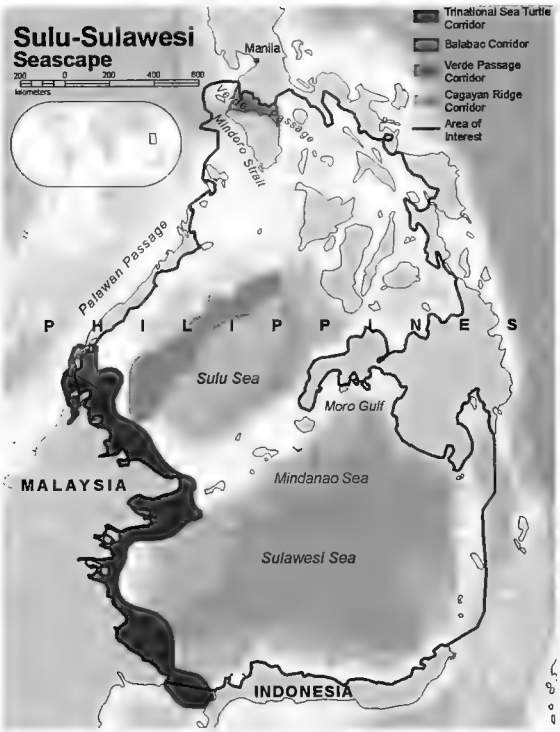


Figure 12: Sulu-Sulawesi Seascape.
Source: Conservation International
Highlights the four focal 'corridors' of CI as part of their Seascape project.

time horizons: Immediate (0-2 years); Intermediate (up to 5 years); and Long-term (3-10 years) (WWF-SSME Program, 2004).

In the *Framework*, the term MPA network is used to describe a system of MPAs that fulfils biodiversity conservation goals, and that also functions as a 'learning network' for the managers of the sites within it (i.e. that provides a social MPA network). The ultimate aim is that each MPA should consist of one or more fully protected areas (NTAs) surrounded by sustainable use zones, and that the system should be fully integrated with broader ICM, CRM and fisheries management and development plans. The development of the MPA network is to be based on criteria listed in the framework (and based on those in Noss (1992)):

1. Representation: Examples of all biological communities and habitats to be included;
2. Viability: MPAs to be large enough and their distribution broad enough to maintain viable populations of all species of special concern in the SSME;
3. Ecological and evolutionary processes: MPAs to be large enough, their distribution broad enough, and controls in place on activities taking place outside MPAs, to ensure continuation of essential ecological and evolutionary processes;
4. Resilience: MPAs selected for strict protection to include sites known or likely to be sources of recruits for other parts of the SSME, and sites that have a high survival or recovery rate following impacts.

5.2.3. PHILIPPINES - NATIONAL NETWORK

The Philippines has an estimated 1170 MPAs (World Bank, 2006; Arceo *et al.*, 2008). The majority (900-1000) are small co-managed sanctuaries and fishing reserves, generally managed at municipal level jointly by communities and local government and comprising small (2-200 ha) NTAs or sanctuaries, surrounded by fishing reserves within which traditional forms of fishing are allowed. Of those with known sizes, 35% are less than 10 ha and 48% are between 11-100 ha; the more recently established MPAs tend to be in the larger category and are increasingly being integrated into ICM plans (Arceo *et al.*, 2008). There are also 13 larger MPAs proclaimed by the government as Protected Seascapes (multiple use) and Marine Parks (no take areas) as part of the National Integrated Protected Areas System (NIPAS), and managed by the Protected Area Management Board, but few are considered effectively managed except for the Tubbataha Reef Natural Park in the Sulu Sea that is managed as a no-take reserve. Additional types of MPAs are mangrove forest reserves and protected artificial reefs.

Following a series of workshops at which terms, definitions and goals were agreed (Arceo *et al.*, 2003) the Philippine Marine Sanctuary Strategy was formulated. This sets a target of 10% of 'marine waters' to be fully protected (i.e. NTA) by 2020 in an MPA network that will include 10% of the country's coral reefs. Criteria for selection of sites are listed in White *et al.* (2005) and address essential principles, including minimum size, amount of habitat to be included and connectivity. Five major biogeographical regions were identified in White *et al.* (2005), revised to six in Arceo *et al.* (2008), based on geomorphology, ocean basins, bathymetry, and major water circulation patterns: South China Sea, Visayas, Northern Philippine Sea, Southern Philippine Sea, Celebes Sea and Sulu Sea. MPA networks are to be established for each bioregion which will contribute to the national level network.

Support for the establishment of the bioregion MPA networks is coming from a variety of sources. The Sulu Sea area is being addressed through WWF's SSME programme (see above). The Fisheries

Improved for Sustainable Harvest (FISH) project, funded by USAID, is helping to implement MPA networks for coral reef protection with a focus on no-take areas as a fishery management tool. The Local Governance for Coastal Management Project (LGCMP) of the Coastal Conservation and Education Foundation funded by the Packard Foundation, is supporting adjoining municipalities to develop and manage existing community-managed MPAs as networks (World Bank, 2006). The 830 municipalities have jurisdiction out to 15 km offshore and haphazard arrangements of small MPAs have developed within these waters, often with no co-ordination either within the municipality or between municipalities. The LGCMP is promoting a more coherent network approach, for example between MPAs in the Visayan Sea and Danajon Bank (Christie *et al.*, 2006).

As yet biogeographic representation is poor, with over 70% of existing MPAs in the Visayas, although there are at least some MPAs in each bioregion (Arceo *et al.*, 2008). The need to give special attention to corridor areas has been recognised. For example, the Calamian Islands, the Visayas and the Sulu-Tawi-Tawi Island areas are thought likely to act as corridors as they link deeper ocean basins (Ong *et al.*, 2002).

There are a growing number of local social networks of MPA practitioners and organisations involved in MPA establishment and implementation and these are linked together nationally via the MPA Support Network, formed in November 2005, and through the national MPA database[50]. Memoranda of agreement are signed and acted on by all participants, which include some 30 governments, academic and other NGOs. Each organisation contributing to the database has automatic access to the information. The database can be used to compare biophysical resources, status and trends, across all MPAs in the country. Maintaining the database has brought challenges in the form of the need for an institutional body to support it; difficulties in updating of the fields given the diffuse sources and the variety of methods used to collect data; lack of financing; and encouraging all members to participate actively. Members of the Support Network provide assistance to each other through research, monitoring and evaluation of MPAs or other forms of technical guidance and assistance. The MPA Support Network holds a regional forum and undertakes training activities with support from NOAA (White *et al.*, 2005; Arceo *et al.*, 2008).

5.2.4. INDONESIA - NATIONAL AND SUB-NATIONAL MPA SYSTEMS

Comprising 18,108 islands and spanning 5,000 km, with 95,000 km of coastline, Indonesia has a vast marine area with an estimated 46,000 km² of mangroves, 19,000 km² seagrass beds and 36,000 km² of coral reef (Carter and Darmawan, 2008). As early as 1982, when the World Parks Congress was held in Bali, the government declared its intention to establish a comprehensive national system of MPAs, covering 100,000 km², in the *National Marine Conservation Strategy*. In 1984, a detailed plan and atlas for development of an Indonesian system of MPAs was produced for the Directorate General of Forest Protection and Nature Conservation, financed by IUCN and WWF. This included criteria for identifying candidate sites and a list of 180 potential MPAs that met those criteria. Significant progress has been made in implementing this, with many of the major MPAs in place today in Indonesia resulting from it.

In 1990, a ministerial decree *(Act No. 5 Conservation of Living Natural Resources and their Ecosystems)* provided Indonesia with its first legal basis for the designation and management of MPAs. The legislation established four categories of protected area - national parks, strict nature reserves, wildlife sanctuaries, and nature recreation zones - each with its own regulatory and management scheme. In 1993, the *Biodiversity Action Plan* was produced and a goal set of 200,000 km² of marine habitat to be protected. The government is currently aiming to protect 100,000 km² by 2010, and 200,000 km² by 2020.

In 2007, there were 50 nationally designated MPAs, under the responsibility of the Ministry of Forests, covering a total area of about 28,260 km², including seven Marine National Parks, eight Marine Strict Nature Reserves, 19 Marine Recreational Parks, and five Marine Wildlife Reserves (Yunia in litt., 2008). Legislation passed in 2007 allows for the establishment of local protected marine sites through the Fisheries Department, and there are 17 District Marine Conservation Areas covering 5,515 km², two community-based MPAs covering 20 km², and ten community fishery reserves covering 4.5 km². There are also some National Parks with marine areas (Ministry of Marine Affairs and Fisheries, 2005), as well as other sites with marine habitat. The total number of MPAs is therefore still unclear. Carter and Darmawan (2008) list 73 in their gap assessment and the WDPA lists 217[51]. MPA coverage is nevertheless still far from representative; Carter and Darmawan (2008) found that large areas of mangroves in north-east Sumatra and south-east

[50] www.coast.ph
[51] http://www.wdpa.org (accessed October, 2008)

Kalimantan have no formal protection, and that reefs in South Java, south-west Sulawesi, Halmahera and Timor-Leste are poorly represented in MPAs.

Over 70 sites have been proposed as new MPAs, but these do not necessarily reflect a systemised consideration of ecological criteria (biodiversity, representativeness, ecosystem status, resilience, importance for fisheries) or the 1984 plan. The National Committee for Marine Conservation, recently established under the Directorate General of Marine, Coasts and Small Islands (Ministry of Fisheries and Marine Affairs) and including representatives of the Directorate General Forest Protection and Nature Conservation (Ministry of Forestry), the Ministry of Environment, and a range of NGOs, is responsible for reviewing the existing MPA network and identifying gaps in the system (Pet-Soede, 2006).

The large size of Indonesia means that it is essential to consider a national MPA system in terms of several linked sub-systems, and this is being initiated at 'ecoregion' and 'seascape' level. Three areas in the Eastern Indonesia seas - Birds Head Seascape, Sunda-Banda Seascape, and Tukang Besi Archipelago - are a particular focus because of their important location between the Pacific and Indian Oceans and are being addressed through the CTI initiative. The surface water masses come from the Pacific via the North Equatorial Current, which splits at the Philippines into the northward flowing Kurishio Current and the southward flowing Mindanao Current. There are also numerous upwellings and the region is strongly influenced by the monsoons. It is a major migratory route for many large marine animals including cetaceans, sharks and rays, turtles and large fish, and the location of key feeding, breeding, calving and nesting grounds. The reefs are relatively healthy and well connected to other reefs by currents. MPA networks are being developed here for:

- **Bird's Head Seascape, Papua (North west Papua, formerly Irian Jaya):** This comprises a number of components that will be linked in overall network. CI is looking at genetic differentiation between reef species:
  - Raja Ampat MPA Network: an archipelago of c 600 islands west of Bird Head Peninsula. Important for sea turtle nesting, spawning aggregations, migrating cetaceans and high biodiversity (535 hard corals, 1149 fish species), with cool upwellings and likely high larval recruitment on account of strong currents between the Indian and Pacific Oceans. A network of seven MPAs extending over 900,000 ha was declared in May 2007, with support from TNC, WWF and CI;
  - Kaimana MPA;
  - Teluk Cendrawasih.
- **Sunda-Banda Seascape (Timor-Leste):** TNC is assisting with the development of an MPA system for this ecoregion that will involve three replicated sites. One of these is the existing Komodo National Park and WHS, of global importance for the Komodo Dragon (the largest reptile in the world) as well as its high marine biodiversity (1000 fish species, 260 coral species, ten dolphins and six whales). Representation will be addressed by ensuring adequate protection of each 'seascape' within the ecoregion. The system will address connectivity by taking migration routes into account, given the importance of the area as a corridor for turtles and cetaceans; manta rays and other species are being radio-tagged. Resilient coral reefs, such as those in cooler southern waters and deeper channels, will be protected. A series of assessments are under way and Marxan will be used to identify candidate sites. A variety of governance approaches are likely to be used, according to the needs and wishes of local stakeholders. In 2006, the Ministry of Fisheries and Marine Affairs announced its intention to designate 12 million ha (120,000 km²) in the Savu Sea as an "ecosystem-based management unit", and design a network of MPAs (Pet-Soede, 2006); work started in 2008 on the 4 million ha Savu Sea MPA supported by TNC and WWF.
- **Tukang Besi Archipelago (off the south-east tip of Sulawesi):** Includes the Wakatobi National Park. Declared in 1996, it covers 13,900 km²; TNC and WWF are assisting with the development of an MPA system.

Indonesia is included in the SSME/SSS described in section 5.2.2, the focus being Derawan MPA which is being supported by WWF and TNC. A network of MPAs is also being developed in Northern Aceh, Sumatra, where current MPAs do not achieve full habitat representation. A systematic conservation plan is being developed with a goal to protect 30% of coastal ecosystems. Satellite imagery, the bioregion approach of Meerman (2005) and Marxan are being used to develop the plan. The approach of many small areas rather than a few large areas has been chosen because of habitat complexity, variation in accessibility and the large number of stakeholders involved. The process is being strengthened by the strong support among local communities for MPAs due to a traditional management system *(Panglima laut)* (Herdiana *et al.*, 2008).

Studies into the potential for a serial marine WHS nomination in Indonesia have created the incentive to establish a multi-sectoral working group to collect existing ecological and socio-economic data, analyse threats, and review management (Steffen, 2005). It has encouraged local governments to consider the demarcation of larger areas, such as entire districts in the case of Raja Ampat (see above). National and local workshops have been held and a nomination task force with representatives of all relevant government agencies was established, which helped to establish a framework of co-operation between sites. There has also been a proposal for an Indonesia Marine Mammal Management Area (IMMMA) to be established as a marine mammal no-take zone throughout the country's EEZ (Hoyt, 2005).

5.2.5. VIETNAM - NATIONAL MPA SYSTEMS

In 2002 the Vietnamese Ministry of Fisheries (MoFI) proposed a network of 15 MPAs, composed of sites selected for their representative biological and physical characteristics[52]. To date, two sites have been established and five are going through the formal designation process. In 2006, in an effort to increase coordination and collaboration between sites, a formal MPA social network was created, a governing board nominated and by-laws established. The network has evolved to include MPA managers and practitioners from outside the MoFI MPA network, with new membership and interest coming mostly from older MPAs that were established as part of the National Park system. Initiatives have also been put in place to establish locally-managed MPAs that promote the MPA network at the grassroots level. An expert workshop was held in 2008 to share experiences, knowledge and lessons learned of MPA management and livelihood support both nationally and internationally; and to identify obstacles, challenges and opportunities for the continual improvement of MPA establishment and management effectiveness in Vietnam.

5.3. NORTH-WEST PACIFIC REGION

The North-West Pacific Region has four participating states: the People's Republic of China, Japan, the Republic of Korea and the Russian Federation, with the Democratic People's Republic of Korea as an observer. The North-West Pacific Action Plan (NOWPAP) was adopted in 1994, and the NOWPAP Data and Information Network Regional Activity Centre (DINRAC) compile national reports and is preparing a database on coastal and marine protected areas in the region.

The NOWPAP region has close and overlapping links with the EAS Region, and the growing collaboration is now being formalised through the annual International Coral Reef Initiative (ICRI) East Asia Regional Workshops that are being planned for the period 2008-2010, co-hosted by the Ministry of the Environment of Japan and ICRI Secretariat. The workshops will seek to develop a regional strategy on MPA networks in East Asia as a basis for regional cooperation.

5.3.1. CHINA - NATIONAL MPA SYSTEM

China's coastline stretches 18,000 km from temperate and subtropical to tropical zones. With 3 million km² of marine area and 6500 islands under its jurisdiction, the country hosts an exceptional marine biodiversity comprising about 20,300 recorded species, of which at least 12,000 are marine. According to the importance of their biodiversity, MPAs are designated at national or local (provincial/ municipal/county) levels. At national level, they are managed by four government agencies: the Ministry of Environmental Protection; the State Oceanic Administration; the State Forestry Administration; and the Bureau of Fisheries. The State Oceanic Administration (SOA) is charged with overall supervision, and also manages 56% of the MPAs in its own right.

There are two broad categories of MPAs: no-take marine nature reserves (MNRs) and multiple-use special marine protected areas (SMPAs). Since the 1980s, there has been a rapid increase in the number and area of MPAs and, by August 2008, the national MPA system comprised 158 MPAs, covering 3.77 million ha, or 1.26% of the total marine area under China's jurisdiction (Table 5.1, overleaf).

No-take MNRs account for 94.4% of the total area of the national MPA system. Under the Regulations on Nature Reserves (1994), the Rule of Marine Nature Reserves (1996), and the Interim Rule of Special Marine Protected Areas (2005), MNRs are usually divided into core, buffer and experimental zones, the core zones being no-entry areas with exceptions for patrolling and monitoring. In the buffer zones, authorised scientific research and educational activities are permitted, while in the experimental zones, activities compatible with nature conservation such as tourism may be conducted. SMPAs are multiple-use areas managed for the sustainable use of coastal and marine resources, and may include NTAs, ecological restoration, sustainable resource use and other zones. Compared to MNRs, the establishment of SMPAs has been a recent development, with the first SMPA declared in 2002 (W. Qiu in litt., 13.08.2008).

[52] Text from Marine Protected Area Network in Vietnam, www.fistenet.gov.vn/mpanet/index.php

Table 5.1: MNRs and SMPAs in China, August 2008 (Source: W. Qiu in litt., 13.08.2008).

	MNR	SMPA	Total
Total number of sites	146	12	158
No. sites designated at national level	32	7	39
No. sites designated at local level	114	5	119
Total area (million ha)	3.56	0.21	3.77
Area of sites designated at national level	2.29	0.13	2.42
Area of sites designated at local level	1.27	0.08	1.35
Average size of individual sites (million ha)	0.024	0.018	0.024
Average area of sites designated at national level	0.072	0.018	0.063
Average area of sites designated at local level	0.011	0.016	0.011
% of China's total marine area	1.19	0.07	1.26

5.3.2. JAPAN

The first 'MPAs' in Japan were the Marine Park Zones designated as part of National Parks and Quasi National Parks in the early 1970s. There are now 140 legally gazetted MPAs covering 56,789.5 ha, under four different designation types: Marine Park Zones in National Parks and Quasi National Parks (69 sites); Nature Conservation Areas (one site); and National Wildlife Protection Areas (18 sites). These include one WHS (Shiretoko) and 12 Ramsar sites. In addition, and less well known, are the numerous fisheries management areas (over 50 sites in 2008), most of which are self-regulated by prefectural Governments and/or local fisheries cooperatives for conservation and management of fisheries resources and fishing grounds. Both the National Biodiversity Strategy of Japan and the Basic Plan on Ocean Policy provide support for the establishment and management of MPAs, and the Japanese government is working toward achievement of the MPA 2012 targets both nationally and in cooperation with other East Asian countries.

5.3.3. REPUBLIC OF KOREA

In the Republic of Korea, research is underway to establish an integrated policy framework for the management of MPAs and coastal protected areas (Nam *et al.*, 2005). Marine and coastal protected areas can be established through nine different pieces of legislation under four different ministries. There are thus nine designation types: Wetland Protected Areas; Coastal and Marine National Parks; Fisheries Resources Protected Areas; Ecosystem Reserves; Bird Habitats; Uninhabited Islands for Special Protection; Natural Heritage; and Underwater Landscape Sites. Nam *et al.* (2005) list 423 coastal and marine protected areas covering 9,274 km² (including coastal sites that may not have inter-tidal or sub-tidal habitat). An estimated 2.1% of national waters are protected and 13.0% of the territorial sea. Plans are underway to establish a National Management Committee for MCPAs and to develop a national policy to give guidance on harmonizing approaches and methods.

In addition, in 2003, the Korea Maritime Institute proposed that a Co-managed MPA System (COMPAS) should be developed for the border area between the Republic of Korea and the Democratic People's Republic of Korea. This has not yet gone ahead because of political reasons, but initial discussions have been held on the potential for the establishment of a Marine Peace Park between the two Koreas (Nam *et al.*, 2005).

6 PACIFIC & AUSTRALASIA

6.1. PACIFIC REGIONAL SEAS PROGRAMME

The Pacific RSP (previously called the South Pacific RSP) has 24 participating states and Territories: American Samoa (US), Australia, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia (France), Guam (US), Kiribati, Marshall Islands, Nauru, New Caledonia (France), New Zealand, Niue, Northern Mariana Islands (US), Palau, Papua New Guinea, Pitcairn Islands (UK), Samoa, Solomon Islands, Tokelau (NZ), Tonga, Tuvalu, Vanuatu, and Wallis and Futuna (France).

Two regional agreements are relevant to MPAs, neither of which have a specific MPA protocol:

- The Convention for the Protection of the Natural Resources and Environment of the South Pacific region (known as the Apia Convention) which was adopted in 1976; and
- The 1986 Convention for the Protection of the Natural Resources and Environment of the South Pacific region (known as the Nouméa Convention) which entered into force in 1990.

The western concept of 'national parks' and other forms of formally protected areas have never been fully accepted in the Pacific, resulting in relatively few government-designated or managed MPAs. However, customary sea tenure is increasingly being recognised in legislation as a legitimate foundation for MPAs, which in this region are generally referred to as Marine Management Areas (MMAs). The term LMMA has also been introduced to describe the growing number of community-managed mainly reef areas, that are being established for fishery management and biodiversity protection, based on traditional conservation practices.

Several regional initiatives have been taken that have contributed to MPA establishment and the development of national networks:

- In 2002, the *Pacific Island Regional Ocean Policy and Framework for Integrated Strategic Action* was endorsed by the Pacific Island Leaders Forum. It provides guidance for national implementation of oceans policy and the protection of inshore and offshore marine biodiversity through the development of networks of MPAs including in the high seas;
- In 2003, the *Action Strategy for Nature Conservation in the Pacific Islands Region* 2003-2007, including *30-Year Goals for the Environment and Pacific Protected Area Database*, was endorsed by all 25 Member State and Territory representatives of the Secretariat of the Pacific Regional Environmental Programme (SPREP) (Small Island Developing States Network, 2003);
- In 2006, the states of Micronesia (Palau, Federated States of Micronesia, Marshall Islands, Guam and Northern Marianas Islands), announced the *Micronesia Challenge* at the CBD COP8, under which they pledged to protect 30% of their near-shore waters by 2020;
- In 2006, State and Territories Ministers of SPREP endorsed a regional initiative to support the establishment and management of MPAs as a strategic planning response to the priorities and commitments made by countries in regional and international fora and to support the implementation of NBSAPs;
- The Regional Forum *Our Sea of Islands* that was held in 2007 to share progress made and discuss priorities in MPA establishment and management[53];
- Many Pacific countries have declared their entire EEZs as whale cetacean sanctuaries.

[53] http://hawaiireef.noaa.gov/news/events/osoi/overview.html

An LMMA Network was launched in 2000[54] as a social information-sharing and co-ordinating network for individuals, projects and organisations involved in establishing and managing LMMAs and is playing a major role in promoting the protection of marine biodiversity, through its inclusion of all levels of local practitioners such as community members, traditional leaders, conservation staff, academic researchers, donors and decision-makers (ICRAN, 2005). Country LMMA leaders coordinate activities on behalf of local LMMAs. Having started in Fiji, the LMMA network is particularly active in Papua New Guinea, Solomon Islands, Federated States of Micronesia and Palau, and has spread to other countries notably Indonesia and the Philippines.

These initiatives have been supported by a number of programmes. The Coral Reef Initiative for the South Pacific (CRISP)[55], launched in 2005 in partnership with SPREP, has total funding of about US$13 million with donors including the Agence Française pour le Développement (AFD), the French GEF, the French Ministry of Foreign Affairs, the UN Foundation, CI, and WWF. The MPA component, supported by US$4 million, is implemented by CI and includes an output on marine conservation planning. About 20 MPAs in nine Pacific countries (Solomon, Vanuatu, New Caledonia, Wallis and Futuna, Fiji, Tuvalu, Kiribati, Cooks and French Polynesia) receive support, either directly or indirectly, through the LMMA network, from CRISP. A further output, implemented by the NGO Foundation of the Pacific People International (FSPI), provides support for establishing a regional social network, with cross-visits of stakeholders amongst and between different countries and regional training. Support for regional MPA networking is also provided by an internet portal called *Reefbase Pacific*[56], implemented by the World Fish Center (WFC).

In 2006, Kiribati and the United States each established new MPAs that are comparable to the Great Barrier Reef Marine Park in size and biological diversity: the Phoenix Islands Protected Area (PIPA) in Kiribati and the North West Hawaiian Islands (NWHI) Marine National Monument. PIPA, covering 410,000 km², is the world's largest MPA and includes eight atolls and two submerged reef systems. It is funded through CRISP and CI, and supported by the New England Aquarium in Baltimore which has been carrying out biological surveys. Consideration is being given to banning commercial inshore reef fishing, including by foreign vessels within PIPA, although the 50 residents will be allowed to continue subsistence fishing (Vieux *et al.*, 2004). The NWHI MPA covers some 362,600 km², representing another very large area of protected marine habitat that will ultimately have a network of no-take reserves within it. Traditional leadership, although no longer having legal authority over natural resources is still recognised in Hawaii and plays an important role. The feasibility of using customarily-declared *kapu* or closed areas in marine resource management is being studied, and there are plans for a LMMA network.

The Samoa Fisheries Project, implemented by Fisheries Division with the Australian Agency for International Development (AusAID) support, has assisted over 80 village communities to develop Fisheries Management Plans, 62 of which have set aside parts of their lagoons as reserves. An IUCN-supported project managed by the Division of Environment and Conservation of the Ministry of Natural Resources, Environment and Meteorology is working with Aleipata and Safata Districts on the management of two MPAs. Progress towards the development of MPA networks in Papua New Guinea, Palau, Solomon Islands, Fiji, New Zealand and Australia is described below.

6.1.1. PAPUA NEW GUINEA - KIMBE BAY AND MADANG LAGOON MPA SYSTEMS

In Papua New Guinea, MPA systems are being developed, using scientific ecological and socio-economic design principles combined with the LMMA concept in Kimbe Bay, with the support of a local NGO, Mahonia Na Dari, and TNC, and in Madang Lagoon, with the support of WWF and Wetlands International.

Kimbe Bay, on the north coast of the island of New Britain, lies within the Bismarck Sea, which is recognised as a globally important area for high coral diversity, pelagic fish (particularly tuna) and cetaceans. With funding from the David and Lucille Packard Foundation, TNC and Mahonia Na Dari have designed an MPA network for the Bay that is designed specifically to address resilience to climate change (Figure 13). The aim is that at least 20% of the high priority areas are effectively protected and an additional 30% in the process of being protected (Green *et al.*, 2007). This is a preliminary step in the development of a larger MPA network for the Bismarck Sea, to include two other priority areas: Tigak Islands (Kavieng, New Ireland Province) and Manus Island.

The scientific design of the MPA network was developed through a six step process, involving expert scientific advice, targeted research and monitoring, and an analytical design process. Rapid ecological assessments were undertaken to provide baseline ecological information. A scientific workshop was held with participants from TNC, local

[54] http://www.lmmanetwork.org/
[55] http://www.crisponline.net/Home/tabid/36/Default.aspx
[56] http://www.reefbase.org

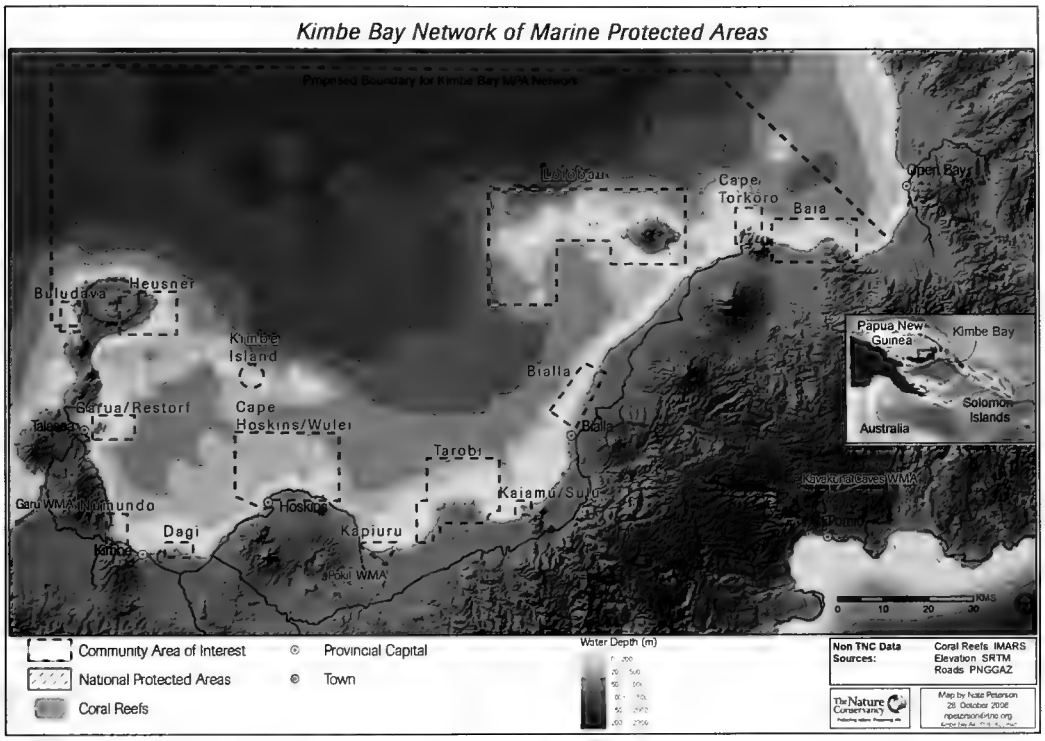


Figure 13: Kimbe Bay MPA Network. Source: TNC
The proposed Kimbe Bay MPA network, on the North Coast of the Island of New Britain, has been designed specifically to address resilience to climate change.

conservation organisations, scientists with expertise in biological, physical and social science, and representatives of local communities, industries and government agencies with an interest in the area to agree the general design principles, objectives and targets, identify specific species and habitats (targets) for protection, and define the boundaries. Specific design principles were defined which take into account both the biophysical and socioeconomic characteristics of the bay, as follows.

Representation and replication criteria were accounted for by trying to include:

- Examples of each shallow water habitat type and key oceanic habitat (e.g. seamounts);
- A "sufficient" number and area of each habitat type;
- 20 % of each habitat type;
- At least three replicate areas of each habitat type, spreading out geographically to reduce the possibility that all areas will be affected by the same disturbance;
- Areas that maximise the number of species protected;
- Sites that are more likely to be resistant or resilient to global change.

Critical area criteria were accounted for by aiming to include:

- Areas that may be naturally more resistant or resilient to coral bleaching;
- Permanent or transient aggregations of large groupers, humphead wrasses, and other key species;
- Turtle nesting areas;
- Cetacean preferred habitats (breeding, resting, feeding areas and migration corridors);
- Breeding areas for crocodiles;
- Areas supporting high diversity;
- Areas supporting species with limited abundance/distribution;
- Areas that are preferred habitats for vulnerable species;
- Areas that contain a variety of habitat types in close proximity to one another.

Connectivity criteria were accounted for by:

- Taking a system-wide approach that recognises patterns of connectivity within and among systems (particularly coral reefs, mangrove forests and seagrass beds);

- Where possible, including entire ecological units (e.g. whole offshore reefs, seamounts) and a buffer around the core area of interest. Where this was not possible, larger areas of continuous ecological units were included (e.g. coastal fringing reefs);
- Maximizing acquisition and use of environmental information to determine best configuration, taking connectivity into account;
- Using rules of thumb for MPA network design i.e. where possible AOIs were a minimum size of 10km² (10-20km in diameter) with a maximum distance of 15 km between them.

There are two objectives for the network: (1) to conserve marine biodiversity and the natural resources of the bay in perpetuity; and (2) to address local marine resource management needs. The proposed Kimbe Bay MPA network encompasses the full range of biodiversity in the Bay including deep waters, covers 19,080 km² (180 x 106 km) and has several replicated areas. Small islands, particularly those that are uninhabited and are important breeding and nesting sites for turtles and seabirds, are included. At present, there are no plans to include mainland terrestrial areas or Lake Dakataua on the Willaumez Peninsula, but other conservation initiatives are under way that may address such areas. Marxan was used to identify 15 priority conservation areas or Broad Areas of Interest (BAOI) for inclusion in the MPA network. The term AOI was used rather than MPA which is not always acceptable to local people. The AOIs were refined using manual accounting; for example, the boundaries were modified where biological, socioeconomic, and cultural interests needed to be taken into account. Lack of information meant that some of the design principles were difficult to apply such as connectivity due to larval dispersal, and inclusion of sites that are more resilient to climate change. These issues were therefore addressed through replication of sites and applying 'rules of thumb' for configuring the network. At least 20% of each habitat type is included in the AOIs for 50 of the 51 targets. 13% of the total area is included and 57% of the coral reefs. AOIs range in size from 6-724 km² with only one below the recommended minimum size of 10 km². The minimum distance between AOIs is 2-35 km with only two separated from others by more than 15 km.

Both the local no-take *tambu* system and the LMMA approach are being incorporated. Six communities have established LMMAs comprising 18 tambu coral reef areas and three tambu mangrove areas on the western side of the Bay, and one community is establishing an LMMA on the eastern side of the bay. Local communities were involved after the network was designed, because of the large number in the area (over 100) and because of fears of raising expectations too high, as it was known that there would be widespread support for the initiatives. It was also thought impractical to involve them in the highly technical process undertaken. However, the communities will make the final decisions on site establishment and TNC will continue to support them developing MPAs in each of the AOIs. It is thought that implementation will take about five years (Green *et al.*, 2007). The relative ease with which this MPA network is being established perhaps reflects the fact that Kimbe Bay at present has a relatively small population, although in a large number of communities, and low levels of both extractive and non-extractive use, although marine ecosystems, notably coral reefs, are declining (Jones *et al.*, 2004).

6.1.2. REPUBLIC OF PALAU - NATIONAL NETWORK OF MPAS

As part of the 'Micronesia Challenge', Palau has committed to protecting 30% of its nearshore waters by 2020 through the MPA component of it national network of protected areas, which is legislated for by the *Protected Areas Network Act* of 2003 (PAN). The PAN allows for designation of protected areas under a variety of categories, ranging from full protection to multiple use management areas, and involves all locally-based environment-related agencies and organisations, local communities, state and national governments, and research organisations. It also involves a number of international agencies and organisations that are providing specific assistance. Although initially conceived as a national effort, it has been recognised that planning needs to be undertaken at the individual state level which, although a slower process, will result in greater involvement and acceptance.

The MPA component is being implemented in partnership with TNC, and will be designed to incorporate principles of resilience. The process being used to develop the network involves:

- Building capacity;
- Assessing gaps;
- Developing rules and criteria for incorporating new protected areas; and
- Developing a plan.

Ecological and biodiversity data have been collected by a number of agencies, including the Palau Conservation Society (PCS), Coral Reef Research Foundation (CRRF), and the Palau International Coral Reef Centre (PICRC), but there are still knowledge

gaps. A marine ecological gap assessment was nevertheless undertaken with assistance from TNC (Verheij and Sengebau, 2007), as part of the larger process of designing the overall protected areas system. Data were gathered from a range of sources and 39 focal biodiversity features were covered. Workshops were held with representatives of the main science and resource management agencies, the communities, and state and national government in Palau to develop: (1) an agreed set of protected area design principles, conservation targets, goals and stratification and; (2) five PAN scenarios based on these, using Marxan. The scenarios covered different options for the selection of areas to meet the conservation goals, for example taking into account the extent of potential economic impacts on existing protected areas, traditional areas, and dive areas.

To ensure effective representation of the full range of environmental, geographic and hydrological variation within each system across the study area, six 'stratification units'[57] were identified for the marine component. Areas were also rated according to their 'suitability' for selection as a protected area. There are already some 27 marine protected and managed areas in Palau, and there is an active LMMA network, with several well managed LMMAs such as Helen Reef. The gap analysis showed that the existing protected areas, if well managed, meet several of the targets for marine lakes, estuaries, atolls, and sunken barrier reefs, and partly meet the remainder. A few, such as mangroves and sunken atolls, need improved representation (Corrigan *et al.*, 2007).

Both biophysical and socio-economic design principles were used. The biophysical principles focus on maximising the biological objectives of the network by taking into account key biological and physical processes as follows:

Representation and replication criteria accounted for by including:

- Representative examples of each biodiversity feature (conservation target);
- "Sufficient" number and area of each habitat type, geographically spaced to reduce chance negative impacts;
- Three replicated areas representing or exceeding % goal of each biodiversity feature;
- Representative areas based on knowledge to maximise number of species protected.

Critical area criteria accounted for by including:

- Special and unique sites including resident or transient species aggregations; and nursery areas of groupers, humphead wrasse, and other key species;
- Marine mammal and reptile preferred habitats (breeding, resting, feeding areas and migratory corridors);
- Cetacean preferred habitats (breeding, resting, feeding areas and migration corridors);
- Nesting and roosting areas given priority;
- Areas that contain a variety of habitat types in close proximity to one another.

Connectivity criteria accounted for by:

- Taking a system-wide approach which recognises patterns of connectivity within and among systems;
- Including entire biological units (e.g. whole reefs, seamounts) and a buffer around the core area.

The lack of information on currents and larval dispersal patterns means that connectivity has had to be addressed through surrogates and by ensuring sufficient representation and replication. Studies on the physical and biological characteristics and dynamics of reef fish spawning aggregations and movements of fish larvae in Palau have resulted in measures of the density of aggregated fishes that provide an additional data layer and can be superimposed on bathymetry maps and aerial photos.

6.1.3. FIJI

Fiji committed in 2005 to manage 30% of its waters as a network of MPAs by 2020 and to protecting 30% of its nearshore reefs by 2015. The Great Sea Reef Marine Protected Area was gazetted in November 2005 and covers an area of 380,000 km². In 2006, prohibition zones were established to protect the most vulnerable habitats and species.

With the assistance of the WWF South Pacific Programme, conservation priorities were established for the Fiji Islands Marine Ecoregion (FIME) through a workshop in 2003 involving some 80 participants, including scientists, government personnel, NGOs and community members (WWF, 2003b) Scientific and anecdotal information were used, and sites were identified according to their biological, geological and cultural attributes. 35 Priority Conservation Areas were identified, of which five were ranked as globally

[57] Stratification units, as used in TNC-led ecological gap assessments, are areas that are distinct in terms of their bio-geography and that are often not reflected in the distribution maps of local biodiversity features (Corrigan *et al.*, 2007).

important, 15 of national importance and 15 of sub-regional importance.

Fiji has a long established system of local marine tenure consisting of several hundred *qoliqolis* (traditional fishing grounds or customary fishing rights areas) that are under the control of the communities adjacent to them. These have been accurately mapped, delineated and bound by survey lines, with the records maintained by the Native Fisheries Commission. Management of *qoliqolis* includes temporary closures, limitations on fisher numbers and catch size, restrictions on gear types, and the use of *tabus* that prohibit fishing of certain species. Many communities still maintain these practices and *tabus* are increasingly used to protect spawning or over-exploited areas and to increase fish stocks.

Modern management techniques are being integrated with the approach, and the LMMA concept has been introduced. The first LMMA was established in Fiji at Ucunivanua village to ensure sustainable management of the *kaikoso* clam, which is a key resource for the local people. The community selected the site and imposed a five year *tabu*. Scientists from the University of the South Pacific provided training in monitoring and simple data analysis. Increased yields of the clams has meant that the *tabu* has been extended indefinitely, and the example led to other villages establishing their own LMMAs for other habitats and species. By 2005, nearly 60 LMMAs involving 125 communities had been declared, covering about 20% of the country's inshore fishery. Typically 10 to 15% of a LMMA is set aside as a closed or *tabu* area to allow recovery from fishing, the location and size of a *tabu* area being determined by the community. Management activities include the assessment of fish stocks, evaluation of potential no-take zones, and monitoring of *tabu* areas (Tawake and Aalbersberg, 2002; Aalbersberg *et al.*, 2005). The primary purpose is to recover and maintain the subsistence and artisanal value of the fishery but marine biodiversity conservation is an important added value.

The Fiji LMMA Network (FLMMA) was set up in 2001 to act as a forum for communities to share their experiences and results. The national government has formally adopted the LMMA aproach and designated a division of the Fisheries Department to work with the FLMMA, and to carry out resource assessments of all the *qoliqolis* and to help develop management plans. The focus to date has been on ensuring effective and sustainable management of existing LMMAs. In time, it will be important to measure the contribution of the LMMAs to Fiji's obligations under the CBD in terms of ecological representation and area of marine habitat under protection. This is likely to be considerable, given that a number of ecosystems, and now a large area, are covered. Furthermore, CI is undertaking research on connectivity between some of the reefs, the results of which will contribute to MPA design.

6.1.4. SOLOMON ISLANDS - WESTERN SOLOMON ISLANDS

There is one formally designated MPA in the Solomon Islands, the Arnavon Marine Conservation Area, which covers 82.7 km² of marine habitat, and approximately 21 further 'informally designated' MPAs which include the customary management areas established in the Western Solomon Islands in Roviana and Vonavona Lagoons. These two lagoons have high marine diversity and are important nurseries for bumphead parrotfish and humphead wrasse, and are within the Bismarck Solomon Seas Ecoregion (BSSE), an ecoregion defined by WWF.

Work has been underway since 1999, with technical assistance from the University of California, Santa Barbara, to establish an MPA network in this area (Aswani and Hamilton, 2004). The sites are based on customary sea tenure and management practices, and were identified using indigenous knowledge on nursery areas and spawning aggregation sites, combined with modern underwater survey methods (Reef Check method) and participatory GIS mapping. 23 MPAs, ranging in size from 25 to 300 ha, have been established to date, covering 40 km² of marine habitat or approximately 15% of all lagoon habitat. Most are permanent no-take zones, but four have dual-zoning regimes with half of the area permanently closed and the other half temporarily closed. Ten of the MPAs protect mainly coral reefs, but two also protect adjacent mangroves and swamp forest. At present, there is insufficient information on larval recruitment and dynamics to take connectivity into account. The work is now being expanded to Vella Lavalle.

6.1.5. NEW ZEALAND - NATIONAL MPA SYSTEM

The early process to establish MPAs involved much stakeholder consultation but was biased towards the protection of unique sites and rocky reefs. The first MPAs, all of which are no-take marine reserves, were established in 1975. There are about 30 marine reserves and some 7.6% of the territorial sea is protected, 99% of which is made up of two large marine reserves (the Kermadecs and Auckland Islands). Beyond the territorial sea, there are fisheries closures on 18 seamounts which, with the marine reserves, mean that about 3% of New Zealand's EEZ is protected.

The 2005 national Marine Protected Areas Policy and Implementation Plan[58] is aimed at ensuring that future MPAs form a network that is representative of all New Zealand's habitats and ecosystems and sets out a target of protecting 10% of the marine environment by 2010 (Government of New Zealand, 2006). The network will be developed using a consistent approach to classification of the marine habitats and ecosystem, and Marxan will be used (Leathwick *et al.*, 2006). An inventory will be taken of existing marine areas that have some level of protection, and the extent to which those areas cover representative habitats and ecosystems (based on the classification of habitats and ecosystems) will be assessed. A protection standard will be used to determine whether existing areas have sufficient protection to be designated as MPAs. Planning for offshore MPAs will be implemented at a national level, while planning for nearshore MPAs will be implemented at a regional level. Both the nearshore and offshore processes will be designed to allow for constructive engagement with *tangata whenua*, user groups and the public to ensure that MPA planning is inclusive, without compromising biodiversity protection. Regional fora have been set up to make recommendations on areas for marine protection and to share knowledge, for example about the various user functions and ecological values of a particular area. For example, an MPA Forum has been established on the South Islands West Coast, and forums will be set up for the Otago Southland, Sub-Antarctic Islands and Hauraki Gulf regions. Around the Kaikoura area, a community process is also underway.

In the Fjordland area of the South Island, a sub-national MPA system had already been developed through the 2005 Fiordland (Te Moana o Atawhenua) Marine Management Act. This covers a total area of 9,280 km². Eight Marine Reserves were established in addition to the two pre-existing areas, making a total system of 100 km². All the sites are no-take and there are also controls on anchoring in fragile habitats, and strengthened biosecurity measures. The process was initiated by the 'Fiordland Marine Guardians', which was formed in 1996 and represents commercial and recreational fishers, charter boats and tourism operators, scientists, conservationists, communities and indigenous people. The Guardians developed a strategy for management of the marine area, with relevant government agencies providing support. The strategy was presented to government at the end of 2003 and legislation passed in 2005[59]. Whether these closures are sufficiently ecologically representative has yet to be determined as there has been no gap analysis.

In October 2007, the New Zealand government designated a network of 17 'benthic protected areas' (BPAs) in which benthic trawling and dredging are banned. These cover 1.2 million km² of the ocean floor from the sub-antarctic waters south of Campbell Island to the sub-tropical Kermadec region and represents 30% of the EEZ. The BPAs include examples of the various marine ecosystems identified in the national marine classification, including 42% of the seamounts, which are distributed geographically and by depth throughout the EEZ (12 to 200 n.mi), are large and have simple boundaries. However, mid-water fishing is still allowed *(MPA News, 9(5) November 2007)*.

6.2. AUSTRALIA - NATIONAL AND STATE LEVEL MPA SYSTEMS

Australia's ocean territory is one of the largest marine jurisdictions in world, covering 16.1 million km² and comprising the EEZ of 8.6 million km², an 'Antarctic' EEZ and two other areas of claimable shelf. Responsibility for management of the territorial sea (up to 3 n.mi) is delegated to the States and Territories under the Offshore Constitutional Settlement 1979, except in the Great Barrier Reef region where the Commonwealth retains primary responsibility. The Commonwealth is responsible for management of the 200 n.mi. EEZ.

In 1990 the Australian Government committed to the development of a National Representative System of Marine Protected Areas (NRSMPA) (Smyth *et al.*, 2003) (Figure 14). A Task Force on MPAs (TFMPA) was established in 1992 to co-ordinate its development (excluding the Great Barrier Reef Marine Park (GBRMP)) and focused initially on developing a classification for coastal and offshore environments in order to provide a basis for locating representative areas. Mapping programmes were undertaken by government agencies, and two tools were developed:

- An Interim Marine and Coastal Regionalisation of Australia (IMCRA), which is a mesoscale (100s to 1000s km) classification of the continental shelf. Agencies use this to locate new sites, using habitat diversity as a surrogate for biodiversity. Recently the Commonwealth has developed additional offshore classifications as part of the regional marine planning and rezoning of the GBRMP;
- Ecological criteria and socio-economic considerations for identifying and selecting MPAs.

[58] http://www.fish.govt.nz/NR/rdonlyres/85FB2343-1355-45EA-A329-88C269A2A84C/0/MPAPolicyandImplementationPlan.pdf
[59] http://www.fmg.org.nz/

The *Strategic Plan of Action for the NRSPMPA* was published in 1999. This uses the IUCN definition of an MPA and aims to establish a CAR system in each jurisdiction. National targets for the level of protection or date of completion were not established, and states and territories are able to adopt their own approaches. Formal policy frameworks for representative MPA systems have been developed in Western Australia, Tasmania, Victoria, New South Wales and South Australia. For identification and selection of sites, Victoria and Tasmania have independent advisory bodies; New South Wales and Western Australia have marine park authorities; and the Commonwealth, Northern Territories, Queensland and South Australia are using conservation departments to drive the process. Planning is considered to have been most successful where independent statutory planning processes have been adopted, for example in Western Australia, Victoria and New South Wales (Edyvane, 2005).

A mainly 'science-driven' approach is being taken, with clear separation of an identification process (applying ecological criteria by scientific experts) and the selection phase (applying socio-cultural and economic criteria in consultation with stakeholders). Western Australia, South Australia and the GBRMP have developed specific scientific methodologies. The Commonwealth has adopted a more participatory approach[60], with candidate MPAs in the South-East Regional Marine Plan (SERMP) (see below) being identified by stakeholders, but it has been criticised for being insufficiently science-based. For example, major fishing areas, upwellings, key foraging areas for seals and seabirds, shark residence areas, and spawning areas for threatened fish have been generally excluded from the candidate sites (Edyvane, 2005).

There are 214 MPAs in total (Edyvane, 2005) (Table 6.1.), covering an estimated 7.5% of the EEZ, and about 3% of the EEZ is no-take. Protection of state waters ranges between 3% and 54%. In terms of representation, there is greater coverage in tropical and sub-tropical regions where tourism is a major economic driver, and in iconic or remote areas, such as the sub-Antarctic islands, where protection is

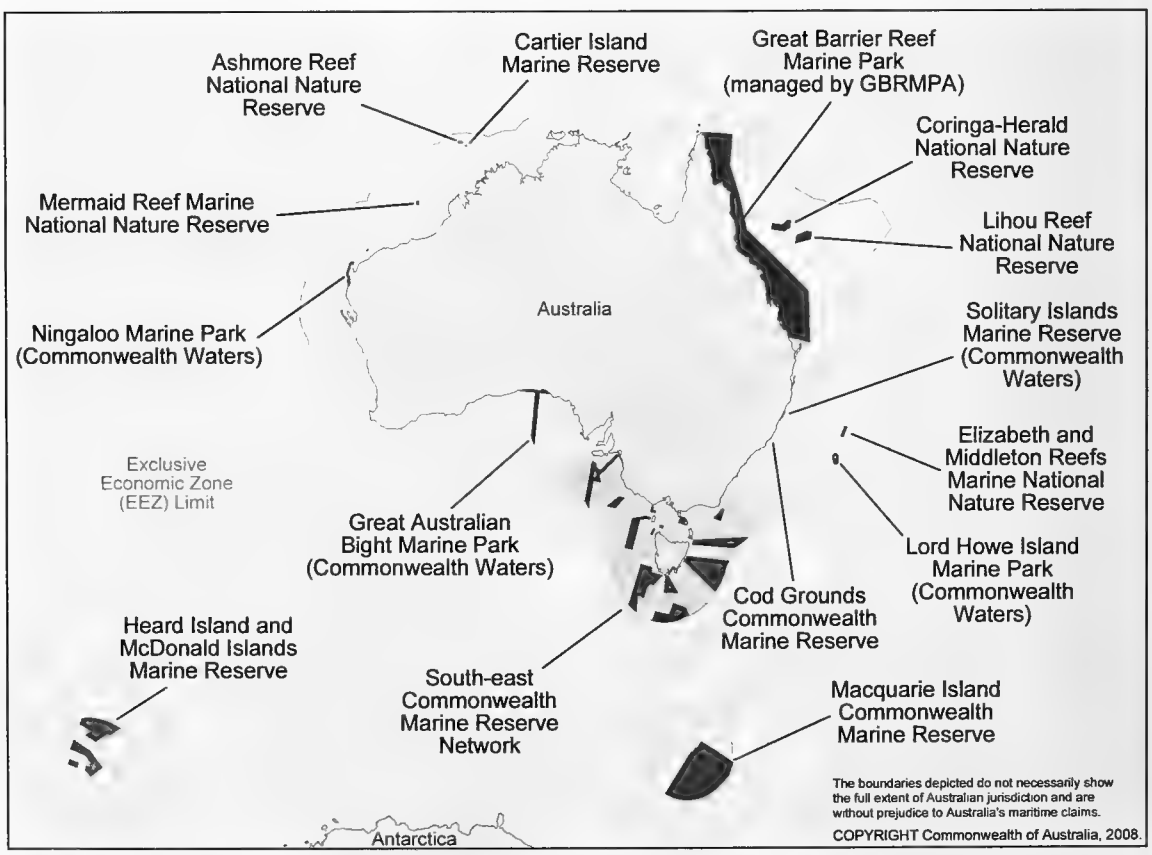


Figure 14: Australian Commonwealth MPA network, Source:Australian Government Department of the Environment, Water, Heritage and the Art
Illustrates the network of MPAs under the management of the Australian Commonwealth (State managed MPAs are not shown).

[60] Goals and Principles for the Establishment of the National Representative System of Marine Protected Areas in Commonwealth Waters http://www.environment.gov.au/coasts/mbp/publications/general/goals-nrsmpa.html

easier to achieve. There is poorer representation of cool temperate regions where the fishing and petroleum industries dominate.

There is much debate over the mechanisms being used to establish MPA systems and the results obtained in different states, and a recognised need to undertake co-operative, cross-jurisdictional planning across the continental shelf to address cross-shelf linkages and known patterns of connectivity. There is also a need for a uniform definition of ecosystems and seascapes, a more consistent use of all terminology, and the identification of common selection processes (Edyvbane, 2005). The following summarises progress being made in in the different states and regions apart from the Northern Territory where at present no system planning is in place.

6.2.1. SOUTH-EAST REGION

Designated in July 2007, this is considered to be the first network of deepwater MPAs in the world and extends to 6,000 metres in depth. The area lies outside the territorial seas and is the responsibility of the Commonwealth and the Department of Environment and Heritage, but also involves four state governments. Each site is being approved as a Commonwealth Marine Reserve. Once completed the network will comprise 13 MPAs totalling 226,000 km² within an area of 2 million km², and cover 12-15% of the coastline. 7.5% of the shelf will be protected and 81% of seamounts. NTAs will cover about 43% of the area. An additional 36% will be closed to commercial fishing but open to recreational fishing and other activities. The remainder will allow for multiple uses excluding demersal trawling, scallop dredging, and various forms of net fishing. Exploration and drilling for oil and gas and seabed sequestration of CO2 is to be allowed in all but the NTAs (Taylor *et al.*, 2005).

The network was developed by identifying 11 BAOIs through a combination of scientific modelling, bio-regionalisation of the shelf and offshore region, expert opinion and stakeholder information. Mapping of the seafloor resulted in the identification of previously unknown canyons, trenches and seamounts. Guidelines, or 'operational criteria', were developed for identifying features and regions to be included using the CAR system. For example, the network had to include at least two adjacent canyons with the intervening sea floor, to ensure replication and connectivity. A fishing 'risk assessment' was carried out to help decide on the types of fishing to be permitted in the multiple-use areas. The BAOIs formed the basis of the consultation to identify candidate MPA sites which involved all stakeholders including the oil, gas and fishing sectors. An effort was made to avoid prime fishing grounds, prospective areas for oil and gas development, and to minimise overlap between MPAs. A Scientific Reference Panel was established to advise on the information to be used, as well as a Scientific Peer Review Panel to monitor achievement of the objectives, and the government funded liaison positions in the fishing industry and conservation sector ((Taylor *et al.*, 2005). The final plan was produced in May 2006. Connectivity has been addressed, for example by taking account of linkages between the River Murray mouth, the continental shelf and slope, the Murray canyon and deeper water areas beyond *(MPA News 7(11), June 2006)*.

Table 6.1a. Summary of Stage Level MPAs in Australia. From Edyvane (2005)

	Area km²	% of state waters	no-take
Queensland	57,895	54.4	Over 33
Western Australia	14,757	12.8	c. 3
New South Wales	1,643	19.1	c. 3
South Australia	3,187	5.3	c. 1
Tasmania	1,288	5.5	c. 4
Victoria	607	5.5	c. 5
Northern Territory	2,239	3.0	c. 1

Table 6.1b. Summary of MPAs in Australia. From Edyvane (2005)

	No. MPAs	Area km²	% total MPA area
Subtotal States	183	81,549	11.7
Common-wealth	31	616,634	88.3
Total	214	698,183	100.0

6.2.2. SOUTH AUSTRALIA

This state has a coastline of over 4,000 km and territorial waters covering 60,000 km², but only one large MPA: the multiple use Great Australian Bight Marine Park which covers 1,683 km² of state waters and 19,207 km² of Commonwealth waters and was established mainly under Commonwealth direction. In 1998, *Our Seas and Coasts - a Marine and Estuarine Strategy for South Australia* was produced, followed by the *Living Coast Strategy* in which the state committed to establishing a South Australian Representative System of MPAs (SARSMPA).

A classification system was developed using IMCRA, and identifies eight bio-regions extending to the continental shelf. The plan for the MPA network, *Blueprint for the SARSMPA*, states that MPAs will be selected according to the CAR principle, in that they will be comprehensive (including the full range of ecosystems within each biogeographical region), adequate (sufficient replication) and representative. Ecologically sustainable development will be taken into account. In 2004, a target was set in the South Australia Strategic Plan, *Creating Opportunity*, to establish the SARSMPA by 2010, comprising 19 multiple use MPAs and marine parks (Shepherd, 2005). In 2008, 19 focus locations were identified, the aim being to site one MPA in each, with the exact location and boundaries to be determined using 14 design principles[61].

6.2.3. VICTORIA

In 1982, the State Government declared its intention to establish a suite of MPAs, and a Marine and Coastal Study was carried out by an independent government advisory body, the Land Conservation Council, in the 1990s. A Bill to establish a comprehensive, adequate and representative system of MPAs was tabled in 2001, and passed in mid-2002. The no-take MPA system was declared in November 2002, comprising 13 Marine National Parks and 11 Marine Sanctuaries, covering just over 5% of state waters (total area 10,200 km²) and including examples of all marine habitats (Parks Victoria, 2003). The process took ten years and involved six periods of public comment. There are also a number of other MPAs in Victoria, that are not considered part of the system, and that are multiple-use areas (termed 'marine and coastal parks'). Many terrestrial parks are declared to low-water and thus protect the inter-tidal zone; national, state and coastal parks in fact now cover half the Victorian coastline. There are still some key areas that need protection however, and 95% of state waters are outside no-take areas (Wescott, 2005).

6.2.4. GREAT BARRIER REEF MARINE PARK

A large part of the Queensland state waters lie within the Great Barrier Reef Marine Park and World Heritage Site, a multiple use MPA of 340,425 km², which is itself a 'network' comprising eight different zone types, ranging from no-take to general use. A representative network of NTAs covering 33% (100,000 km²) of the MPA was established after a process that took several years, and the revised zoning plan came into force in July 2004. The process involved the setting up of several working groups involving some 70 scientists and gathering of information in the form of GIS layers comprising 31 biological and ecological and 35 physical data sets (Fernandes *et al.*, 2005).

A Scientific Steering Committee was established to guide the process and help with the development of biophysical operational principles, and to provide advice and guidance. A second Committee was established to develop the social, economic, cultural and management feasibility principles. The principles were developed in relation to (a) biological objectives, (b) available data and knowledge of the reef, (c) available scientific knowledge of good reserve design, and (d) communications between experts. The principles were also used to help determine how to address areas subject to or threatened by human activity and also the minimum size limits for the no-take areas. Highest priority went to establishing the minimum level of no-take protection per bio-region. Decisions were taken by the management agency.

Representative examples of each of 70 broad habitat types or 'bioregions' were defined, and the levels of replication and amount of no-take area to be established were considered separately for each one. For most bio-regions, it was recommended that 20% should be protected in no-take zones (where recreation is permitted). It was recognised that protecting only representative examples of habitats or bioregions would potentially result in unique or otherwise special locations being excluded, and so a separate process was used to derive a list of such areas that needed protection[62] (Fernandes *et al*, 2005).

In 2004, the Great Barrier Reef Coast Marine Park was established to cover the inter-tidal area above marine low water mark, over which the Queensland Government has jurisdiction with zoning that mirrors that of adjacent areas of the GBRMP. There are a number of plans for new MPAs in the State but no overall system plan (Leck, 2005).

[61] www.environment.sa.gov.au/coasts/marineparks.html
[62] www.gbrmpa.gov.au

6.2.5. WESTERN AUSTRALIA

This State has about 126,000 km² of mainly shallow waters along 13,000 km of coastline, and is one of the most diverse marine regions of Australia, with rich coral reefs and mangroves and high endemism. Over 12% of the State waters are protected, but the current system is not fully comprehensive or representative (for example, only six of the 18 bioregions in the State have MPAs). However, the existing sites are considered to represent a good foundation for a state-wide MPA system, although there is no specific process for this in place at the moment (Ward, 2005).

6.2.6. NEW SOUTH WALES

The State Government of New South Wales (NSW) promised to establish a 'comprehensive system of marine parks' in 1995. In 1997, a Marine Parks Act was passed to support this, and a Marine Parks Authority was established. A number of MPAs have now been declared, which are zoned multiple-use in character, and this State has the second largest amount (19%) of state water in MPAs, although a relatively small amount is no-take. The NSW Marine Parks Research Committee has proposed that each of the State's six marine bioregions should have a large marine park by 2007, and scientists, divers and conservationists are calling for 20% of state waters to be fully protected (Anderson, 2005).

6.2.7. TASMANIA

A Tasmanian Marine Protected Area Strategy (TMPAS) was prepared by the Marine Industries Council in 2001, and a number of MPAs have been established. Two of the nine marine bio-regions in the State are well-represented in MPAs, and three have some representation. Further work to develop a comprehensive, adequate and representative system is required (Nicol, 2005).

7 EUROPE & MEDITERRANEAN

Regional programmes relevant to MPAs in Europe are highly complex with four European UNEP-RSPs, two European-wide initiatives (Natura 2000, a network of sites being established within the countries of the European Union, and the Emerald Network, a *de facto* extension of Natura 2000 to non-Community countries), and a number of other programmes. EU-Member States are also bound by the EU Marine Strategy Framework Directive, which was adopted in May 2008 and is aimed at achieving healthy European waters by 2020. Under this, Member States are required to prepare *marine strategies* that comprise an initial assessment, specification of what constitutes 'good environmental status' in state waters, a set of targets and associated indicators, a monitoring programme and a programme of measures. The programmes of measures, defined under Article 13 of the Directive and to be completed in the period 2012-2015, must address spatial protection measures in order to contribute to coherent and representative networks of MPAs that adequately cover the diversity of the constituent ecosystems. MPAs are recognised as a specific means to achieve 'good environmental status' in the marine environment.

7.1. EUROPEAN COMMISSION (EC) NATURA 2000 NETWORK

For EU Member States, 20 of which border the sea, two legal instruments require countries to designate sites that will ultimately lead to a coherent European ecological network of protected areas known at Natura 2000:

- The *Habitats Directive* allows for the establishment of Sites of Community Importance (SCIs) that are subsequently designated as Special Areas of Conservation (SACs). These provide protection for listed species (including 18 marine) and habitat types (nine of which are marine[63]). Habitat types are listed in Annex I of the Directive, and the 18 marine species are listed in Annex II; the Directive is still limited in relation to marine habitats and species, especially those offshore
- The *Wild Birds Directive* allows for the establishment of Special Protected Areas (SPAs[64]) for listed bird species (29 of which are seabirds) and for significant populations of migratory birds (many of which are marine and coastal).

Natura 2000 sites are selected on the basis of their importance for species and habitats according to criteria in both Directives, the Habitats Directive being the main driver as it sets out a statutory obligation for an ecologically coherent network of protected areas. Article 3 of the Directive requires the setting up of coherent ecological networks of SACs and this, with the SPAs classified under the Birds Directive, will form the Natura 2000 network. The network is not being designed as a single entity, but the site selection criteria in the Habitats Directive include representativity.

The marine component of Natura 2000 will be developed in the same way as the terrestrial component, through the SACs and SPAs, but specific guidelines[65] have been published by the European Commission covering both inshore waters (internal waters and territorial seas) and offshore waters (waters beyond the territorial seas where Member States exercise sovereignty rights). In 2004, at a conference on Biodiveristy and the EU in Malahide, broad consensus was reached (the 'Message from Malahide') that the marine Natura 2000 network should be completed by 2008, and management of all sites should be underway by 2010. This was re-iterated in a communication of May 2006 on 'Halting the Loss of Biodiversity by 2010 and Beyond[66].

By December 2007, EU Member States had designated 520 marine SPAs under the Birds Directive, covering 65,816 km², with 43 sites being are fully marine. A total of 1,283 marine (proposed Sites of Community Importance (pSCIs), covering 84,650 km², have been identified under the Habitats Directive, of which 205 are totally marine (Table 7.1). Most of these areas are very small (average size, from Table 7.1, is 126 km² for SPAs and 66 km² for pSCIs) and are in coastal and inshore waters, often as an extension of a terrestrial site. Initially, several

[63] Covered sandbanks; estuaries; mudflats and sandflats not covered at low tide; coastal lagoons; large shallow inlets and bays; reefs; submarine structures made by leaking gases; submerged or partially submerged sea caves.
[64] Note that the abbreviation SPA is used in two different ways in Europe: for Special Protected Areas designated under the Wild Birds Directive, and for Specially Protected Areas designated in the Mediterranean under the Barcelona Convention.
[65] *Guidelines for the establishment of the Natura 2000 network in the marine environment. Application of the Habitats and Birds Directives.* http://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf
[66] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0216:FIN:EN:PDF

Table 7.1. Numbers and areas of SPAs and pSCIs with a marine component in the European Union States (Source: Unit ENV. B2 - Nature & Biodiversity, European Commission)

Country	No. SPAs	Marine area km²	No. pSCIs	Marine area km²
Belgium	4	315	2	198
Bulgaria	3	9	8	124
Cyprus	1	21	5	50
Denmark	59	12,173	118	7,959
Estonia	26	6,654	36	3,854
Finland	66	5,567	98	5,460
France	62	3,260	94	5,688
Germany	14	16,216	48	18,086
Greece	16	567	102	5,998
Ireland	66	810	92	3,386
Italy	41	2,718	160	2,243
Latvia	4	520	6	562
Lithuania	1	171	2	171
Malta	0	0	1	8
Netherlands	6	4,895	10	4,067
Poland	6	6,726	6	3,832
Portugal	10	622	23	490
Romania	0	0	6	1,353
Slovenia	1	3	3	0.2
Spain	23	634	94	5,548
Sweden	107	3,033	325	5,849
UK	4	901	44	9,724
Total	520	65,816	1,283	84,650

Member States saw their obligations as being restricted to territorial waters but the European Commission has consistently challenged this, arguing for a more extensive scope. The Council of Ministers of EU Member States has now recognised the need for implementation of the Directives in the entire EEZ, a view that is supported by the EU Court of Justice[67]. There are already some offshore sites, most notably in Germany which committed in March 2005 to protect 38% of its marine waters as MPAs, and nominated ten Environmentally Sound Fishery Management Areas (EMPAs) within its EEZ (North Sea and Baltic Sea) to Natura 2000 in 2004. Fisheries management plans are being developed for these and Working Groups have been established to set criteria for fisheries activities in Natura 2000 sites.

7.2. EMERALD NETWORK

This was launched by the Council of Europe as part of its work under the Convention on Conservation of European Wildlife and Natural Habitats or Bern Convention which covers 51 countries including all EU states, some non-Community states (those with coasts are Norway, Iceland, Croatia, Bosnia-Herzegovina, Serbia, Albania, Bulgaria, Romania, Ukraine and Russia), and some African states (Tunisia, Morocco, Senegal and Burkina Faso, with others that may join). The Emerald Network is an extension of the ecological network process to non-EU States and allows for the establishment of 'areas of special conservation interest' (ASCIs).

[67] Judgment of case C-6/04 of 20 October 2005, and other Member States Courts' positions (such as the UK Case nºCO/1336/1999 The Queen -v- The Secretary of State for Trade and Industry ex parte Greenpeace Limited.)

7.3. MEDITERRANEAN REGIONAL SEAS PROGRAMME

There are numerous MPA network initiatives in the Mediterranean, which is recognised as a global biodiversity hotspot, is listed in the top 15 marine hotspots by CI and is on the WWF Global 200 list (GEF, 2005). Although there is some concern that European initiatives do not treat the Mediterranean as a complete region, but as a sub-region of other broader initiatives, this largely enclosed sea is increasingly managed as a single unit. The countries bordering the northern Mediterranean shores participate in relevant European protected area initiatives including Natura 2000 and the Emerald Network, while those in the south and east participate in African and Middle Eastern initiatives respectively. All countries are involved in the Mediterranean RSP, Ramsar sites, and MaB Biosphere Reserves. Broad social networks include the Pan-European Biological and Landscape Diversity Strategy, Parks for Life, the EUROPARC Federation, and the WWF conservation and training regional programmes.

For most countries bordering the Mediterranean, their jurisdiction stops at the 12 n. mi territorial seas limit, areas beyond this being defined as high seas. Mediterranean states however have the right to establish an EEZ but so far have been reluctant to do so or, at least to give effect to such a claim. This is partly because of the problems of delimitation in this relatively small area and also because of the desire of most states to preserve freedom of navigation, naval mobility and access to fisheries. At least three Mediterranean states have taken preliminary steps: Morocco, Egypt and Croatia, but further negotiations are required. Spain and France have proclaimed a 200-mile EEZ but stated that this is not applicable to Mediterranean waters, although they have extended their jurisdiction beyond their territorial seas by declaring ecological or fisheries conservation zones (Notobartolo di Sciara, in litt., March 2008; Cacaud, 2005).

Specific Mediterranean MPA programmes underway include:

- **Mediterranean Action Plan (MAP) and Regional Activity Centre for Specially Protected Areas (RAC/SPA):** see below;
- **MedPAN:** A social network first established in 1990 and then relaunched in 2005. It is co-ordinated by WWF-France and brings together 23 partners (14 European and nine non-European) from 14 countries representing over 40 MPAs. MedPAN is working towards the creation of new sites, with much emphasis on training and facilitating exchange between sites[68];
- **Mediterranean Wetlands Initiative (MedWet):** Established in 1991 and recognised in 2002 as a formal regional initiative under the Ramsar Convention, it involves 25 countries and is developing a marine component;
- **IUCN Centre for Mediterranean Co-operation:** Leads a number of activities, in collaboration with the WCPA Marine Mediterranean Group (WCPA MMED);
- **Med-MPA project:** An EU-funded project involving Algeria, Cyprus, Israel, Malta, Morocco, Syria and Tunisia, this initiative aims to create MPAs and strengthen their effectiveness in the eastern and southern Mediterranean (Etienne, 2005). From 2008, a new five-year extension of the initial 2003-2005 project will be undertaken by the Regional Activity Centre for Specially Protected Areas (RAC/SPA) and WWF with support from the EC, FFEM, the MAVA Foundation and the Spanish Agency of International Cooperation for Development (AECID). It will continue work in the countries involved in the first phase (apart from Cyprus, Israel and Malta) and will be extended to Libya, Egypt, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Lebanon and Turkey;
- **Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean and Contiguous Atlantic Area (ACCOBAMS):** At the ACCOBAMS meeting in Dubrovnik 2007, it was agreed that a network of MPAs for cetaceans should be established in the region.

The MAP, the first Action Plan for a RSP, was adopted in 1975. It is implemented through the Programme for the Assessment and Control of Pollution in the Mediterranean region (MedPOL) and six regional activity centres. The Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (the Barcelona Convention) was adopted in 1976, entered into force in 1978, and was amended in 1995, these latter amendments entering into force in July 2004. A Protocol Concerning SPAs was signed in 1982, and replaced in 1995 by the Protocol Concerning SPAs and Biological Diversity (SPA/BD), which entered into force in 1999. Responsibility for its implementation lies with the RAC/SPA in Tunisia. Under Article 8 of the Protocol,

[68] www.medpan.org

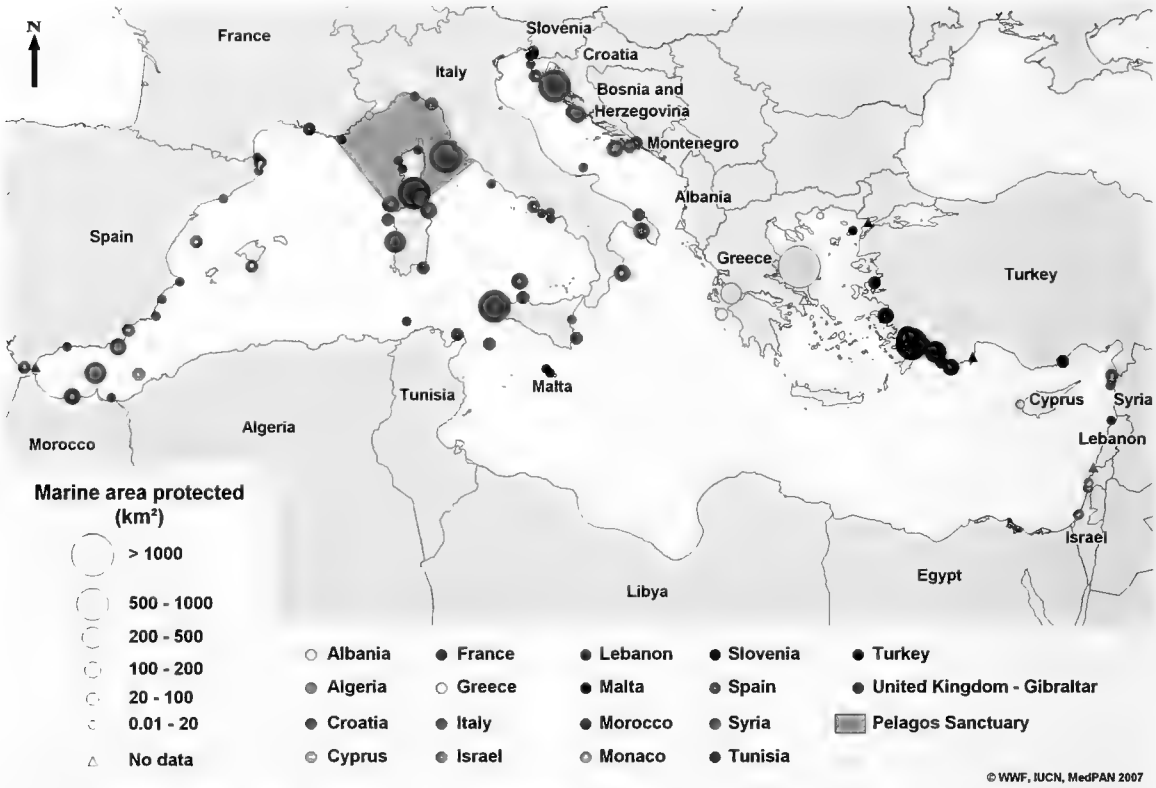


Figure 15: Mediterranean MPAs identified by IUCN, MedPan and WWF. Source: WWF
Illustrates Mediterranean MPAs identified in a recent survey by IUCN, MedPAN and WWF (http://www.medpan.org/_upload/1120.pdf).

Parties to the Barcelona Convention should draw up a 'List of Specially Protected Areas of Mediterranean Importance', known as the SPAMI List. This includes sites within territorial waters and on the high seas that are:

- Of importance for conserving the components of biological diversity in the Mediterranean;
- Contain ecosystems specific to the Mediterranean area or the habitats of endangered species;
- Of special scientific, aesthetic, cultural or educational interest.

By the time of 15th Barcelona Convention COP (Almeria, 15-18, January 2008), the SPAMI List comprised 21 MPAs (UNEP, 2008), but many other protected areas include marine habitat. The 2005 directory of Mediterranean MPAs compiled by WWF-France, the RAC/SPA, and the EU (Mabile and Piante, 2005) lists 74 MPAs, defined using stricter criteria than the IUCN definition, and stipulating that a site must have a clear marine objective, legal basis, regulations on use, and a management body. A database established for the West Mediterranean (including Spain, Gibraltar, France, Monaco, Italy, Malta, Tunisia, Algeria, and Morocco) by the IUCN Centre for Mediterranean Co-operation (Broquere, 2005), uses a broader definition than that used for SPAMIs and includes sites protected for fisheries management (71 sites) and cultural (50 sites) reasons. A total of 121 MPAs, with more than 20 different designation/categories were placed under the umbrella of the Barcelona Convention in March 2007 (GFCM, 2007). The WDPA lists 252 MPAs, of which over 50% lie within the waters of France, Italy and Spain. Many sites in the WDPA have inter-tidal habitat only or are coastal lagoons with brackish water and tidal exchange of marine water, such as the sites in France that are acquired by the 'Conservatoire du Littoral' and often have little, if any sub-tidal water.

An estimated 3% of the total Mediterranean coastline is included in SPAs, and these cover an estimated 1.1% of the total area of 2,513,698 km² (Gugliemi, 2004; CIESM, 1999; Francic, in litt., Sept 2006). The establishment, in 2002, of the Pelagos Sanctuary for Mediterranean Marine Mammals (Notarbartolo di Sciara *et al.*, 2008), which includes high seas as well as the territorial national waters of Italy, France and Monaco, represents a major increase as it covers some 87,500 km², or 3.5% of

the Mediterranean basin (Mabile and Piante, 2005). Existing MPAs do not, however, constitute a representative system (Notarbartolo di Sciara, 2005), with most in inshore waters, apart from the Pelagos Sanctuary. There are also many more sites are located in the north than in the south, and in the west compared to the east.

In 2000, the following targets were set under a UNEP/GEF project, the Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region (SAP/BIO), which is implemented by the RAC/SPA:

- By 2012, increase by 50% the coverage of MPAs compared to 2003 (when, according to the project document, there were over 150 MCPAs, of which an estimated 52 had inter-tidal and sub-tidal habitat);
- By 2012, protect 20% of the coast as marine fishery reserves.

In 2004, at a workshop led by the IUCN WCPA-MMED, a process to establish a region-wide system of ecologically and culturally representative 'networks' to complement the existing networks of SPAMIs and Natura 2000 was discussed. It was agreed that the concepts of representativeness, defined at habitat level, and uniqueness should be incorporated and that the criteria listed in Annex 1 of the SPA Protocol could be adopted for the design of national systems. Steps were laid out for developing a system, including a proposal for a gap analysis (Notarbartolo di Sciara, 2005). The Port Cros Declaration, drawn up in October 2007 during the first MedPAN conference, supported by IUCN and RAC/SPA, reinforced the targets of the SAP/BIO through the recommendation that a coherent, representative and effectively managed ecological network of MPAs should be established in the Mediterranean by 2012.

Given the limited human and financial resources available, particularly in Southern and Eastern countries, there is a need to improve synergies between existing networks and plans, given their similar objectives and priorities (UNEP, 2006a). Recommendations for improving Mediterranean MPA networks include:

- Creating sub-regional networks linked to other efforts at a pan-Mediterranean scale. For example, the RAC/SPA, IUCN, MedWet, WCPA and WWF, together with sub-regional working groups from the existing European networks (Natura 2000, Emerald, EUROPARC, PEEN) could collaborate through SAP/BIO in a sub-regional network, sharing a common action plan focused on two or three of the main thematic priorities and promoting pilot projects making full use of, and building on, the already existing initiatives;
- Establishing common management standards and field programmes between Natura 2000, Emerald Network and the RAC/SPA system to serve as a basis to expand European support to the Mediterranean region; the existing bilateral agreements (RAC/SPA with MedWet; MedWet with WWF; Ramsar with MaB) are potential starting points;
- Establishing transboundary protected areas linked to international organisations and Conventions, such as in the High Seas, in order to foster the development of joint multilateral conservation programmes, under the *aegis* of international conventions[69];
- Consider initiatives for NTAs, particularly with the EU.

Support from the EC to the Mediterranean RSP in 2008, is permitting the development of a process to start identifying MPAs in areas beyond national jurisdiction (ABNJ) in the Mediterranean, in order to achieve their protection under the umbrella of the SPA/BD Protocol. In 2008-2009, a group of experts will prepare a short list of potential Mediterranean High Seas sites qualifying as SPAMIs. The process involves an in-depth assessment of ecological knowledge of the Mediterranean High Seas (deep sea included) and production of an inventory of its known biodiversity values and an analysis of knowledge gaps. Numerous stakeholders are to be involved including: governmental agencies; relevant UNEP MAP structures and ACCOBAMS; international NGOs (such as IUCN Med and WWF); public and private institutions related to the use of Mediterranean Sea goods and Services; and the Commission Scientifique de la Méditerranée (CIESM). The main deliverable of the first phase will be a proposal for the designation of several SPAMIs, scientifically based, to be followed by a second process to assure the support by Mediterranean countries, NGOs and stakeholders. Actions will be carried out under the direction of MAP Coordinating Unit and managed by the RAC/SP. Greenpeace had previously proposed the establishment of a network of NTAs across the entire Mediterranean Sea. 32 areas were identified, in both 'coastal' waters and high seas, covering roughly 40% of the sea (Greenpeace, 2005), and including representative examples of the region's habitats, as well as areas known to be spawning and nursery grounds. Selection was based on a manual analysis of data gathered from a variety of sources and feedback from scientists.

[69] For example, immediate action is essential to protect seamounts and other vulnerable deep-sea ecosystems and to improve implementation of the existing legal framework for oceans governance (IUCN-WCPA-WWF 2003).

At the national level Croatia has attempted to develop an MPA network (see below). In Italy, an initiative called *Sistema Afrodite* was set up in 2001 by the Central Institute for Applied Marine Research (ICRAM) (Greco *et al.*, 2004) aimed at bringing together the Italian MPAs as a social network. This was aimed at helping to standardise research, harmonise monitoring approaches and establish a country-wide programme on assessing management effectiveness. A first assessment of effectiveness has been produced (Guidetti *et al.*, 2008).

7.3.1. CROATIA - PROPOSED DALMATIAN COAST MPA SYSTEM

The 5,037 km coastline of Croatia is characterised by numerous archipelagos and chains of islands and rocky outcrops that run parallel to the coast and result in highly diverse ecosystems and marine communities. There are an estimated 79 islands (of which 48 are permanently inhabited), 526 islets and 641 reefs and rocks. Although these make up only 6% of the total land mass of Croatia, they account for 70% (4,057 km) of the coastline. The Dalmatian coast of Croatia has thus been recognised by WWF as one of 13 high biodiversity sites in the Mediterranean - the Dinaric Alps and Dalmatian Coast Conservation Planning Area (WWF, 1998) - and the need for an MPA system is well recognised, particularly given the importance of this coast for the rapidly developing tourism sector.

The WDPA lists 19 MPAs but only eight of these have confirmed sub-tidal or inter-tidal habitat (Jakl e-mail, 13/9/2006), covering about 318 km², or about 1% of Croatian territorial waters. They are mainly terrestrial protected areas that include marine habitat. In addition, two new MPAs are in the process of gazettement: Lošinj Dolphin Reserve, which is a fully marine area and the largest MPA (526 km²) in the Adriatic; and Lastova Nature Park (terrestrial and marine). Once these are established, marine coverage will rise to over 980 km² (Jakl, e-mail 13/9/2006), or about 3.1% of Croatian territorial waters. Under the land use plans of each of the four coastal 'counties' a number of other areas are proposed, but these have not been selected under any harmonized criteria and may not necessarily function as an ecologically representative system.
A planned UNDP/GEF project 'COAST' was designed to provide some of the enabling environment for MPA establishment, in that it was aimed at the development of an ICM strategy for the country and the sustainable use of coastal and marine resources. A proposal was drawn up for a more detailed project to develop an MPA system (Frankic, 2005a and b) but so far funding has not been found. A national MPA system would need to be considered at three scales:

- Coast: The inshore and estuarine areas where there are already a number of terrestrial protected areas that would be made part of the broader system. For example, through 'green corridors' and improved management of existing protected sites, such as Limski and Malostonski Zaljev;
- Islands and their coastal waters: This will need the involvement of local communities, and an early socio-economic assessment, given the economic importance of this area. Smaller biodiversity hotspots need to be defined and conservation efforts need to be focused on these priority areas;
- Open sea: The Croatian maritime zone covers 31,720 km², with an additional 27,205 km² recently claimed beyond the territorial seas limit as an 'ecological and fisheries zone'. It is recommended that there should be a network of no-take zones and 'blue corridors' in this larger area, and specifically areas 'managed by specially developed fishery management measures'.

7.4. BLACK SEA REGIONAL SEAS PROGRAMME

The Black Sea RSP has six participating states (Bulgaria, Georgia, Romania, Russian Federation, Turkey and Ukraine). The Convention on the Protection of the Black Sea against Pollution (known as the Bucharest Convention) was adopted in 1992 and entered into force in 1994. Its aims include preserving representative types of coastal and marine ecosystems, wetlands, and other critical habitats. A Biological Diversity and Landscape Protection Protocol, signed in 2003, encourages contracting parties to establish protected areas to protect and preserve areas of particular biological or landscape value, and to manage these in a sustainable and environmentally sound way.

A Strategic Action Plan for the Rehabilitation and Protection of the Black Sea was adopted in 1996 and revised in 2002. The Commission for the Protection of the Black Sea against Pollution and its Permanent Secretariat acts as the coordinating mechanism for the implementation of the Convention and SAP and has launched projects that include establishment of, and preliminary studies on, Specially Protected Areas and MPAs (Black Sea Commission, 2005).

Since this region is just embarking on MPA establishment, it is too early to comment on regional progress towards the CBD target. According to Hoyt (2005), there were 63 MPAs in 2002, and a further

43 proposed MPAs. The main site is the Danube Delta Biosphere Reserve, 1,939 km² of which (or about 50% of the total area) is marine.

7.5. OSPAR NETWORK OF MPAS IN THE NORTH-EAST ATLANTIC

The Oslo-Paris (OSPAR) Commission[70] for the protection of the North-East Atlantic has 15 participating states: Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK, together with the European Union. Finland, Switzerland and Luxembourg do not have marine habitat in the North-east Atlantic, and thus are not directly concerned with the issue of MPAs. Their involvement in the OSPAR Commission is primarily in relation to land-based sources of pollution.

The Convention for the Protection of the Marine Environment of the North-East Atlantic (known as the OSPAR Convention) was ratified in 1992. In 1998, the Strategy on the Protection and Conservation of Ecosystems and Biological Diversity of the Maritime Area (Annex 5 of the OSPAR Convention) was adopted. In 2003, a commitment (Recommendation 2003/3) was made by the OSPAR Contracting Parties to establish an 'ecologically coherent network of well-managed MPAs in the North-East Atlantic by 2010' (Gjerde and Breide, 2003)(Figure 16).

Contracting Parties have agreed to identify and select MPAs within their waters in accordance with the OSPAR Guidelines (OSPAR, 2006 and 2007d[71]) and to report these to the OSPAR Commission as components of the OSPAR network. The main criteria for selection of sites are the presence of a species or habitat in need of protection (as identified on the initial OSPAR List of threatened and/or declining species and habitats), ecological significance, high natural biodiversity, representativity, sensitivity and

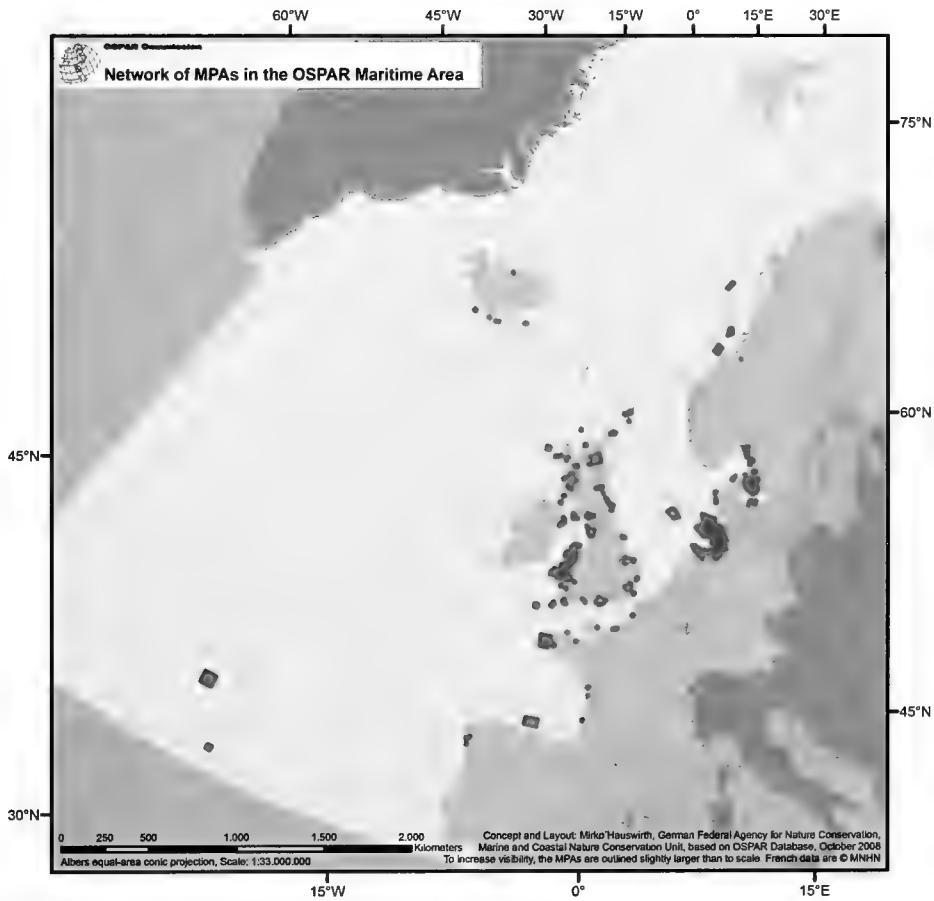


Figure 16: OSPAR network of Marine Protected Areas. Source: OSPAR
The OSPAR network of MPAs (as of Dec, 2007). Most recently designated MPAs are highlighted in red, whereas those previously in existence are highlighted in green.

[70] http://www.ospar.org/
[71] http://www.ospar.org/asp/ospar/download.asp?ftp=%5C%5Cserver%5Corg%5Cdbase%5Cdecrecs%5Cagreements%5C03%2D17e%7E2%2Edoc&function=4

Table 7.2. Number and area of MPAs nominated for the OSPAR network. (Source: OSPAR Commission 2006)

	MPAs	Km²
Belgium	0	0
Denmark	18	5,399
France	8	275
Iceland	0	0
Ireland	0	0
Germany	4	11,923
Netherlands	0	0
Norway	6	1,905
Portugal	8	5,698
Spain	1	85
Sweden	6	972
UK*	55	11,921
TOTAL	106	38,178
OSPAR area**		13,618,510

*Areas for the three Northern Ireland UK sites are estimates based on Natura 2000 marine area. Actual OSPAR numbers have not yet been received.
**Not all of the OSPAR Maritime Area is navigable with significant ice cover in the Arctic region.

naturalness. Existing MPAs such as SACs or SPAs under the EC Habitats and Birds Directive may contribute to the OSPAR network. OSPAR has also developed guidelines for the management of the MPAs that are part of the network.

There is close collaboration with the Baltic states through the Helsinki Commission (HELCOM) (section 7.6) because of common membership by some states, and a joint target of achieving an ecologically coherent network of well-managed MPAs by 2010 (Gjerde and Breide, 2003; Helsinki Commission 2005). The joint OSPAR-HELCOM work programme on MPAs involves:

- Development of co-ordinated approaches for the compilation and evaluation of proposed MPAs;
- Evaluation of the status of MPA proposals by 2006;
- Identification of the gaps and necessary steps to be taken;
- Development of guidance for the application of the management guidelines and for assessing the effectiveness of management of MPAs.

The OSPAR process is also reinforced by a second framework, the North Sea Conference, which is ratified by the countries that border the North Sea. In 2002, the Fifth International Conference on the Protection of the North Sea adopted the Bergen Declaration, which states that:

By 2010, relevant areas of the North Sea will be designated as MPAs belonging to a network of well-managed sites safeguarding threatened and declining species, habitats and ecosystem functions, as well as areas which best represent the range of ecological and other relevant character in the OSPAR area.

By the end of 2007, the OSPAR network comprised 106 MPAs selected by Denmark, France, Germany, Norway, Portugal, Spain, Sweden and the UK, and covered an area of 38,173km² (Table 7.2). The MPAs selected, most of which are part of the Natura 2000 network, provide protection for a range of features including offshore ecosystems such as *Lophelia pertusa* reefs, seamounts and hydrothermal vents. The UK has nominated the largest number of sites, and Germany the largest area. The Netherlands has not yet designated any but will be designating some of its Natura 2000 sites. WWF Netherlands has drawn up a list of suitable sites for nominating as OSPAR sites (Hugenholtz, 2008). Not all nationally designated MPAs are considered part of the OSPAR MPA network, and the WDPA (September 2006) lists over 600 MPAs in the North-East Atlantic Region.

In order to assess ecological representation, the OSPAR maritime area has been divided into three *biomes* within which there are *provinces* and *sub-provinces*, as follows:

1. *Pelagic:* Waters less than 1,000m in depth, with three provinces;
2. *Shelf and Slope:* Waters and the seafloor to a depth of 1,000m, with 17 provinces and sub-provinces;
3. *Deep Sea:* Waters and the seafloor deeper than 1,000m, with two provinces.

There are 22 provinces in total, of which 11 have no MPAs (Table 7.3). The 'boreal' province (within the Shelf biome) has greatest protection, with 3.72% of the area lying within MPAs (OSPAR Commission, 2006).

This initial network is not yet ecologically coherent or well managed with most nominated sites in territorial waters (OSPAR Commission, 2007a), although Germany and Norway have nominated offshore sites within their EEZs. Norway has designated several sites for the protection of cold-water coral reefs,

Table 7.3 Bio-geographic Representation of MPAs nominated for the OSPAR network (Source: OSPAR Commission 2006)

Biome	(Sub-) Region	Province	MPAs	Km²	% Cover
Pelagic	Arctic	N/A	0	0.0	0.00
	E. Atlantic Temperate	Cool-temperate	92	32,242.0	0.48
	E. Atlantic Temperate	Warm-temperate	14	5,936.1	0.17
Shelf	Arctic	Barents Sea	0	0.0	0.00
	Arctic	Barents Sea: White Sea	0	0.0	0.00
	Arctic	High Arctic Maritime	0	0.0	0.00
	Arctic	NE Greenland Shelf	0	0.0	0.00
	Arctic	NE Water Polynya	0	0.0	0.00
	Arctic	SE Greenland, N Iceland	0	0.0	0.00
	E. Atlantic Temperate	Boreal	61	26,671.7	3.72
	E. Atlantic Temperate	Boreal-Lusitanean	23	3,125.2	0.69
	E. Atlantic Temperate	Lusitanean-Boreal	4	130.4	0.09
	E. Atlantic Temperate	Lusitanean Cool	1	85.4	0.17
	E. Atlantic Temperate	Lusitanean Warm N	1	22.0	0.05
	E. Atlantic Temperate	Lusitanean Warm S	0	0.0	0.00
	E. Atlantic Temperate	Lusitanean (cool and warm)	2	107.4	0.09
	E. Atlantic Temperate	Macaronesian: Azores	4	1,376.4	6.10
	E. Atlantic Temperate	Norway: Finnmark	0	0.0	0.00
	E. Atlantic Temperate	Norway: Skagerrak	4	543.4	2.23
	E. Atlantic Temperate	Norway: W. Norwegian	4	1,901.7	0.55
	E. Atlantic Temperate	Norwegian Coast (all)	8	24,45.07	0.56
	E. Atlantic Temperate	S Iceland-Faero Shelf	0	0.0	0.00
Deep Sea	Arctic	N/A	0	0.0	0.00
	Atlantic	N/A	4	4,321.9	0.06

including the Sula reef (closed to bottom trawling), Røst Reef and the Seligrunnen (Hain and Corcoran, 2004). Portugal has proposed a number of sites for the protection of hydrothermal vent comunities in its EEZ around the Azores, and the Rainbow Hydrothermal Vent Field, located on the Portuguese legally extended continental shelf, already forms part of the network.

Further identification and selection of sites will continue and OSPAR will prepare annual reports on the status of the OSPAR network of MPAs up to 2010. A first guidance document setting out principles for the ecological coherence of the network has been published (OSPAR Commission, 2007b), criteria for evaluating the ecological coherence of the network are being applied, and a tool for assessing the effectiveness of management across the network has been developed (OSPAR Commission, 2007c).

The Mapping European Seabed Habitats (MESH) project is producing seabed habitat maps for North-West Europe (including the North Sea), and is an important component of the process to develop an MPA network in this region. It will result in a meta-database of mapping studies, a web-delivered GIS showing the habitat maps, guidance for marine habitat mapping including protocols and standards, a report describing case histories of habitat mapping, a stakeholder database and an international conference with published proceedings[72].

The OSPAR Maritime Area covers waters extending from the territorial seas boundary (12 n mi) through the EEZ to the High Seas. Some 40% of the Area is high seas and there is thus an opportunity to establish a regional system of MPAs that includes offshore, pelagic and deep sea marine environments. The OSPAR Commission has agreed to consider reports and assessments from Contracting Parties and observers on the need for protection of the biodiversity and ecosystems in the maritime area outside the jurisdiction of the Contracting Parties, in order to achieve the purposes of the network set out in OSPAR Recommendation 2003/3. If appropriate, and in accordance with the United Nations Convention on the Law of the Sea (UNCLOS), OSPAR will consider, in consultation with the international organisations having the necessary competence, how such protection could be achieved. WWF has compiled an inventory of MPAs[73] and a directory of offshore features and proposed offshore MPAs and proposed protection of 60% of cold water coral reefs in the North-East Atlantic. The proposed 'Charlie Gibbs Fracture Zone' (CGFZ) located on the Mid-Atlantic ridge, was approved as a potential MPA in 2008 by the OSPAR Commission and a further seven sites are being recommended for peer review by ICES. A 'road-map' has also been agreed, which sets

[72] http://www.searchmesh.net/default.aspx
[73] http://www.ngo.grida.no/wwfneap/Projects/Reports/Treasures.pdf

the steps to be undertaken in order to adopt HSMPAs at the OSPAR Ministerial Meeting in 2010. In July 2008, OSPAR adopted an MOU with the North-East Atlantic Fisheries Commission (NEAFC) concerning cooperation in the management of ABNJ (NEAFC, 2008) (see also section 8.3).

7.5.1. UNITED KINGDOM (UK) - PROPOSED NATIONAL NETWORK

The UK has over 200 sites with protected inter-tidal and sub-tidal habitat. As of 2007, total marine area protected is 9,841 km² or about 6.3% of inshore waters and includes (Boyes *et al.*, 2005; Gubbay *et al.*, 2007):

- 76 marine SACs, all of which are coastal, including many estuaries and other inshore waters, and covering just over 1% of UK waters. These are multi-use MPAs, where activities such as shipping, fishing, marine recreation and sometimes dredging are permitted. Activities that threaten listed habitats and species (essentially those that are regionally important) are restricted and controlled through Environmental Impact Assessments (EIAs). The Darwin Mounds (cold-water corals), closed to bottom trawling since 2004, have been designated as a SAC and represent the first deep water MPA in the UK.
- Three Marine Nature Reserves covering 209 km² or 0.0006% of inshore waters of which only the 3 km² Marine Reserve off Lundy is a NTA.
- 72 marine SPAs covering a total area of about 710 km². Areas of high seabird density are considered to be well protected but not all are managed effectively.

Several other designations afford protection to inter-tidal and marine habitats, including Heritage Coast, National Nature Reserves, National Scenic Areas, Areas of Outstanding Natural Beauty, and voluntary marine nature reserves, some of which have been in place for many years.

The 2007 White Paper 'A Sea Change' proposes the designation of a network of MPAs by 2020 within a broader marine spatial planning framework. The network would comprise 'Marine Conservation Zones' which may be either multiple use MPAs or NTAs. This approach has been adopted in the Marine Bill which lays out the intended framework for introducing a national marine planning system, but it has yet to be passed as legislation. Lists of representative marine habitats and Nationally Important Marine Features have been prepared, and studies undertaken of existing legislation and mechanisms that provide for spatial planning in the marine environment such as fisheries (for example, Fisheries Boxes - which prohibit fishing of certain commercial species in certain areas at certain times), shipping (for example, Sensitive Sea Areas), military activities, archaeology (including wrecks), marine aggregates (such as the licensed extraction areas) and safety zones around cables, pipelines, oil/gas platforms and windfarms (Boyes *et al.*, 2005; Gubbay, 2005). A set of principles for planning and management of the UK network have been developed (Stevens *et al.*, 2006).

England, Scotland, Wales and Northern Ireland are autonomous within the 12 n.mi limit for establishment and implementation of MPAs and work through their respective conservation agencies (Natural England, Scottish Natural Heritage, Countryside Council for Wales and the Council for Nature Conservation and the Countryside). In England, a conference was held by Natural England in 2007 to look at progress being made so far to establish the MPA network (Gubbay *et al.*, 2008), in the context of its target of establishing a coherent network of 'Marine Conservation Zones' by 2012. Four regional projects are being set up around the coasts of England to recommend an ecologically coherent network to the Secretary of State by 2011. In Scotland, discussions are underway to develop a strategy incorporating a system of Marine Spatial Planning and a network of protected areas around the coast and sea to conserve species and habitats of Scottish importance.

The Joint Nature Conservation Committee (JNCC) provides a co-ordinating and advisory role to ensure that overall UK and international responsibilities for biodiversity conservation are delivered, and has been supporting all four conservation agencies in their MPA work. It is also responsible for identifying offshore areas, for which seven proposals have been prepared, with survey work underway for an eighth (the Dogger Bank) (Gubbay *et al.*, 2008).

7.6. HELCOM NETWORK OF BALTIC SEA PROTECTED AREAS

The Baltic Region has nine contracting parties: Denmark*, Estonia, Finland*, Germany*, Latvia, Lithuania, Poland, the Russian Federation, Sweden* and the European Commission. Four states (marked with*) are also members of OSPAR. The Convention for the Protection of the Marine Environment of the Baltic Sea Area (known as the Helsinki Convention) was first signed in 1974 and a revised version was adopted in 1992. HELCOM is the governing body of the Convention. The Convention is primarily oriented to preventing pollution but since 1994 has addressed MPAs as a result of the HELCOM Recommendation

15/5 on a 'System of Coastal and Marine Protected Areas' which required contracting parties to '*protect representative ecosystems of the Baltic*'. The initial proposal was for 62 MPAs, with a further 24, mainly offshore, sites proposed in 1998 (Hägerhäll and Skov, 1998).

In 2003, a joint work programme was initiated by the HELCOM and OSPAR countries with the aim of establishing an MPA network of Baltic Sea Protected Areas (BSPAs) by 2010 that, together with the EU Natura 2000 sites, would be ecologically coherent. In 2004, with funding from the EU, Germany and WWF, a comprehensive database on MPAs in the Baltic Sea[74] was established.

In 2005, an EU funded project BALANCE - *A Network of MPAs in the Baltic Sea, Skagerrak and Kattegat* (Baltic Sea Management - Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning)[75] was initiated, involving a consortium of 27 government agencies, research institutions, universities, regional authorities and NGOs in eight countries, to assist with the implementation of the network. Through this project, tools and guidelines for marine spatial planning in the Baltic Sea, Skagerrak and Kattegat were developed, criteria and methods for assessing and identifying MPAs were prepared and the concept of 'blue corridors' (channels or a routes of particular importance for population exchange between locations and for the maintenance of biogeographical patterns of species and communities) proposed. Using Marxan, an option was selected for a representative MPA network in the Baltic Sea that would cover at least 20% of each of marine landscape, 60% of all seal haul-out sites, and 100% of deepwater coral reefs. One of the main principles

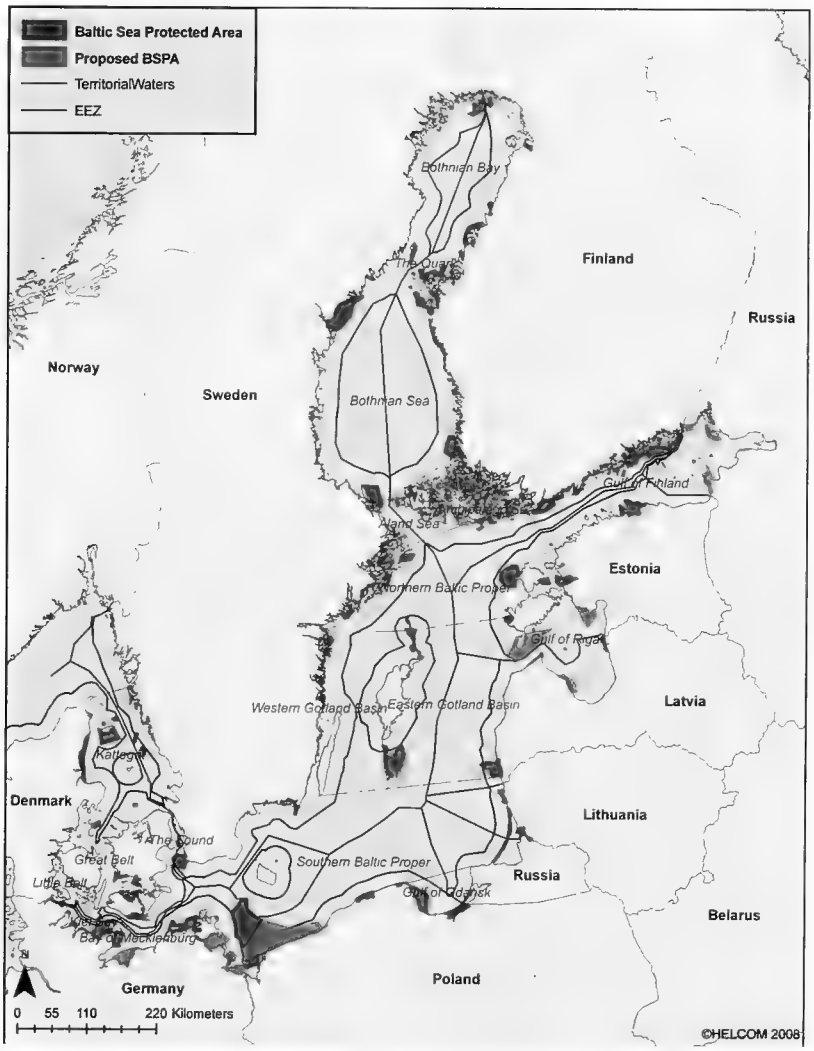


Figure 17: Baltic Sea MPA Network. Source: HELCOM
Illustrates existing and proposed Baltic Sea Protected Areas, under the HELCOM Baltic Sea Action Plan.

[74] http://www.balance-eu.org/

was to select new sites that complement sites already designated under the Habitats Directive.

The criteria took into account the selection criteria for a BSPA (Guidelines in relation to HELCOM Recommendation 15/5, 199476), Annex III of the EC Habitat Directive and the corresponding OSPAR criteria.and a first set of tools to assess ecological coherence of the Baltic Sea MPA networks (Piekainen and Korpinen, 2007). Four theoretical criteria were adopted: adequacy, representativity, replication and connectivity and were transformed into measurable units for use as tools to assess ecological coherence. Benthic marine landscape maps were used as proxies of biological communities, with maps of marine habitats listed in the EU Habitats Directive that had been produced for a pilot area. The assessment of ecological coherence found that only 18% of the benthic marine landscape types received 20% protection within the Natura 2000 network; non-photic landscape types needed considerably more protection, which meant that offshore areas were a priority for designation of new SAC sites.

The size distribution of SACs and SPAs was biased to small sites but replication of the landscape patches within the network was generally very good, a likely result of the natural patchiness of the Baltic Sea marine landscapes. A connectivity assessment was carried out with 25km distance for widespread benthic marine landscape types and 1-100km distances for sets of marine landscape types, combined according to requirements of selected species. The assessment with 25-100km distances showed that most of the landscape patches were well connected, but as expected, short-distance dispersers (1km dispersal distance) have poor connectivity within the network. Better ecological data will be needed in the future as several aspects were not considered in the assessment, such as habitat quality (e.g. water quality, oxygen depleted areas, areas of strong human impact), currents and other water movements aiding propagule dispersal among habitat patches or life histories of species assessed. The 2006 analysis of ecological coherence showed that the sites in the HELCOM BSPA Database, including BSPAs, proposed BSPAs (Rec. 15/5) and Expert opinion (1998 sites) could potentially form a network of areas protecting representative ecosystems, biotopes, habitats and species, but that the present BSPA network does not fulfil the criteria for an ecologically coherent network.

By October 2008, there were 90 designated BSPAs, and information on these and a further 21 proposed sites is available on the database[77]. By comparison, WDPA (October 2008) lists 425 MPAs in the Baltic Sea Region. The BSPAs cover over 6.5 % of the Baltic Sea (some 30,000 km²) (Table 2; Figure 17) and all sub-basins are represented. If all 111 sites in the database are ultimately designated, almost 10 % of the Baltic Sea area will be protected (HELCOM, 2008). In line with HELCOM Recommendation 15/5, 99 % of the notified and designated BSPAs are larger than 10 km². Most sites include both terrestrial and marine areas, and 89 % are within territorial waters. Denmark and Germany have designated one site each within their EEZs; and Denmark and Lithuanian have two sites and Sweden one site partly within their EEZs. 98.6 % of the notified and designated sites are also legally protected EU Natura 2000 sites. Some marine Natura 2000 sites have not been designated as BSPAs, although this was recommended by HELCOM 28/2007 (Minutes of the Meeting, paragraph 3.20, LD 30[78]; European Nature Information System (EUNIS Database[79])).

The HELCOM Baltic Sea Action Plan[80], which was adopted in November 2007, makes specific reference to an ecologically coherent network of well-managed BSPAs as one means of reaching the ecological objective of maintaining and restoring "natural marine and coastal landscapes". With the Action Plan, the Contracting Parties to the Helsinki Convention also reaffirmed their commitment to the 2003 Joint HELCOM/OSPAR Work Programme on Marine Protected Areas and to improve the management effectiveness of the BSPA network by 2010, and committed to:

- By 2010, having an ecologically coherent and well-managed network of BSPAs, Natura 2000 areas and Emerald sites in the Baltic Sea;
- By 2012, having common broad-scale spatial planning principles in place for protecting the marine environment;
- By 2021, ensuring that "natural" and near-natural marine landscapes are adequately protected and that degraded areas will be restored.

[75] http://www.balance-eu.org/
[76] http://www.helcom.fi/Recommendations/guidelines/en_GB/guide15_5/
[77] Minutes of the 28th meeting of Baltic Marine Environment Protection Commission (HELCOM 28/2007). http://sea.helcom.fi/dps/docs/documents/COMMISSION%20MEETINGS%20(HELCOM)/HELCOM%2028%202007/Minutes%20of%20the%20Meeting.pdf
[78] http://eunis.eea.europa.eu/
[79] http://eunis.eea.europa.eu/
[80] http://www.helcom.fi/BSAP/en_GB/intro/

8 POLAR REGIONS & HIGH SEAS

8.1. ANTARCTIC INDEPENDENT PARTNER PROGRAMME

The Antarctic Region is geographically defined as the area lying to the south of the Polar Front (formerly called the Antarctic Convergence). It includes the Antarctic continent and islands to the north, which fall under the sovereign control of a variety of States, although the surrounding waters are generally considered to be high seas. The Antarctic LME comprises the waters around the Antarctic land mass.

The legal framework for MPAs in this Region has its origins in the various legal instruments of the Antarctic Treaty System. These are the:

- 1961 Antarctic Treaty and its 1991 Protocol on Environment Protection (known as the Madrid Protocol) that apply to the area south of 60°S. The marine areas covered by both instruments consist entirely of the high seas. 46 states are party to the Antarctic Treaty, of which 28 are Consultative Parties and take part in decision making.
- 1980 Convention on the Conservation of Antarctic Marine Living Resources (known as the CAMLR Convention), which covers a wider area, extending north to the Antarctic Polar Front (around 45°S), the majority of which is high seas apart from the Sub-Antarctic islands over which France, Norway, South Africa and Australia have sovereignty. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) oversees the implementation of the Convention. There are 34 Contracting Parties of which 25 are full (decision making) Members of CCAMLR.
- 1973 Convention on Conservation of Antarctic Seals, which is less directly relevant to MPAs.

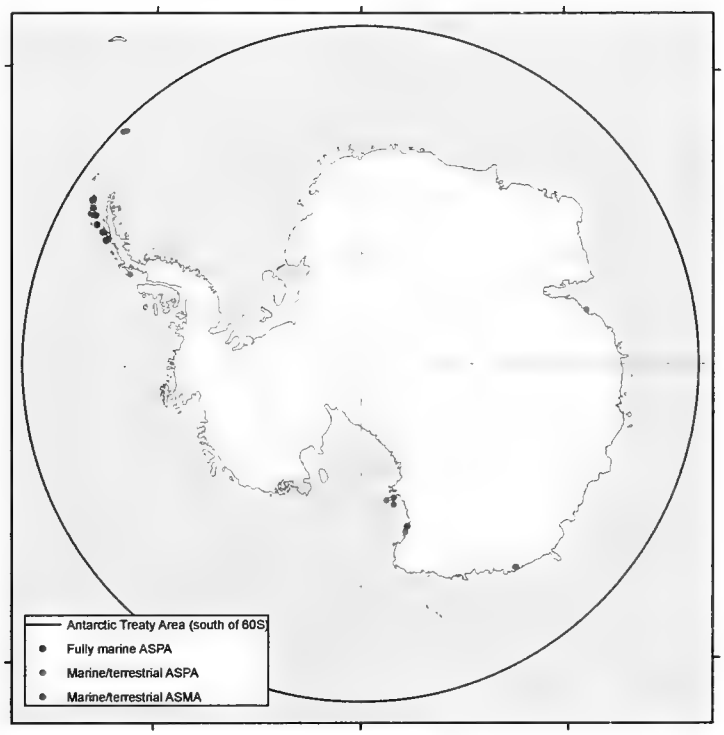


Figure 18: Antarctic MPA network. Source: British Antarctic Survey
The existing PAs with a marine component designated by the Antarctic Treaty, comprise Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Areas (ASMAs).

Annex V of the Madrid Protocol contains provisions for the establishment of a system of protected areas. These comprise Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Areas (ASMAs) (Figure 18). ASPAs are equivalent to IUCN Category 1a (Strictly Protected Areas), and require a permit for entry and other activities. ASMAs correspond to IUCN Category IV (Protected Areas) and have a non-mandatory code of conduct for multiple uses such as tourism, scientific research, shipping and research station logistics. An entry permit is not required. Under paragraph 6(2) of Annex V of the Protocol, marine areas in the Antarctic Treaty Area may not be designated as an ASPA or ASMA without prior approval of CCAMLR. The procedures for acquiring such approval are outlined in Antarctic Treaty Consultative Meeting Decision 9 (Grant, 2005).

Currently, there are six fully marine ASPAs, and 11 terrestrial ASPAs have a partial marine component. These cover a total area of about 1,800 km², or 0.012% of the marine area south of 60°S. The areas are not ecologically representative and the majority are coastal. They are also of limited extent, and none are located in important fishing grounds. There are four ASMAs with marine components.

There is also potential for establishing MPAs through the CAMLR Convention, but no specific MPAs have been designated using these mechanisms. For example, Article II requires that an *ecosystem and precautionary approach* to conservation be implemented using a range of measures. The measures listed in Article IX include "the designation of the opening and closing of areas, regions or sub-regions for purposes of scientific study or conservation, including special areas for protection and scientific studies". However, CCAMLR Conservation Measures in force for 2007/08[81] include the opening and closing of areas for fishing, prohibition of fishing in a number of areas, protection of areas for scientific studies conducted under the CCAMLR Ecosystem Monitoring Program (CEMP) and general environmental protection. Three areas (sub-areas 48.1, 48.2 and 48.3) have been closed to bottom trawling for more than ten years, and the Ob and Lena Banks have been closed for at least five years. CCAMLR is also in the process of developing measures to manage bottom fishing within the context of "vulnerable marine ecosystems" in the Convention Area consistent with UN General Assembly Resolution 61/105 of 8 December 2006. An interim prohibition on bottom fishing in the CCAMLR Area is currently in place.

Resolution 2.54 of the 2000 World Conservation Congress called for development of a comprehensive network of Antarctic and Southern Ocean protected areas that are representative of the principal habitats as well as the biological diversity of the region and also incorporate other values. This was re-iterated in 2003 at the World Parks Congress. Grant (2005) considered that there has been inadequate consideration of the objectives, criteria and procedures for establishing MPAs in the Antarctic region. A CCAMLR workshop held in 2005 to discuss MPAs resulted in a number of recommendations, including agreement that steps should be taken to develop a full system of MPAs, that CCAMLR provides a suitable mechanism for this, and that there should be closer links with the Committee for Environmental Protection (CEP) that serves to implement the Madrid Protocol under the Antarctic Treaty. Within CCAMLR, it has also been recognised that a broad-scale bio-regionalisation will be required to underpin development of MPAs in the Southern Ocean through the delineation of fine-scale bio-geographic provinces. An expert workshop in 2006, supported by WWF and Peregrine Travel (Grant *et al.*, 2006), and a CCAMLR/CEP workshop in 2007, to address data requirements and methods for large-scale bio-regionalisation of the Antarctic region have been helping to take these recommendations forward.

8.2. ARCTIC INDEPENDENT PARTNER PROGRAMME

Unlike the Antarctic, there is no comprehensive treaty or regional resource management organisation for Arctic natural resources. The Arctic Council is the voluntary, non-binding intergovernmental forum for the eight Arctic countries (Canada, Denmark (for Greenland and the Faeroes), Finland, Iceland, Norway, Russia, Sweden and the USA (for Alaska) and their peoples and is responsible for a broad programme on sustainable development.

Compared to many regions, the Arctic has few resident species although numbers rise sharply during the short summer season with a massive influx of migratory species. The low number of resident species and their highly adapted physiological characteristics, means that species replacement is difficult and the loss of one species has a more disruptive influence on ecosystems and their processes than elsewhere. Conservation of habitats throughout the range of resident species and along migration routes is therefore fundamentally important (Cooch and Pagnan, 1996). Furthermore, the melting of the ice over the Arctic Ocean as a result of global warming is creating an entirely new situation in relation to potential fishing grounds, navigation channels for shipping and

[81] www.ccamlr.org/pu/e/e_pubs/cm/07-08/toc.htm

access to marine resources. There is thus an urgent need for sound ecosystem-based planning, with the establishment of a network of MPAs as a core strategy. 17 LMEs have been designated in the Arctic.

In 1991, Ministers of the Arctic countries adopted a circumpolar Arctic Environmental Protection Strategy (AEPS) and established several working groups to implement it. In the Strategy, the countries agreed to promote the development of a network of protected marine, freshwater and terrestrial areas, with due regard for the needs of indigenous peoples, that would promote ecological, information-sharing, managerial and inter-jurisdictional linkages (Pagnan, 2004). The task of developing the protected areas network was assigned to the AEPS Conservation of Arctic Flora and Fauna (CAFF) working group. In 1996, CAFF presented a Circumpolar Protected Areas Network (CPAN) Strategy and Action Plan (Hansen, *et al.*, 1996) and a set of CPAN Principles and Guidelines for Site Selection (Cooch and Pagnan, 1996) to the Ministers. The Strategy and associated Action Plan including three action items relating to MPAs:

- To assess and evaluate the need for MPAs and special protection of dynamic regions of ice edge ecosystems and international migratory routes as part of an integrated strategy for the protection of the marine environment, including marine areas which fall outside individual or shared national jurisdiction.
- To co-operate with and contribute to IUCN's efforts to establish a global system of representative MPAs covering all major biogeographic types and ecosystems.
- To establish linkages with other jurisdictions for species migrating outside CAFF countries, to ensure appropriate habitat conservation throughout the range of migratory species utilising the Arctic.

The CPAN Principles and Guidelines addressed the "governance" and effectiveness dimensions of CPAN and proposed a set of common guidelines for site selection, including the use of buffer zones, and the application of the "corridor concept", the principle of connectivity and the "cluster principle". It also pointed out the need to select sites important for marine primary production (for example, the ice edges), sites important as congregating, breeding and feeding grounds (such as for seabirds and migratory whales) and sites important as spawning grounds and fish migration routes (Pagnan, 2004).

In 1996, the AEPS was subsumed into the Arctic Council, but the Working Groups of the AEPS and their previously approved work plans, including the implementation of CPAN, were maintained. Over the years, however, the resolve to implement CPAN declined partly because some actions were considered too demanding, others were no longer relevant, there was no team to oversee implementation, no clear targets and timelines, and the voluntary nature of the Arctic Council and CAFF worked against it. Some countries suggested that the existing Strategy and Action Plan and Principles and Guidelines be set aside. Currently the initiative is dormant although there are still calls to resuscitate it (Pagnan, 2004).

The Arctic Council, through CAFF and other Working Groups, has nonetheless continued to address the issue of Arctic marine protection. In 1999, IUCN-WCPA established an Arctic Task Force that produced a WCPA Arctic Action Plan with a section devoted to marine protection. In 2000, IUCN-WCPA co-sponsored a Circumpolar Marine Workshop with two of the Arctic Council Working Groups (Pagnan and Legare, 2000). WWF is also working to ensure a representative network of MPAs in the Arctic (WWF, 2005b).

In 2004, the Arctic Council approved an Arctic Marine Strategic Plan in 2004, which included a target to establish MPAs and networks of representative areas by 2012. CAFF, with Ministerial endorsement, has established a Circumpolar Biodiversity Monitoring Programme (CBMP) and is setting up a series of expert groups, including a marine expert group, for its implementation. The Arctic Council's working group on the Protection of the Arctic Marine Environment[82] (PAME) has also prepared an Arctic Marine Strategic Plan.

Individual Arctic countries have also put in place legislation to enhance marine protection, including:

- Canada's Oceans Act (1997) and National Marine Conservation Areas Act (2002) under which nine marine conservation areas will be established in the Arctic. Proposed MPAs include Qaqulluit and Akpait National Wildlife Area, Southern Beaufort Sea, Gilbert Bay and Igaliqtuuq National Wildlife Area.
- Greenland's Nature Conservation Act which will give greater protection to marine habitats; recently gazetted MPAs include Ikka Fjord (2000) and Ilulissat Isfjord (a World Heritage Site) (2004).
- Norway's Svalbard Environmental Act, which allows for the designation of MPAs and other marine conservation measures within the 12 n. mi zone, and its regulation on Conservation of Coral Reefs (1999). Recently gazetted MPAs

[82] www.pame.is

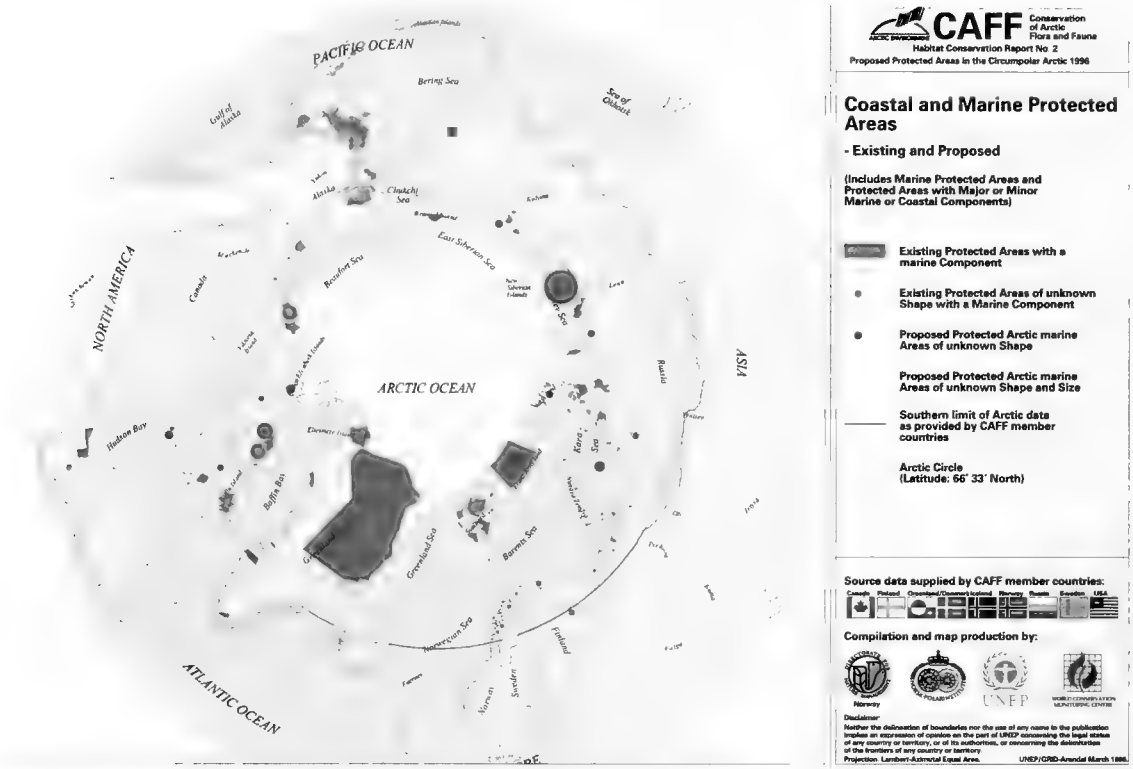


Figure 19: Existing and Proposed Arctic MPAs (1996). Source: GRID Arendal
An example of the Arctic existing and proposed coastal and marine MPA network from 1996. See text for current situation.

include Grunnfjorden (2000), Bear Island (2002) and Svalbard (2004). The Svaalbard Archipelago is one example of an MPA system within the Arctic region, with at least 12 protected sites that qualify as MPAs[83].

- Russia's Laws on Internal Marine Waters, Territorial Sea and Adjacent Zones (1998) and on the Exclusive Economic Zone of the Russian Federation (1998). Wrangel Island out to 12 n. mi listed as a World Heritage Sites
- USA's national initiative on MPAs (see section 3.4.4).
- Iceland: Surtsey is being evaluated for World Heritage status; Hverastrytur (2001) (Stagley, 2004).

8.3. HIGH SEAS

Some 64% of the world's oceans (approximately 202 million km²) are in ABNJ, and includes most of the deep sea (waters below 200 metres, extending to as much as 11,000 metres). These areas have many highly diverse and at the same time fragile habitats, such as cold water coral reefs, sea mounts and hydrothermal vents, that are relatively rare in waters under national jurisdiction. About 70% of the known 14,000-100,000 sea mounts are located in the high seas, and are of particular concern as they are often linked with cold water coral reefs and hydrothermal vents, attract predators and have high species biodiversity, with many endemic species. Pelagic species in the high seas also need to be considered, many having core areas of distribution despite their migratory habits (Myers and Worm, 2003; Baum and Myers, 2004; UNEP, 2006b; Cheung *et al.*, 2005). Managing and protecting high seas areas, with the adjacent coastal zones, is essential given the intricate relationship that exists between shallow coastal waters and deeper areas of the open ocean. A complex array of biophysical processes, such as ocean currents and nutrient upwelling, connect the

[83] www.mpaglobal.org

shallow waters of the ocean surface with the depths of the sea and provide critical services to marine life both in the water column and the seabed (UNEP, 2007).

Interest in establishing High Seas MPAs (HSMPAs) has developed rapidly in the last 30 years as fishing pressure has escalated, a result of declining nearshore stocks and the increasing value on world markets of fish, such as swordfish, tuna, marlin and sharks, whose populations are now plummeting. The legal framework for their management is the 1982 UNCLOS with the CBD providing technical and scientific information, but the protection of any area of high sea depends on several states agreeing to regulate the conduct of their nationals and nationally flagged vessels within it, and the lack of a mechanism for this has been a major obstacle (Gjerde and Kelleher, 2005; IUCN, 2006).

Some mechanisms allow for protection of ABNJ, including species-specific or area-specific closures under the Regional Fisheries Management Organisations (RFMOs), designation of Special Areas and Particularly Sensitive Sea Areas protected from pollution under the International Maritime Organisation (IMO), and whale sanctuaries as delineated under the IWC. However, these mechanisms have limited competencies, with none applying to all potential human activities in the high seas and thus leaving spatial and regulatory gaps in coverage of important species, habitats, and ecological processes that are essential for a comprehensive network of HSMPAs. For example, the Southern Ocean and Indian Ocean Whale Sanctuaries, and the Pelagos Sanctuary for Mediterranean Marine Mammals, cover vast areas of the high seas, but offer protection only to certain commercial whale species. However, it is hoped that the conservation measures in place for marine mammals will act as an 'umbrella' and contribute to the protection of the wider ecosystem.

At the World Parks Congress in 2003, a target was set to have at least five ecologically significant MPAs designated on the high seas by 2008. A High Seas MPA Task Force was established by IUCN-WCPA also in 2003 which led to the adoption of the IUCN 10 year High Seas MPA Strategy (Gjerde, 2003; Gjerde and Kelleher, 2005). In 2004, the CBD Parties were encouraged to take action to establish MPAs in ABNJ by 2008, and the UN General Assembly also established an *ad hoc* open ended informal working group to analyse issues relating to the conservation and sustainable use of marine biodiversity in ABNJ. At COP8 in May 2006, the Parties recognised their role in supporting the work of the General Assembly by providing scientific and technical information and advice relating to marine biological diversity and advising on the application of the ecosystem approach and the precautionary approach. Subsequently, through the CBD criteria for the establishment of areas in need of protection were developed as well as guidance for the establishment of representative networks of MPAs[84]. An expert workshop in 2005 in Ottawa, Canada reviewed and assessed existing ecological criteria and biogeographical classification systems and developed a set of scientifically rigorous ecological criteria that could be used to identify potential sites for MPAs in ABNJ. In January 2007, at a Workshop on Biogeographic Classification Systems in Open Ocean and Deep Seabed Areas Beyond National Jurisdiction was held in Mexico City, criteria for a classification framework for the high seas, building on existing broad classification systems was developed, with preliminary maps, and recommendations for further work to fill gaps were made.[85]

At a further workshop in the Azores in October 2007, a set of scientific criteria for representative MPA networks in open ocean waters and deep-sea habitats was compiled[86] which was accepted at COP9 in May 2008. The criteria considered essential to achieving "ecological coherence" (a term adapted from the OSPAR/HELCOM network initiative) were considered to be: ecologically and biologically significant areas (EBSAS); representativity; connectivity; replication; and adequacy/viability. Four initial steps were proposed for the design of networks of MPAs in ABNJ:

1. Scientific identification of an initial set of EBSAs;
2. Development or selection of a biogeographic, habitat, and/or community classification system;
3. Drawing upon steps 1 and 2, iteratively use qualitative and/or quantitative techniques to identify sites to include in the network;
4. Assess the adequacy and viability of the selected sites.

Given the dynamic nature of the high seas in terms of species movement, ocean currents and productivity, permanent or 'static' protected areas may not be the most effective means of protection. A HSMPA network will preferably incorporate both permanent MPAs located at static features such as seamounts, as well as MPAs that are flexible in time and space, such as seasonal closures, which possess the dynamism necessary to track variable biologically and ecologically important sites (Hyrenbach *et al.*, 2000; Gubbay, 2006). Furthermore, connectivity

[84] SBSTTA report XIII/3
[85] http://www.ias.unu.edu/resource_centre/ocean%20bioregionalisation.pdf
[86] Report of the Expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection. Azores, Portugal, October 2007. UNEP/CBD/EWS.MPA/1/2

needs particular attention, not only larval dispersal routes but also migration routes of pelagic mega-fauna - such as cetaceans, tuna, and sea turtles.

The development of HSMPA pilot sites is one way to begin gaining practical experience in understanding what mechanisms are needed to effectively designate, implement and enforce HSMPAs[87]. Several sites already exist (Ardron, 2007). Substantial work is underway in the OSPAR Maritime Area (section 7.5) and the Mediterranean (section 7.3) to identify potential HSMPAs as described earlier, and MPAs already exist in the Antarctic (section 8.1) (Table 8.1; Figure 18). However, many of these sites are very limited in size and are generally located close to EEZs. For example, the Antarctic sites are very small with eight ranging from less than 0.5 to 30km², with the largest covering 900km², and all located close to the Antarctic continent and its surrounding islands.

A number of high seas areas are also now being closed either permanently or seasonally to certain types of fishing through the Regional Fisheries Management Organisations (RFMOs), and the implementation of these areas will provide valuable experience for the establishment of HSMPAs (Table 8.1). The MOU between OSPAR and the NEAFC is the first example of a Regional Seas Organisation with an environmental protection remit and a Regional Fisheries Management Organisation (RFMO) creating a firm basis for cooperation regarding the management of ABNJ (NEAFC 2008) and Agreements may be able to play a role by, for example, coordinating with the RSPs (section 7.5).

Proposals for HSMPAs include a variety of approaches ranging from scientific collaboration and NGO campaigns to multinational agreements (Ardron, 2007; Corrigan *et al.*, 2008). The Fundacion Vida Silvestre Argentina's South-west Atlantic Squid HSMPA is specific to one area, whereas Greenpeace's Roadmap to Recovery is a proposal for a global system of 26 large areas that, if designated, would provide representative protection 40% for the high seas ecosystems. The Greenpeace sites were identified using expert opinion (65 experts recommended 41 areas) and Marxan, which was used to analyse data layers comprising biological,

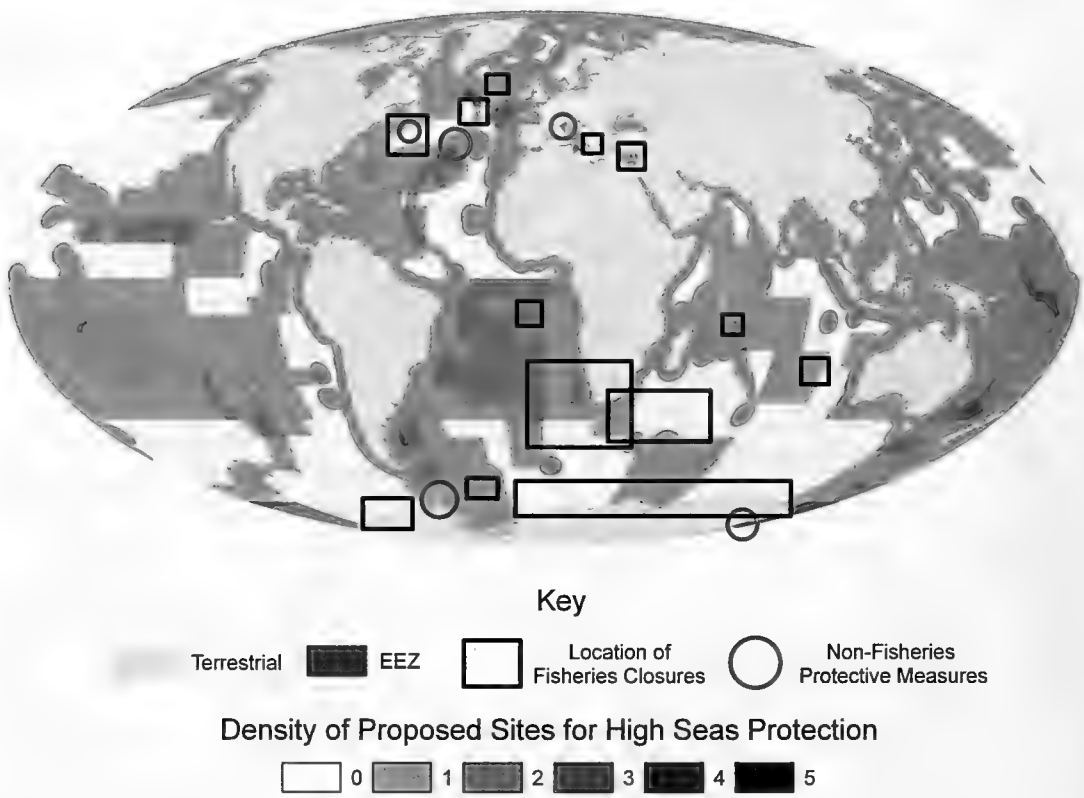


Figure 20: Location and density of HSMPA proposals in relation to existing High Seas Protective Measures. Source: UNEP-WCMC

Illustrates the geographic location and density of HSMPA proposals in relation to existing high seas protective measures including fisheries closures and non-fisheries measures. The general area of the existing measures is defined as most are too small to be visible at a global scale.

[87] See http://groups.google.com/group/wcpamarine-summit/web/iucn-wcpa---marine-high-seas-work for backing paper

Table 8.1. Summary of arrangements under which geographically specific high seas protection measures have been adopted (from Ardron, 2007).

Arrangements	Current Measures
Regional Fisheries Management Organisations (RFMOs)	South-east Atlantic Fisheries Organisation: 10 bottom fishing closures North-east Atlantic Fisheries Commission: 8 bottom fishing closures North Atlantic Fisheries Organiations: 4 bottom fishing closures; General Fisheries Commission for the Mediterranean: 3 trawl closures and trawl ban >1000m
RFMOs in development	South Pacific RFMO: precautionary trawl restrictions, and "frozen footprint"
Regional Seas Conventions	Barcelona Convention: Pelagos Sanctuary SPAMI. OSPAR Convention: Portugal has 1 MPA on its claimed extended continental shelf
Antarctic Treaty and CCAMLR	Antarctic Treaty: 17 ASPAs (of which 6 are fully marine), 4 ASMAs; CCAMLR: several species-specific closures as well as 2 full fisheries closures, 1 CEMP monitoring site, and area-wide gillnet ban and trawl ban
Other International Conventions	IMO (through MARPOL): 2 Special Areas; IMO can also designate PSSAs, but there are none in ABNJ; IWC: 3 ocean basin whale sanctuaries
International Agreements	Pelagos Sanctuary for Mediterranean Marine Mammals; Agreement Concerning the Shipwrecked Vessel RMS Titanic
Inter-governmental Organisations	Pacific Islands Forum: a ministerial call for precautionary trawl restrictions in the Western Tropical Pacific Islands Area
Voluntary Measures	Southern Indian Ocean Deepwater Fishers' Association (SIODFA): 4 voluntary trawl closures on seamounts

oceanographic, and physical measures (Roberts *et al.*, 2005). The large size of the units in this proposal means that they are most unlikely to be politically acceptable. UNEP-WCMC has mapped a variety of proposals for HSMPAs[88] to identify the locations where there is greatest agreement in terms of priority. Nine priority sites with the greatest agreement among proposals have been identified, with representation in the North and South-west Atlantic, the Western and Central Pacific, and the Southern Ocean (Corrigan *et al.* 2008). An important next step will be to review the sites for their biological and ecological significance, in line with the CBD criteria and guidelines. A description of ten priority sites in the high seas was released by IUCN at the WCC in Barcelona, in 2008.

There are numerous gaps in current knowledge of the distributions of habitats and species in the high seas at the global scale, and suitable proxies for biodiversity are therefore necessary. Since species distributions are influenced by physical oceanographic variables such as sea surface temperature and ocean productivity, such data, which are available at a number of scales, can be used as a proxy to identify areas of biological and ecological significance. Where measures of biodiversity data have been published, such as the maps of species richness produced by Cheung *et al.* (2005), these can also form the basis of useful data layers in identifying priority sites for HSMPAs (see Figure 20). For example, Cheung *et al.* (2005)'s priority areas include:

- The high seas of the Indo-Pacific, specifically centered on South-east Asia, Northern Australia and the Tasman Sea.
- Seamounts in the high seas of the North and South Atlantic, and the Southern Ocean convergence zone, especially as protecting seamounts and surrounding areas will help to protect cold-water corals.
- High seas areas adjacent to islands in the Southern Ocean.
- Small shelf areas in the high seas of the Northeast and Northwest Atlantic

Further work to select priorities for pilot HSMPAs is the immediate next step as recommended in Resolution 43 of the WCC at Barcelona in October 2008[89].

[88] See Corrigan *et al.*, 2008 for further information on individual sites.
[89] http://cmsdata.iucn.org/downloads/high_seas_gems_booklet_final.pdf

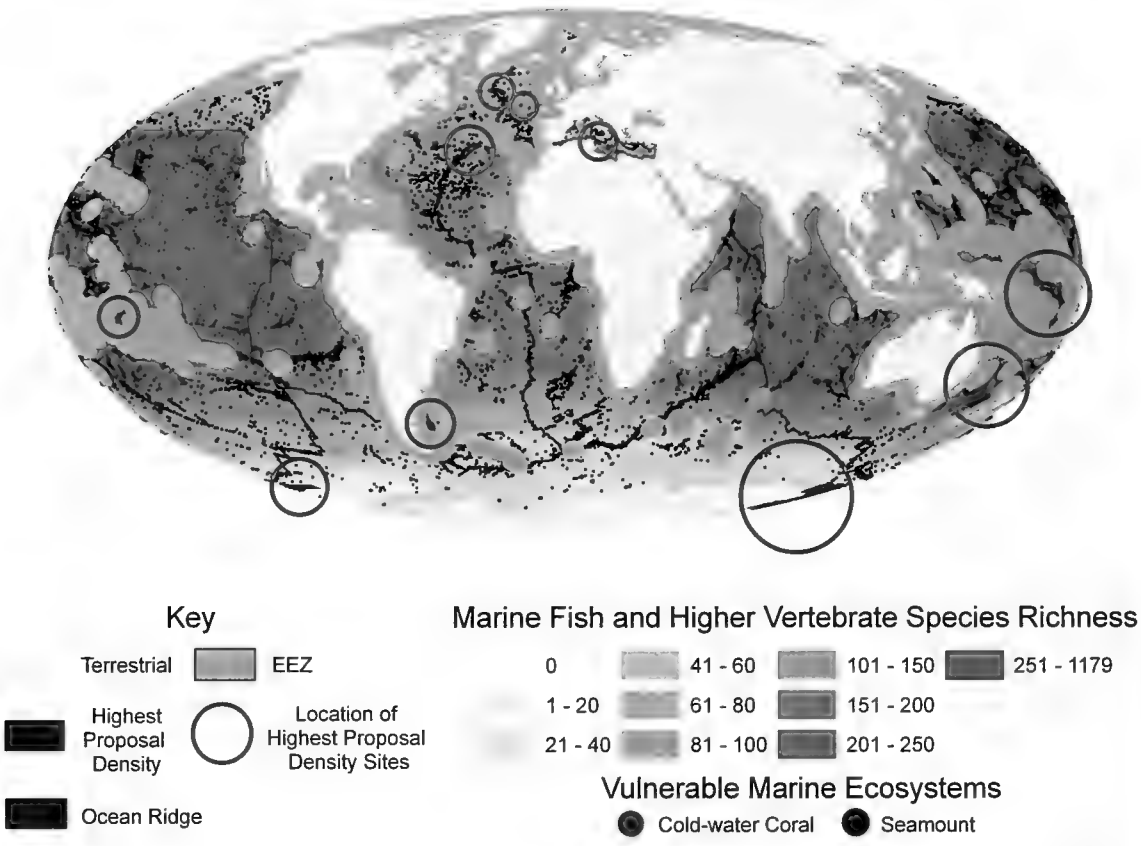


Figure 21: Marine Fish and Higher Vertebrate Species Richness overlain with the Highest Priority Areas identified in Corrigan *et al.* 2008. Source: UNEP-WCMC

Proxies for biodiversity can be incorporated into HSMPA planning so that proposals can be evaluated in terms of the CBD COP9 criteria and guidelines.

9 CONCLUSIONS

This chapter summarises the key findings of the report and discusses some of the challenges that are being encountered in establishing MPA networks.

9.1. PROGRESS IN ESTABLISHING MPA NETWORKS

The report does not provide a globally comprehensive review but general conclusions can be drawn, as the many initiatives underway are providing a solid body of experience on how MPA networks can be established in practice, and how the process may need to respond to different needs and priorities. The wide range of approaches and different spatial or geographical scales being used makes comparison difficult but there is much value in the experimentation underway.

A key finding is the length of time needed to develop MPA networks, if stakeholders are to be fully involved and if scientific design principles are to be applied. The principle of representation is relatively easy to address, provided adequate classifications and biodiversity distribution (or suitable proxies) are available. However, the principles of adequacy, resilience and connectivity are proving more difficult to incoporate, since specific guidelines on applying them are still lacking due to dearth of clear scientific understanding. 'Rules of thumb' are being used where possible (see IUCN/WCPA, 2008a), and the rapid growth of research in this field means that new information is constantly becoming available.

9.1.1. NATIONAL ECOLOGICAL NETWORKS OF MPAS

Annex 1 summarises the case studies and information provided in Chapters 3-8 and lists 30 national and 35 sub-national MPA network initiatives. The majority of MPA networks are currently under development with very few formally gazetted, and even fewer effectively managed. MPA networks that have been declared and are being implemented are limited mainly to networks that either cover small areas (e.g. in the Philippines) or that are part of large management initiatives or multiple-use MPAs (such as the GBRMP in Australia). A total of 34 of the 123 countries that have reported to the CBD during the period of 2005-2008 stated that they have a national MPA system (assumed to mean network) in place, and 60 reported that they are developing one (Global Ocean Forum, 2008). However, the CBD reporting process does not require elaboration as to how MPA systems are defined and what criteria are being used.

The CBD Programme of Work for the protection of marine biodiversity recognises the need for at least three levels of spatial planning for MPAs within a country:

- A core system of No Take Areas (NTAs) within a large MPA.
- A larger system of multiple-use MPAs, including fishery management areas.
- A national MPA system embedded within a national integrated coastal management programme and overall management framework for the EEZ.

Many countries are starting to take this multi-level approach and develop it further. In terms of the three-tier structure proposed by the CBD, the following conclusions can be drawn:

Networks of NTAs: The concept of a core network of NTAs within larger multiple use MPAs is widely accepted, and many MPAs are zoned to include one or more NTAs. In some countries, national or state-level networks of NTAs are being developed, such as the Bahamas (section 3.1.3), and the state of Victoria in Australia (section 6.2.3). This is a useful approach, but raises the question of how the multiple use MPAs that exist in addition to the no-take MPAs will fit into the overall framework. The GBRMP in Australia (section 6.2.4) and the Channel Islands Marine Sanctuary in California (section 3.4.4) provide good examples of how the key principles (adequacy, representation, connectivity and resilience) can be used for NTA network establishment.

Networks of different types of MPAs: The majority of national MPA networks being developed comprise a range of different types of MPAs including

both NTAs and multiple use sites. The planning and implementation of a national MPA network as part of a broader national protected area systems plan is probably a preferable approach where this is feasible. Examples include Belize (section 3.1.4) and the B.V.I. (section 3.1.9), both of which are small countries that are relatively easy to address through a single process, and Cuba and Mexico, where the MPA networks are components of the national protected area systems plans. In other countries, MPA networks are being developed through separate initiatives, although often co-ordinated with those being used to establish terrestrial protected area systems, for example South Africa, Tanzania, USA and Canada.

In large countries where MPA management is devolved to state or local-level governments, MPA networks are most easily established using a hierarchical approach, with small systems nested within the larger national system (Agardy, 2005). Examples of this approach include Mexico, Indonesia, Australia, USA, Palau, and countries where sub-national administrative levels comprise an entire island or archipelago, such as San Andres in Colombia, Rodrigues in Mauritius and Socotra in Yemen. This approach can however lead to a lack of harmonisation. In Australia, each state, as well as the Commonwealth, is developing its own network in rather different ways; for example, Victoria is establishing a system of NTAs only, whereas other states are including multiple use MPAs. In Palau, planning started at national level, but a state-level approach has since been found to be necessary. Some of the best examples of the application of theory and science are at sub-national level, and are being undertaken by NGOs and academic institutions, with the involvement of local communities and other stakeholders, as in Kimbe Bay in Papua New Guinea, and the Gulf of California in Mexico.

The case studies show that simple methods can sometimes be used to design MPA networks, such as expert workshops, as in Tanzania. The availability and increasing 'user-friendliness' of Marxan, however, means that this is becoming the method of choice and has been used in the majority of case studies in the report, particularly those led by TNC. Where resources allow, detailed inter-disciplinary studies of the type underway in the Bahamas (section 3.1.3) are clearly ideal. Institutional arrangements for managing the information that is required for developing a network need particularly careful consideration since data must be maintained and expanded as the network is implemented and monitored, which requires GIS facilities and well trained personnel.

The MPA systems being developed in Australia and North America involved the preparation of an overall detailed plan, with the aim of establishing and implementing the components simultaneously. However, a step-wise process is often more practical, whereby pilot areas are initiated first, lessons learnt, and the system progressively built up. Preparation of a full system plan for a country is often not feasible and a better approach may be to prepare a general framework that can be refined as information, funding and capacity becomes available. The establishment of clear goals and objectives for the network is essential. The main issue is often deciding whether the network is primarily for biodiversity protection or for resource management for human use (such as fisheries management), since different approaches may be required. Examples of goals and objectives for MPA networks are found in the USA and Canada (section 3.4).

It is important to be opportunistic in selecting sites (Roberts, 2000), and use of criteria should be flexible. An independent scientific panel is often useful. For example, in Australia, such a panel was established for the Great Barrier Marine Park planning process but not for South East Region, and consensus is that the former approach was more successful. Selecting the preferred option should preferably be done as part of a long-term process involving all stakeholders, through a series of working groups or consultation meetings, and using a decision-support system where appropriate. The methodology proposed for developing a regional MPA system for the Sulu Sulawesi Sea Marine Ecoregion in South-east Asia is one model (see Chapter 5). A variety of designs for the MPA network should be generated, as it may be possible to increase conservation benefit whilst decreasing socio-economic impact through careful analysis of different options as was the case with the Southeast Region MPA system in Australia. Development of the Channel Islands MPA system in California demonstrated that it is much easier to predict the outcomes of a particular option on ecological grounds than in terms of socio-economic impact (Davis, 2005).

The IUCN Protected Area Management Categories can be used to ensure that a range of types of MPA are incorporated into a network. Countries that demonstrate how the IUCN categories can be used in this way include:

- Cuba (section 3.1.6) has eight different designation types within its MPA system, which have been equated with particular IUCN categories (Natural Reserve: Cat I; National Park and Ecological Reserve: both are Cat II; Outstanding Natural Element: Cat III; Managed

Floral Reserve and Faunal Refuge: both Cat.IV; Protected Natural Landscape: Cat V; and Protected Area for Managed Resources: Cat VI).

- Australia (section 6.2): the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires that an IUCN Category be assigned when declaring an area to be a Commonwealth reserve. For example, the Southeast Region MPA System has categories assigned to all the component sites, but a flexible approach is being taken. Some sites are designated as 'future' no-take zones and although closed to commercial fishing, may potentially be exploited for oil and gas; however if exploratory activities conclude that these areas will not be used, they will be reassigned to Category 1a (meaning Strict Protection).

Ecological MPA networks within systems of broader spatial planning: The need to develop MPA networks as part of broader marine spatial planning or ocean zoning is increasingly recognised. Marine spatial planning, which is broadly equivalent to land use planning in the terrestrial environment, allows for activities to be undertaken in different areas according to certain regulations or standards. It is an agreed approach in several countries and regions including UK, Belgium, Netherlands, Canada, North Sea, China and Germany (Maes *et al.*, 2005; Crowder *et al.*, 2006; Agardy, 2007; Ehler and Douvere, 2007) and is being promoted through the HELCOM and OSPAR Conventions and the EU Marine Strategy. The South-east Region MPA System Plan in Australia demonstrates how an MPA network can be integrated into a range of broader measures, such as recovery plans for listed species, fishery management closures and regulations for oil and gas activities. Belize demonstrates how a national MPA system can be part of not only a national integrated coastal management plan but also a regional MPA network (the MAR initiative). It also incorporates international protected area designations, such as the Belize Barrier Reef World Heritage Site. On a smaller scale, waters around several islands are now fully zoned, incorporating MPAs with different levels of protection, such as the Cayman Islands, Socotra Island in Yemen, and the San Andrés Archipelago in Colombia.

9.1.2. REGIONAL ECOLOGICAL NETWORKS OF MPAS

Table 9.1. lists the 20 regional MPA networks (i.e. networks involving two or more countries) that are described in the report. Regions with a strong co-ordinating framework and with a supportive a treaty or agreement tend to have progressed furthest. Europe has some ten agreements and initiatives that are promoting MPA networks and providing an institutional framework for a regional approach, including: the Habitats Directive and the Birds Directive) with the associated Natura 2000 programme in the EU states; the Bern Convention and associated Emerald Network in the EU states, other European countries, and some African countries; the Mediterranean and Black Sea UNEP RSPs and associated Conventions; OSPAR and HELCOM; and the North Sea Conference. Regional MPA network planning is well advanced in the Baltic Sea, North-East Atlantic through the HELCOM and OSPAR processes, and these initiatives are stimulating and accelerating national efforts.

The UNEP-RSP regions for East Africa, the North-east Pacific, South-East Pacific, and Wider Caribbean also have Protocols specifically aimed at promoting the establishment of MPAs. Some have Regional Activity Centres or other bodies to undertake the activities necessary to promote a collaborative approach and establish regional networks of organisations and individuals, such as the Wider Caribbean with the SPAW programme, and the Mediterranean with its extensive MPA programme. The ROPME Sea is working on the development of an MPA programme. The more recently created RSPs, such as the North-West Pacific and South Asian Seas, plan to address MPAs in the near future or have MPA related activities under development. Discussions are also underway concerning the urgent need for MPA networks in the Antarctic and Arctic.

Regional initiatives are also being initiated through agreements directly between countries, often supported by NGOs. These tend to be based on ecoregions in the case of WWF-supported programmes (such as the EAME and WIOMER programmes in the WIO, and the RAMPOA programme in West Africa) or seascapes in the case of the CI supported programmes (such as Birds Head Seascape in Indonesia and the Eastern Tropical Pacific Seascape). Smaller regional networks can be successfully nested within larger ones, although good co-ordination is essential. South-East Asia for example, has several nested network initiatives that are currently being supported and co-ordinated through the much larger CTI involving six countries (section 5.2).

The case studies indicate that there is demonstrated added value in developing networks at broader spatial scales, and undertaking systematic conservation and planning process in a collaborative manner between several countries, even though issues of sovereignty mean that regional MPA networks will be made up of their constituent national MPA networks. The wide range of

Table 9.1. Examples of regional MPA networks (involving two or more countries)

Region	Countries	Progress
Mesoamerican Barrier Reef	Mexico, Belize, Guatemala, Honduras	NTAs and multiple use; several initiatives underway to develop the network with support of TNC and WWF
Gulf of Mexico 'Islands in the Stream'	USA, Mexico, Belize	Early proposal
North-east Pacific	Countries from Mexico south to Colombia	Proposal developed
South-east Pacific	Countries from Panama south to Peru	Recommendation; to include MPAs and MCPAs
Tropical Eastern Pacific Marine Corridor Network (CMAR - or Corredor Marino)	Colombia, Costa Rica, Panama, Ecuador - San Jose Declaration	Implementation of network of five existing MPAs underway
Baja California to the Bering Sea (B2B)	USA, Canada, Mexico	28 sites identified
Scotian Shelf/Gulf of Maine	Canada, USA	
Eastern African Marine Ecoregion (EAME) Programme	Somalia, Kenya, Tanzania, Mozambique, South Africa	Priority 'seascapes' identified and ranked by WWF and support provided to protect some of these
MPA network for the countries of the Indian Ocean Commission	Madagascar, Mauritius, France (Reunion), Comores, Seychelles	Data-gathering underway
Western Africa regional network	Mauritania, Senegal, Gambia, Guinea-Bissau, Guinea, and Cape Verde	Initial steps underway
PERSGA MPA network	Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan and Yemen	Master Plan for the network prepared and some sites established
Caspian regional MPA network	Azerbaijan, Islamic Republic of Iran, Kazakhstan, the Russia Federation and Turkmenistan	Initial discussions underway
South-east Asian MPA network	ASEAN and other countries	Action Plan prepared
Sulu-Sulawesi Marine Ecoregion (SSME)	Indonesia, Malaysia, Philippines	Framework for network developed with criteria for site selection
Natura 2000	Member countries of the EU	Under development and many sites established
Mediterranean	All countries bordering Mediterranean	Under development; to be comprised of several sub-regional networks
OSPAR	Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK	Criteria and guidelines developed and process well underway; sites currently being nominated
HELCOM	Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russian Federation, Sweden	Criteria and guidelines developed and process well underway; sites currently being nominated
Antarctic	34 members of CLAMR	Planning underway for a regional MPA system
Arctic	Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, USA	Discussions underway for an MPA network

approaches and lack of guidelines for regional MPA networks however are obstacles to measuring progress. It may be valuable to look at the ways in which the different types of region (such as UNEP RSPs, ecoregions, seascapes) are being used for systematic conservation planning, and whether there would be value in attempting to harmonise some of the approaches.

9.1.3. NETWORKS OF INTERNATIONALLY DESIGNATED MPAS

The World Heritage and Wetland Conventions (Ramsar) and the international MaB Programme both contribute to the development of the global MPA network. MPA networks may include one or more sites with international designations, or an entire network may lie within a larger internationally designated area. The World Heritage Convention allows for the nomination of 'serial' or 'cluster' sites, which means that several protected areas, or a network, linked by a common theme or feature may together form the WHS. Thus the Belize Barrier Reef WHS comprises seven MPAs, rather than the entire Barrier Reef. The potential for cluster nominations is helping to drive the establishment of ecologically representative and resilient MPAs in Indonesia, as well as the CMAR network managed by Colombia, Ecuador, Costa Rica and Panama. No analysis of WHSs has been undertaken to assess the extent to which the network is ecologically coherent (this is of course not a stated objective of the Convention, since it deals with 'unique' locations). An analysis of marine and coastal Ramsar Sites to assess their representativity in relation to the MEOW classification showed that 92% of the realms in the MEOW classification are represented, but only 73% of provinces and 52% of ecoregions. About 112 ecoregions have no Ramsar representation, including four in the temperate North Atlantic (Spalding *et al.*, 2007).

HSMPAs will be another form of international designation and as described in section 8.3, these are being planned using a systematic approach and knowledge gained from the development of networks in waters under national jurisdiction.

9.1.4. SOCIAL MPA NETWORKS

Networks of individuals, such as managers and other MPA practitioners, and of MPA institutions are essential catalysts and facilitators for the development of ecological networks of MPAs. At the global level, WCPA-Marine provides an umbrella network of experts, and at the regional and national levels, there are now many social and learning networks (Table 9.2). The LMMA networks in the Pacific demonstrate how social networks, although initially based around groups of MPAs that are not linked in an ecologically meaningful way, can contribute to and accelerate the rapid development of ecological MPA networks. Inter-regional networks of MPA practitioners may also be of value; for example, an Ibero-American Network of Marine Reserves (RIRM) is reportedly being established to exchange information. Social and learning networks are generally a key aspect of the successful management of an ecological MPA network, as demonstrated by the Philippines (section 5.2.2).

Table 9.2. Examples of social MPA networks

Regional

Caribbean MPA Managers Network and Forum (CaMPAM)
North American MPA Network (NAMPAN)
Mediterranean Protected Area Network (MedPAN)
Proposed WIOMSA network of MPA professionals
Regional Network of Protected Coastal and Marine Areas in the South-East Pacific
Tropical Eastern Pacific Marine Corridor Network (CMAR - or Corredor Marino)
Pacific Local Marine Management Area (LMMA) Network

National

Philippine MPA Support Network
Vietnam social MPA Network
Fiji LMMA Network
Ecuador Grupo Nacional de Trabajo sobre Biodiversidad Marina

9.2. PROGRESS IN ADOPTING PRINCIPLES AND CRITERIA FOR ECOLOGICAL NETWORKS

The previous section showed that in many countries and regions, establishment of MPAs is being 'scaled up' to create networks. This section looks at the extent to which these networks are being set up using the principles and criteria that are being promoted, focusing on the four key criteria: adequacy, representation, resilience and connectivity.

Several regions and countries have also developed their own sets of criteria and principles. Thus, for the North-East Atlantic, four criteria were established for assessing whether the OSPAR network of MPAs (see section 7.5 and Appendix 3) is ecologically coherent: adequacy, representativity, replication and connectivity (MASH, 2006). Four criteria have also been developed for the proposed network of MPAs in the Sulu-Sulawesi Marine Ecoregion (section 5.2.1): representation, viability, resilience and ecological and evolutionary processes. Australia has developed a set of IMCRA principles (section 6.2).

9.2.1. ADEQUACY

There is now have a good understanding of progress at the global level in terms of coverage and number of MPAs as a result of the work of Wood *et al.* (2008) and the continuing work of UNEP-WCMC to monitor global protected area conservation targets (UNEP-WCMC 2008). 'Extent of cover' has been endorsed by the COP as an indicator of progress in the establishment of protected areas, and this indicator, as well as 'number' of protected areas, has been widely adopted; for example the EU is using both these indicators (EASAC, 2005). Using the MPAGlobal database (December 2006), developed as a result of a joint project between UNEP-WCMC, which manages the WDPA, and the Sea Around Us Project (SAUP) of the Fisheries Centre of the University of British Columbia (Canada), in collaboration with WCPA-Marine and WWF, Spalding *et al.* (in press) estimated a global total of 5,045 MPAs, covering about 2.59 million km². This is equivalent to 0.72% of the world's ocean surface or only 1.9% of the world's total EEZ coverage. Wood *et al.* (2008) estimated that at the current rate of establishment, the 10% target will not be until 2067 for the oceans as a whole, or 2047 for the world's EEZs. MPAs currently cover less than 1.6% of the EEZ in over 87% of the 226 coastal countries (this figure includes 69 overseas territories and the non-contiguous US states of Hawaii and Alaska). Only 12.8% of the total MPA area (or 0.08% of the world's oceans) is no-take or strictly protected (Wood *et al.*, 2008). Lastly, 5.9% of the territorial seas, from the high water mark out to 12 n. mi, are under some form of marine protection whereas only 0.5% of the area beyond 12 n. mi, is protected (UNEP-WCMC, 2008).

More detailed analysis is needed to show progress at national and regional levels. Although 'Extent of cover' and 'number' should be easy to measure, in practice it has proved difficult to collate accurate and comprehensive data for the WDPA, partly as a result of limited access to some marine data and the disparity of data among national institutions. It is often challenging to know whether a protected area qualifies as an MPA if the available data do not indicate whether inter-tidal or sub-tidal habitats are included; even when this is known, the exact area is often unknown. Unless the legislation describing the boundaries is available, the area of marine habitat may not be clear, as small islands or other parts of the site may be excluded from protection; and the legal definitions of the boundaries are often in any case ambiguous (Wood, 2006). Wood *et al.* (2008) and Spalding *et al.* (in press) used attribute data (i.e. the area provided by MPA staff or agencies) which is available for most of the larger sites in MPAGlobal and so provides an adequate global approximation. The majority of the smaller MPAs lack attribute data, and so this dataset tends to be too incomplete for analysis at regional and national levels. A further problem is that although there are global datasets on the sizes of national EEZ's, territorial seas, and continental shelves, such as WRI 'Earthtrends' and the Sea Around Us Project, these are not always accepted by the countries themselves, and cannot always be analysed according to different regions. For example, for countries with coastlines bordering more than one ocean, the areas of their EEZs and continental shelves according to each different coast are not in the public domain which makes it difficult to analyse MPA coverage; examples include countries in Central and North America with coasts on both the Caribbean and Pacific Oceans. To address these challenges, the WDPA has undergone significant redevelopment recently to improve both the quantity and quality of marine data accessible online. UNEP-WCMC is working diligently with national governments, organisations and individuals around the world to increase the provision of data to improve these analytical standards.

Despite these shortcomings, Wood *et al.* (2008) carried out a rough estimate at national level. Only four countries (Cameroon, Dominican Republic, Germany and Jordan) have over 10% of their EEZ protected. The mainland USA has over 1.6% of its EEZ protected, with over 10% of the EEZ surrounding Hawai'i protected. Wood *et al.* (2008) estimated that Australia has over 1.6% of its EEZ around the mainland protected, and over 10% of the EEZ around Heard and McDonald Islands, and Macquarie Island. The case studies in this report give details for a number of countries. Some countries and regions are making good progress towards protecting inshore waters and/or waters over the continental shelf, for example, in Kenya, Mexico, Republic of Korea, Socotra, Tanzania and the UK, but that there is still along way to go in terms of offshore waters and national EEZs as a whole. More recently Spalding *et al.* (in press) have analysed coverage at ecoregion level.

As described in Chapter 2, the 'adequacy' of an ecological MPA network also relates to whether the size of the individual components and their spatial distribution ensures that the full range of ecosystems or habitats in the area are protected.

There is a growing tendency to designate large MPAs covering several linked ecosystems. Chape *et al.* (2005) estimated that the average size of an MPA was 445 km² (Table 9.3), and ranged from less than 100 km² in Europe, East Asia, Eastern and Southern Africa, and South Asia, to over 1,000 km² in Australia/New Zealand, the Pacific, North Eurasia and Antarctic. However, within any one region MPAs

ranged in size from less than a hectare to 100s of 1000s of square kilometres. Wood *et al.* (2008) calculated the mean size to be 544 km², and the median 4.6 km², this large difference a consequence of the fact that the ten largest MPAs account for 68% of the total global MPA area. The average size of SPAs and SACs in the EU is about 123 km² (section 7.1).

There is little to no information on how the sizes of the individual MPAs within networks are being selected. Most research on optimal MPA size has been in relation to NTAs and the results have been variable, with recommended sizes ranging from 10 to 100 km² (Dayton *et al.*, 1995; Hastings and Botsford, 2003; Shanks *et al.*, 2003; Halpern and Warner, 2003; Laurel and Bradbury, 2006). Using this size range, Wood *et al.* (2008) estimated that about 35 to 60% of the world's MPAs are an adequate size.

9.2.2. REPRESENTATIVITY

Representation can be assessed using bio-geographical classifications or by assessing coverage of the individual components of biodiversity, such as ecosystem, habitat and species, where there is adequate distribution data. Although the target for protection, as set by the CBD, is 10% of each ecological region, many scientists and conservationists consider that, for the marine environment, this should be larger, particularly for ecosystems such as coral reefs.

At the global level, it is clear that many ecosystems and species are poorly represented in MPAs. Wood *et al.* (2008) found that 43% of all MPAs (or about 65% of the total marine area that is protected) lie in the tropics (between 30°N and 30°S), with most of the remainder in the northern hemisphere. Intermediate latitudes (20°N to 50°N) and the southern temperate and polar latitudes are least well represented. Most MPAs are on the continental shelf and in coastal waters and an estimated 4.3% of shelf areas to 200m depth are protected.

Kelleher *et al.* (1995) found most MPAs were in the Australia/New Zealand, Wider Caribbean, and North-east and North-west Pacific regions, and fewest in South Asia; about one quarter (21%) of the zones had no MPAs. Chape *et al.* (2005), using a different set of bio-geographic regions and a different method, reached a similar conclusion, finding less MPA coverage in Asia and Africa. Spalding *et al.* (in press) have undertaken an analysis using the MEOW classification system and found a particular lack of representation in the temperate realms of Southern Africa, Northern Africa and South America. Some care has to be taken of analyses at this level however; for example, the existence of three vast MPAs - the GBRMPA in Australia, PIPA in Kiribati and the Papahanaumokuakea Marine National Monument in Hawaii - means that the Indo-Pacific is, at one level, relatively well represented. However, if looked at at national level, as through the case studies, there is still much work needed.

At the more detailed ecosystem and habitat level, there is little information available on the extent of coverage by each MPA, although this has been a long-standing recommendation (Kelleher *et al.*, 1995). The WDPA lists presence/absence for four ecosystems: coral reefs, mangroves, sea grass and saltmarsh. The datasets for reefs and mangroves are considered reasonably comprehensive and both ecosystems are found in a large proportion (61% and 47% respectively) of tropical MPAs. (Table 9.3).

Table 9.3. Number of MPAs with different habitat types (data from WDPA September 2006)

Habitat type	No. of MPAs	
Coral reefs	1,092	61% of the 1,783 tropical MPAs listed
Mangroves	830	47% of the 1,783 tropical MPAs listed
Sea grass	326	18% of the 1,783 tropical MPAs listed
Saltmarsh	1	Less than 1% of the 2,309 temperate MPAs listed

A more detailed analysis of coverage for mangroves and reefs, using both the WDPA and global maps compiled at UNEP-WCMC, showed that 19% of global mangrove cover lies within protected areas, and 21% of coral reefs (Chape *et al.*, 2005). Several further global analyses have recently been undertaken for reefs, and the general consensus is now that about 1,100 MPAs have coral reefs[90], or about 25% of the world's MPAs, and an estimated 15-22% of the area of the world's reef lies within MPAs (Mora *et al.*, 2006; Ricciardi *et al.*, 2006; Wood *et al.*, 2008). This means that the 10% target has been reached for reefs. But for ecosystems such as these, where the total area is small and the decline precipitous, a much greater level of protection is needed. Wood *et al.* (2008) estimated that 8% of estuaries lie within MPAs, 17% of mangroves, 10% of seagrasses and 2% of seamounts. In the majority of the case studies described in this report,

[90] World Database on Protected Areas, September 2006

conservation targets for protection of different marine ecosystems and biodiversity within a network have been set higher than the globally recommended 10%, and are often 20% or above. Thus Belize has conservation targets of 30% for reefs, 80% for spawning aggregations and 60% for turtle nesting sites.

A growing number of MPAs are being established that include offshore water and deep sea benthic habitats, such as the hydrothermal vents in Canada and the Azores, seamounts in Australia and the UK, deep water cold coral reefs in Norway, and the deep sea benthic habitat closed to trawling in the Azores, Madeira and New Zealand, and the potential High Seas MPAs.

Ecological representation can also be assessed to some extent using taxonomic groups (Zacharias and Roff, 2000 and 2001; Roff *et al.*, 2003). There are now good distribution data for marine mammals, marine turtle nesting beaches, coastal and sea birds (such as Important Bird Areas) that can be used in the planning of MPAs systems, as is demonstrated by the Sulu Sea Marine Ecoregion MPA network and the proposed MPA system for Tanzania. The SAUP project of the University of British Colombia is designing models to demonstrate how commercial fish and invertebrates, and potentially Red List species, could be protected through networks of no-take zones, using the software methods that are now available for situations where data are scarce. A range of options and scenarios can be determined. Cook and Auster (2006) have developed a process for the North-eastern USA that uses water mass and substrate characteristics as proxies for biological diversity of benthic communities in order to model a representative set of no-take areas.

At the national and regional level, adequate data are largely lacking to assess representation except for a few regions. Preliminary results for the North-east Atlantic show that 13 of 22 bio-geographic zones have no MPAs (see Chapter 7). For some of the smaller regions, such as the Black Sea, a finer scale classification than the MEOW ecoregions will be necessary.

The concept of comprehensiveness must be kept in mind when assessing representation. Over-rigorous attention to representation could potentially mean that key sites are omitted from an MPA network because 'enough' of a habitat or species has been included for the purpose of representation.

9.2.3. RESILIENCE

The principles of resilience, replication and redundancy have been used relatively little in the planning of MPA networks so far, perhaps because this is a new concept and scientific understanding of it in the marine environment is still incomplete. TNC has produced guidelines for addressing resilience in MPA design in to coral reefs and spawning aggregations, and these are being tested at some sites (see sections on Papua New Guinea, Indonesia, Belize in Chapter 4). A manual on mangrove resilience is in preparation. Allison *et al.* (2003) propose a method for quantifying how much extra area, or replication would be needed in a system to provide the necessary 'insurance factor', and have tested it in models for oil spills and hurricanes; the theoretical extra area, above that needed for representation, to ensure resilience depend on levels of disturbance and recovery rates. Much further work is required on this important concept.

9.2.4 CONNECTIVITY

How to put the theory of connectivity into practice in an MPA network has yet to be fully demonstrated, as well as how to maintain connectivity between sites. Although establishing corridors between MPAs is conceptually similar to conserving corridors between habitat patches on land that have become fragmented (Haddad *et al.*, 2003), the mechanisms to create the necessary protection for migrating species or to ensure other types of linkages between ecosystems are not so immediately obvious. This may not be possible in a spatial sense and may require regulation of exploitation. National or even regional level MPA networks may not be able to protect all the key sites for particular species, and this emphasises the need for ensuring that appropriate transboundary linkages are made and that MPA networks are considered at the regional level. Calabrese and Fagan (2004) have developed a classification of different degrees/types of connectivity that may be useful in considering this issue.

9.3. GOVERNANCE OF ECOLOGICAL NETWORKS OF MPAS

Although individual MPAs need to work together so that overall goals and objectives are achieved if an MPA network is to function fully, the sites do not necessarily have to be managed in the same way or come under the same management authority. It may be more appropriate to have a mix of MPAs under different forms of governance within a single system. At the World Parks Congress in 2003, IUCN developed a typology for the governance types of protected areas. There are four main types: Government managed; Co-managed; Private; and Community managed. Each comprises two or three sub-types. These are defined in Table 9.3 and the typology may provide a useful mechanism for the development of MPA networks. Countries are being encouraged to test it.

Table 9.3. IUCN classification of governance types for protected areas. Definitions based on descriptions in IUCN/WCPA (2008b).

Governance Type	Definition
A. Governance by government (at federal/state/sub-national or municipal level)	A government body, such as a Ministry or Park Agency reporting directly to the government or a sub-national or municipal government body, holds the authority, responsibility and accountability for managing the protected area, determines its conservation objectives, develops and enforces its management plan and often also owns the protected area's land, water and related resources. The government may retain control over the protected area - in other words decides the objectives of managing the area - but delegates the planning and/or daily management tasks to a para-statal organisation, NGO, private operator or community. Under a state's legal framework and governance, there may or may not be a legal obligation to inform or consult stakeholders prior to setting up protected areas and making or enforcing management decisions. Participatory approaches are, however, increasingly common and generally desirable.
B. Shared governance (co-managed protected areas)	Management authority and responsibility are shared between both formally and informally entitled governmental and non-governmental actors. Co-management comes in many forms, but there are two general approaches: ▪ In "collaborative" management, decision-making authority and responsibility rest with one agency, which is required - by law or policy - to inform or consult other stakeholders. Participation can be strengthened by assigning to multi-stakeholder bodies the responsibility of developing technical proposals for protected area regulation and management, to be submitted ultimately to a decision-making authority for approval. ▪ In "joint" management, various actors sit on a management body with decision-making authority and responsibility. Decisions may or may not require consensus. In any of these cases, once decisions about management are taken, their implementation needs to be delegated to agreed bodies or individuals. Transboundary protected areas are also a form of shared governance, involving at least two or more governments and occasionally local actors.
C. Private protected areas	Under individual, cooperative, NGO or corporate control and/or ownership set up and managed under not-for-profit or for-profit schemes. May include lands and resources acquired by NGOs explicitly for conservation purposes, individual landowners pursuing conservation objectives out of respect for the land and a desire to maintain its aesthetic and ecological values; or gaining revenue from ecotourism, hunting or the reduction of levies and taxes. In all cases, the authority for management rests with the landowners, who determine the conservation objective, develop and enforce management plans and remain in charge of decisions, subject only to relevant legislation.
D. Community conserved areas	Community conserved areas include protected aeas established and run by (i) indigenous peoples and (ii) local communities, both of which may be either sedentary or mobile. Management authority and responsibility rest with indigenous peoples and/or local communities through various forms of customary or legal, formal or informal, institutions and rules. These can be relatively complex. For instance, land and/or sea resources may be collectively owned and managed while other resources may be managed individually or on a clan-basis. Different communities may be in charge of the same area at different times, or of different resources within the same area. Rules generally intertwine with cultural and spiritual values. The customary rules and organisations managing natural resources sometimes have no statutory legal recognition or sanctioning power but in some cases, they may be fully recognised as the legitimate authority in charge of state-listed protected areas. At times, they are the legitimate owners of the site and its resources.

10 RECOMMENDATIONS

The World Conservation Congress in Barcelona, October 2008, passed a resolution[91] calling for the expansion of MPA networks. The following recommendations build on this.

1. CLARIFY TERMINOLOGY AND HARMONISE APPROACHES

The terminology surrounding MPAs and MPA networks is often confusing and can hinder both communication the measurement and comparison of progress. Common terms need to be agreed and,, as recommended by the South-east Pacific RSP, clear definitions and standardised nomenclature for concepts such as MCPAs, MPAs, and networks should be developed by WCPA-Marine, in collaboration with the CBD and other organisations that have adopted certain terms and definitions. Priorities include:

- An explanation of the term 'coastal' in the context of the CBD's terminology for MCPAs (in effect, what types of protected areas qualify as 'coastal' rather than 'marine'). Latin American countries in particular are using the CBD terminology, and it is thus difficult to compare their networks with others using the IUCN MPA definition.
- Consideration of the need to define NTAs as a sub-type of MPA, recognising that the terms 'marine reserve' and 'fully protected MPA' are widely used but in some countries are used for MPAs in which fishing is permitted.
- Clarification of the meaning and use of the terms 'network' and 'system', and of how these relate to broader marine spatial planning approaches. Leslie (2005) recommended that the extent to which the terms network and system imply connectivity and ecological relationships between sites should be clarified.

Another area of potential confusion is the fact that some countries and regions do not consider all their MPAs to be part of the 'official' MPA network, for example the Bahamas which is excluding multiple-use MPAs and Canada which is excluding sites designated at state-level. The Mediterranean MPA network excludes MPAs that have no or very little sub-tidal habitat, or if the marine component is primarily inter-tidal.

A harmonised approach to classifications and bioregionalisation would also be useful, and this is becoming possible with the development of the MEOW classification for waters over the continental shelf (Spalding *et al.*, 2007) and the forthcoming GOODS bioregionalisation which will provide a tool for the same purpose for high seas MPAs.

National and regional targets should be worded in a less ambiguous fashion if they are to be successfully monitored, and should specify what is to be protected, such as EEZ, shelf area, ecosystems or biomes. Assessing progress towards these targets is not always easy as many are very general - the countries in the Caribbean and Micronesia Challenge, for example, refer to 'nearshore marine ecosystems' without clearly specifying what these are.

2. STRENGTHEN CAPACITY FOR MPA NETWORK ESTABLISHMENT

There is an urgent need to build the capacity necessary, at both individual and institutional levels, for the development of MPA networks. Increased awareness of the benefits of and reasons for MPA networks is needed in order to gain support from all stakeholders, including MPA practitioners, policy makers, international organisations, NGOs, research institutes and the public. The WCC Resolution calls on the Secretariat of the CBD, together with partners, to expand technical support, training, and the development of tools and resources to assist Parties to accelerate their efforts to create and improve the effectiveness of MPAs and networks. Methodologies for MPA network and systematic conservation planning should be promoted and disseminated, and additional guidelines and materials produced where necessary. The compilation of case studies and lessons learned should be encouraged and facilitated, and shared between countries and regions. Social networks facilitating the sharing of experiences, challenges

[91] CGR4.MOT067 - Consolidated motion: Accelerating progress to establish marine protected areas and creating marine protected area networks

and successes amongst regions should be enhanced through workshops, study tours and twinning arrangements, and electronic networking. A wide range of organisations and agencies, including IUCN, the CBD, UNEP-RSP, international NGOs, and donors can play a role in facilitating and supporting such work, but much can also be done at the local level.

One example is the Marine Learning Partnership established by TNC, CI, WCS and WWF, with funding from US-AID (Corrigan, 2006). The goal of this is to accelerate MPA network development by improving knowledge and understanding of MPA network implementation in the field by improving conservation practice on ground, scaling up from MPA sites to ecological networks, and generating and disseminating increased knowledge of MPA networks though inter-organisational collaboration, in particular, by including local MPA managers in the initiatives. The Partnership comprises some 30 representatives of MPAs in South-east Asia (Philippines and Indonesia), the Pacific (Fiji, Micronesia, Palau and Papua New Guinea), the Caribbean (Belize, Mexico, Jamaica, Virgin Islands), the Eastern Tropical Pacific (Baja California, Costa Rica, Galápagos) and Africa (Madagascar, Tanzania, Sénégal and Gabon). A series of field trips and study visits were undertaken to different sites in the Partnership and workshops undertaken to learn about and develop work plans relating to biophysical aspects of network design, sustainable financing and social financing. Further initiatives of this nature would be valuable.

3. EXPAND REGIONAL, NATIONAL AND LOCAL INITIATIVES TO ESTABLISH MPA NETWORKS

MPA network planning must start, or be increased, in all coastal countries as soon as possible, and implementation fully addressed, if real progress is to be made by 2012. The 2008 WCC resolution calls on States to accelerate their efforts to meet the target, and on civil society, regional organisations, and bilateral and multilateral assistance agencies, to support the commitments of governments to create and improve the effectiveness of MPAs and networks.

The WCC Resolution recommends States to define MPA networks using a diversity of complementary tools to allow the combining of highly protected areas (NTAs) with managed multiple use areas. MPA networks need to be larger, contain the most resistant and resilient populations of marine organisms, and be connected in such a way to ensure free transfer of larvae, juveniles and adults to restock populations and repair damage. Scientific guidance is now available through the CBD and WCPA-Marine (IUCN/WCPA, 2008a) with agreed guidelines and principles, suitable biogeographical classifications (e.g. MEOW) and decision-support tools (e.g. Marxan) have been developed, and encouragement must given to countries to use these, adapt them where necessary. The basic science for developing MPA networks is understood and should not therefore be considered an obstacle, but there is an important role for scientists and academic institutions in further developing understanding of concepts such as adequacy, connectivity and resilience.

Full and effective participation of indigenous and local communities, in accordance with the national legislation and applicable international obligations, is essential. Lack of funding, political will and government commitment is a constraint in many countries, particularly when it comes to implementation of plans that have been developed, and, as recommended by Leslie (2005), assessments of the costs and benefits of the network approach are needed so that countries can budget for it and appreciate its value. Linking the development of MPA networks with overall national conservation system planning, and harmonising the process with the establishment of terrestrial protected area systems should also be considered. Appropriate policies and legislation must be introduced where needed.

Gaps in MPA network development at the regional level could be reduced by improved coordination between government, international organisations and NGOs, and the development of guidance on how regional networks might best be established. The value of UNEP-RSP as a framework for MPA network initiatives is recognised (ICRAN, 2005), but this organisation lacks adequate financial resources and capacity to take this role on fully, and there is a need to establish specific work plans, and obtain the necessary resources, including dedicated staff, for this activity. Better cooperation and coordinated action regarding the establishment of MPAs is required is also required with the RFMOs, both within and beyond areas of national jurisdiction. Support for the growing number of social networks will also help to promote the development of ecological MPA networks.

4. MONITOR AND EVALUATE PROGRESS IN THE DEVELOPMENT OF MPA NETWORKS

Compilation of this report has demonstrated the scattered and *ad hoc* nature of many data-gathering efforts on MPAs and the lack of any ongoing initiatives to measure progress in developing ecological networks of MPAs. The WCC resolution calls for a comprehensive report on progress towards the goal of creating MPA networks to be prepared by 2012, and requests IUCN to establish, in consultation with WCPA and working with the WDPA and others, a regular and transparent process for tracking and reporting commitments and progress toward creating MPAs and networks, as well as significant remaining gaps in MPA coverage. Planning for this should be started promptly, and efforts should be co-ordinated with the CBD Secretariat. Relatively few parties report on MPA progress fully at each COP (for example, at COP8, only 25 provided such reports and many of these were incomplete). Better understanding of why reporting is important, as well as greater harmonisation of the various national reporting requirements, is needed.

Increased efforts are required to establish effective and structured data-gathering initiatives at all national and regional levels to facilitate reporting. Accurate information on the name of the MPA, its total area, area of inter-tidal and sub-tidal habitat, bio-geographic region and ocean or sea, designation, legislation and governance, and presence and area of no-take zones is essential. This will help in both measuring the number of MPAs and the area of sub-tidal and inter-tidal water that is protected and thus be a valuable contribution to gap analysis activities as well as to measuring progress towards targets. Information on the WDPA should be provided in a simple and clear way, with an explanation of why it is important, and especially why the data provided for it should be accurate. The recording of mangrove forest reserves, Ramsar sites and other designated areas over which there is some question as to whether they fulfil the definition of a protected area needs resolving.

Amendments needed to the global MPA database include the addition of fields for the ocean, LME, ecoregion and other main geographical regions in which the MPA lies, and the main ecosystems covered by the MPA. Good comparative datasets on areas of marine jurisdiction (EEZs, territorial seas, continental and insular shelves) are also needed. UNEP-RSP and UNEP-WCMC have the use of the 'Global Maritime Database and GIS' that gives much of this information, and WRI and UBC/SAUP also have datasets. The geographical boundaries to be used for assessing progress at the regional level (such as those of the UNEP-RSP and WCPA-Marine) need to be discussed.

Indicators to measure the progress being made towards the development of ecological networks, as opposed to individual MPAs, are also needed. This will involve organisations such as WCPA-Marine, UNEP-WCMC and the many MPA experts in the regions. Day and Laffoley (2006) have prepared a self-assessment checklist, using the WCPA-Marine ecological design criteria such as representation, resilience, adequacy and connectivity, and best practices. A questionnaire produced by UNEP-WCMC, for the compilation of data for this project provided a similar but more detailed mechanism for assessing progress. Lundquist and Granek (2005) identified the following characteristics as essential for success in establishment of MPA networks: clear objectives, stakeholder involvement, full use of available science, effective design; and subsequent monitoring to assess impact, and these might also be considered as potential indicators. Key data needed include ecosystem and habitat coverage, information about the bio-geographical region and other classification information, and evidence of connectivity between sites. Regular assessments of progress at local, national and regional levels, using the criteria and principles that have been developed, will help to encourage countries to take a network approach to MPA establishment. The UNEP-RSP can play an important role as well as the LME and WWF Ecoregion programmes in promoting the need for assessments.

5. IMPROVE MANAGEMENT OF MPAS AND OF THE MPA NETWORKS AS THEY ARE ETABLISHED

The current focus on establishing new MPAs in order to create networks presents a considerable risk that attention will be detracted from ensuring effective management of existing sites, and thus creating more 'paper parks'. Renewed efforts must also go into all aspects of effective management. New guidelines for management planning are being prepared by WCPA-Marine and NOAA, and there is a growing recognition of the value of carrying out assessments of management effectiveness, which provide a useful tool for identifying where improvements are needed. Until each country and initiative is using at least some basic management effectiveness measures, it will not be possible to know whether there is real progress in protection and if the network approach is delivering its anticipated additional benefits. Effective management requires careful attention to the governance mechanisms used for individual sites within a network, and the IUCN governance categories can play a useful role in this; and their use should be encouraged. The basic principles of good MPA network management and governance, as opposed to those for individual MPAs, are discussed in IUCN/WCPA (2007a) but have yet to be clearly identified, with indicators that can be used to measure the success of the network in reducing the rate of biodiversity loss. The 2008 WCC Resolution thus calls on States to improve the management effectiveness of existing and future MPAs to increase marine resilience in the face of climate change and ocean acidification.

6. ENSURE THAT MPA NETWORKS ARE ESTABLISHED WITHIN A BROADER SPATIAL PLANNING AND ECOSYSTEM-BASED MANAGEMENT FRAMEWORK

MPA networks alone, even if effectively managed will not protect all marine biodiversity effectively. To achieve this, systematic conservation planning must be extended to the oceans as a whole, to ensure that MPAs are established within a broad framework of spatial planning and ecosystem-based management, as called for by the CBD.

11 REFERENCES

Aalbersberg, W., Tawake, A., and Parras, T. 2005. Village by village: Recovering Fiji's coastal fisheries. Case study. p. 144-151. World Resources Institute.

Agardy, T.S. 1997. *Marine Protected Areas and Ocean Conservation*. Academic Press, Dallas, Texas, USA.

Agardy, T. 2003a. Optimal design of individual marine protected areas and MPA systems. *Proceedings of the Conference on Aquatic Protected Areas*, 8-12 August 2002, Cairns, Australia.

Agardy, T. 2005. Melding large scale marine policy with small scale conservation projects through MPA networks. Abstract 14. International Marine Protected Areas Congress (IMPAC), Geelong, Australia.

Agardy, T. 2007. Ocean zoning is coming! Ocean zoning is coming! Music to some ears, a fearsome sound to others. W2O Observer Newsletter of World Ocean Observatory.

Agardy, T., P. Bridgewater, M.P. Crosby, J. Day, P.K. Dayton, R. Kenchington, D. Laffoley, P. McConney, P.A. Murray, J.E. Parks and L. Peau. 2003. Dangerous targets: Differing perspectives, unresolved issues, and ideological clashes regarding marine protected areas. *Aquatic Conservation: Marine and Freshwater Ecosystems* 13:1-15

Agardy, T. and Wolfe, L. 2002. Institutional Options for Integrated Management of a North American Marine Protected Areas Network: Commission on Environmental Cooperation Report. CEC, Montreal.

AHTEG/MCPA 2004. *Technical Advice on the Establishment and Management of a National System of Marine and Coastal Protected Areas*. CBD Technical Series no. 13, *Ad hoc* Technical Expert Group on Marine and Coastal Protected Areas. Secretariat of the Convention on Biological Diversity, Montreal. 40 pp.

Airame, S., Dugan, J., Lafferty, K.D., Leslie, H., McArdle, D.A., and Warner, R.R. 2003. Applying ecological criteria to marine reserve design: a case study from the California Channel Islands. *Ecological Applications* 13: S170-S184.

Allison, G., S. Gaines, J. Lubchenco, and H. Possingham. 2003. Ensuring persistence of marine reserves: catastrophes require adopting an insurance factor. *Ecological Applications* 13 S:8-24.

Anderson, T. 2005. Marine protected areas - the NSW experience. *Waves* 11(2): 28.

Anon. 2005. Natura 2000 in the marine environment. *Natura 2000. European Commission DG Env Nature Newsletter* Issue 19: 2-4.

Anon. 2008. 5th Meeting of the *ad hoc* Expert Group on Protected Marine and Coastal Areas Responsible for Defining the Implementation Mechanisms for The Regional South-East Pacific AMCP Network, held in Guayaquil, Ecuador (27-29 Feb 2008)

ANZECC Task Force on Marine Protected Areas 1998. Guidelines for establishing the National Representative System of Marine Protected Areas. In: Strategic Plan of Action for the National Representative System of Marine Protected Areas: a guide for action by Australian Governments. Environment Australia, Canberra.

Arceo, H.O., Alino, P.A., Gonzales, R.O.M. 2008. Where are we now with Marine Protected Areas? In: Reefs Through Time 2008: Initiating the State of the Coastsl Reports. Coral Reef Information Network of the Philippines (PhilReefs). Marine Science Institute, Univ. Philippines, Quezon City.

Ardron, J. 2007. Overview of Existing High Seas Spatial Measures and Proposals with Relevance to High Seas Conservation. German Federal Agency for Nature Conservation.

Ardron, J.A., J. Lash and D. Haggarty. 2002. Modeling a Network of Marine Protected Areas for the Central Coast of British Columbia. Version 3.1. Living Oceans Society, Sointula, BC, Canada.

Ardron, J.A., Possingham, H.P., and Klein, C.J. (eds) 2008. Marxan Good Practices Handbook. External review version; 17 May, 2008. Pacific Marine Analysis and Research Association, Vancouver, BC, Canada. 155 pages. www.pacmara.org

Aswani, S. and Hamilton, R. 2004. The value of many small vs few large marine protected areas in the Western Solomon Islands. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin* 16: 3-14.

Ballantine, W. 1997. Design principles for systems of "no-take" marine reserves. In The Design and Monitoring of Marine Reserves: 1-19. Fisheries Center, UBC, Vancouver, British Columbia

Barber, P.H, Palumbi S.R, Erdmann M.V, Moosa M.K (2002) Sharp genetic breaks among populations of a benthic marine crustacean indicate limited oceanic larval transport: patterns, causes, and consequences. *Molecular Ecology* 11, 659-674.

Baum, J.K. and Myers, R.A. 2004. Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico. *Ecology Letters* 7: 135-145.

Beaver, K. 2004. Final Report. Seychelles Marine Ecosystem Management Project. GEF/Seychelles Government.

Bedward, M., Pressey, R.L. and Keith, D.A. 1992. A new approach for selecting fully representative reserve networks: addressing efficiency, reserve design and land suitability with an iterative analysis. *Biological Conservation* 62: 115-125.

Benitez, S. 2007. Ecuador Marine Gap Assessment. TNC, Arlington, Virginia, USA.

Bennett, A.F. 2003. *Linkages in the Landscape: the role of corridors and connectivity in wildlife conservation.* IUCN, Gland, Switzerland and Cambridge, UK. 254 pp.

Bennett, G. and Mulongoy, K.J. 2006. *Review of Experience with Ecological Networks, Corridors and Buffer Zones.* Technical Series No. 23. Secretariat of the Convention on Biological Diversity, Montreal, 100 pp.

Bezaury-Creel, J.E. 2005. Protected areas and coastal and ocean management in Mexico. *Ocean and Coastal Management* 48: 1016-1046.

BirdLife International. 2008. BirdLife International/American Bird Conservancy Workshop on Seabirds and Seabird-Fishery Interactions in Peru. RSPB, Sandy, UK.

Bishop, K., Dudley, N., Phillips, A. and Stolton, S. 2004. *Speaking a Common Language: the uses and performance of the IUCN System of Management Categories for Protected Areas.* Cardiff University/IUCN-World Conservation Union/UNEP-World Conservation Monitoring Centre.

Black Sea Commission. 2005. The Black Sea Biodiversity and Landscape Conservation Protocol to the Convention on the Protection of the Black Sea Against Pollution. www.blacksea-commission.org/Main.htm (Accessed 16 March, 2005).

Block, B.A., Teo, S.L.H., Walli, A., Boustany, A., Stokesbury, M.J.W., Farwell, C.J., Weng, K.C., Dewar, H. and Williams, T.D. (2005) Electronic tagging and population structure of Atlantic Bluefin Tuna. *Nature*, 434: 1121-1128.

Borrini-Feyerabend, G., Kothari, A. and Oviedo, G. 2004. *Indigenous and Local Communities and Protected Areas: Towards Equity and Enhanced Conservation.* IUCN, Gland, Switzerland and Cambridge, UK. 111 pp.

Boyes, S., Elliott, M., Thomson, S., Atkins, S., Gilliland, P., Hamer, J. and Hill, A. 2005. Multiple-use zoning in UK and Manx Waters of the Irish Sea: An interpretation of current legislation through the use of GIS-based zoning approaches. Scottish Natural Heritage, Perth. 69 pp.

Broquere, M. 2005. How Many Marine Protected Areas Exist in the West Mediterranean? Report, IUCN Centre for Mediterranean Co-operation.

Brumbaugh, D. 2008. Future directions in MPA site selection. *MPA News* 10(2): 4

Brumbaugh, D., *et al.* 2008. Inferring the appropriate spatial scale of design and management for MPA networks: an interdisciplinary case study from the Bahamian Archipelago. Abstract 23-16. 11th International Coral Reef Symposium, Fort Lauderdale, Florida. July 2008.

Bustamante, G. 2003. *Marine Reserves Regional Enhancement Plan for the Wider Caribbean.* ...

Bustamante, G., Glazer, R., Vanzella-Khouri, A., and Rodriguez, J.V. 2005. The Caribbean Marine Protected Areas Management Network and Forum (CaMPAM), a model for enhancing communication and training in biological corridors and MPA networks of other Latin American region. Paper given at Latin American Congress of Marine Science, Vina del Mar, Chile, May 2005.

Cacaud, P., 2005. Fisheries laws and regulations in the Mediterranean: a comparative study. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 75. Rome, FAO. 40p.

Calabrese, J.M. and Fagan, W.F. 2004. A comparison-shopper's guide to connectivity matrices. *Frontiers in Ecology and the Environment* 2: 529-536.

Cappo, M.and Kelley, R. 2000. Connectivity in the Great Barrier Reef World Heritage Area: an overview of pathways and processes. In: Wolankski, E. (ed). *Oceanographic Processes of Coral Reefs: physical and biological links in the Great Barrier Reef.* CRC Press: 161-187.

Carpenter, S.R., B. H. Walker, J. M. Anderies, and N. Abel. 2001. From metaphor to measurement: resilience of what to what? *Ecosystems* 4:765-781.

Carr, M.H., Neigel, J.E., Esters, J.A., Andelman, S., Warner, R.R. and Largier, J.L. 2003. Comparing marine and terrestrial ecosystems: implications for the design of coastal marine reserves. *Ecol. Appl. (Suppl).* 13: S90-S107.

Carter, E. and Darmawan, A. 2008. Marine Protected Area Gap Assessment, Indonesia. Report to TNC-Coral Triangle Center, Bali, Indonesia.

Carvajal, M., Bezaury-Creel, J.E., Barrera, J.C. and Saenz-Arroyo, A. 2005. Developing the Gulf of California's Regional System of Marine Protected Areas. Paper presented at Symposium and Workshop of the North American Marine Protected Areas Network, Loreto, Baja California Sur, Mexico. www.cec.org

CBD. 2002. *Summary Report of the ad hoc Technical Expert Group on Marine and Coastal Protected Areas to the Subsidiary Body on Scientific, Technical and Technological Advice on the Marine and Coastal Biodiversity: Review, Further Elaboration and Refinement of the Programme of Work,* UNEP/CBD/SBSTTA/8/9/Add.1, 27 November 2002. Convention on Biological Diversity

CBD. 2003. Marine and coastal biodiversity: review, further elaboration and refinement of the Programme of Work. Report of the *ad hoc* Technical Expert Group on Marine and Coastal Protected Areas to the Subsidiary Body on Scientific, Technical and Technological Advice. Eighth meeting, UNEP/CBD/SBSTTA/8/INF/7. Convention on Biological Diversity. 50 pp. www.biodiv.org/doc/meeting.aspx?mtg=sbstta-08&tab=1

CBD. 2005. Draft global outcome-oriented targets for the programmeof work on marine and coastal biological diversity. UNEP/CBD/SBSTTA/10/8/Add.1., Convention on Biological Diveristy. 15 pp. www.biodiv.org/doc/meeting.aspx?mtg=sbstta-10

Chape, S., Harrison, J., Spalding, M. and Lysenko, I. 2005. Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. *Phil. Trans. R. Soc. B* 360: 443-455.

Chapman, B. and Turner, J.R. 2004. Development of a Geographical Information System for the marine resources of Rodrigues. *J. Nat. Hist.* 38: 2937-2957.

Chatwin, A. 2007 (Ed). *Priorities for Marine Conservation in South America.* TNC, Arlington, Virginia, USA. 63 pp.

Cheung, W., Alder, J., Karpouzi, V., Watson, R., Lam, V., Day, C., Kaechner, K., and Pauly, D. 2005. Patterns of Species Richness in the High Seas. Technical Series No. 20, Secretariat of the Convention on Biological Diversity, Montreal. 31 pp.

Cheung, C. and L. DeVantier, 2006. *Socotra - A Natural History of the Islands and their People.* Odyssey Books and Guides, Airphoto International Ltd. 408 pp.

Christie, P., Armada, N.B., White, A.T., Gulayan, A.M. and de Dios, H.H.Y. 2006. Coastal environmental and fisheries profile of Danajon Bank, Bohol, Philippines. Fisheries Improved for Sustainable Harvest (FISH) Project, Cebu City, Philippines. 63 p.

Christie P, White AT (2007) Best practices for improved governance of coral reef marine protected areas. *Coral Reefs* 26:1047-1056.

CIESM. 1999. Scientific design and monitoring of Mediterranean marine protected areas. Workshop, Italy, October, 1999. www.ciesm.org/online/monographs/porto.pdf

Clark, B.M. and Lombard, A.T. 2007. A Marine Conservation Plan for the Agulhas Bioregion: options and opportunities for enhancing the existing MPA network. Report for WWF-SA, CAPE, Cape Nature, and South African National Parks. Anchor Environmental Consultants CC/Conservation Systems. South Africa.

Claro, R. and Lindman, K.C. 2003. Spawning aggregation sites of snapper and grouper species (Lutjanidae and Serranidae) on the insular shelf of Cuba. *Gulf and Caribbean Research* 14(2): 91-106.

Claudet J., Osenberg C.W., Benedetti-Cecchi L., Domenici P., García-Charton J.A., Pérez-Ruzafa A., Badalamenti F., Bayle-Sempere J., Brito A., Bulleri F., Colioli J.M., Dimech M., Falcón J.M., Guala I., Milazzo M., Sánchez-Meca J., Somerfield P.J., Stobart B., Vandeperre F., Valle C., Planes S. 2008. Marine reserves: size and age do matter. *Ecology Letters* 11(5): 481-489.

CLF-USA/WWF Canada. 2007. Marine Ecosystem Conservation for New England and Maritime Canada: a science-based approach to identifyng priority areas for conservation. Conservation Law Foundation-USA/WWF Canada. 194 pp.

CNAP. 2002. Sistema Nacional de Areas Protegidas, Cuba. Plan 2003-2008. Centro Nacional de Areas Protegidas (CNAP). 202 pp.

Coello, S., P. Gastezzi and D. Vinueza (2007) Evaluación del desempeño de los acuerdos de uso sustentable y custodia de manglar en la provincia de Esmeraldas. Proyecto de conservación integral de recursos marinos y costeros en la provincia de Esmeraldas. Convenio ALA/2001/003-235. Programa de apoyo a la gestión descentralizada de los recursos naturales en las tres provincias del norte del Ecuador (PRODERENA). Unión Europea - República del Ecuador - Ministerio del Ambiente.

Coello, S., D. Vinueza, R. Alemán. (in press) Evaluación del desempeño de los acuerdos de uso sustentable y custodia de manglar de Ecuador. Ministerio del Ambiente (MAE) - Conservación Internacional (CI) - Unión Mundial para la Naturaleza (UICN).

CONABIO-CONANP-TNC-PRONATURA. 2007. Análisis de vacios y omisiones en conservación de la biodiversidad marina de México: océanos, costas e islas. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Comisión Nacional de Áreas Naturales Protegidas, The Nature Conservancy Programa México, Pronatura A.C. México, D.F. 130 pp.

Connor, D.W., Dalkin, M.J., Hill, T.O., Holt, R.H.F., and Sanderson, W.G. 1997. Marine Nature Conservation Review: Marine Biotope Classification for Britain and Ireland. Vol. 2. Sublittoral Biotopes. Version 97.06. JNCC Report no. 230. Joint Nature Conservation Committee, Peterborough, UK. 448 pp.

Cooch, F and Pagnan, J. 1996. Circumpolar Protected Area Network (CPAN) Principles and Guidelines. CAFF, Ottawa.

Cook, R. and Auster, P. 2006. *Developing Alternatives for Optimal Representation of Seafloor Habitats and Associated Communities in Stellwagen Bank National Marine Sanctuary,* 24 pp. http://sanctuaries.noaa.gov/science/conservation/seafloor_sbnms.html

Corrigan, C. 2006. The Marine Learning Partnership: Effective Design and Management of Tropical Marine Protected Area Networks through Cross-Institutional Learning. The Nature Conservancy, Arlington, Virginia, 144 pp.

Corrigan, C., J. Ervin, P. Kramer, and Z. Ferdaña, 2007. *A Quick Guide to Conducting Marine Ecological Gap Assessments.* Protected Area Quick Guide Series, editor, J. Ervin. Arlington, VA: The Nature Conservancy. 21 pages.

Corrigan, C., Kershaw, F. and Turner, D. (2008) *Working Toward High Seas Marine Protected Areas: An Assessment of Progress Made and Recommendations for Collaboration.* UNEP-WCMC, Cambridge, UK. see http://www.unep-wcmc.org/protected_areas/pubs.htm.

Cowen, R.K., Paris, C.B. and A. Srinivasam,. 2006. Scaling of connectivity in marine populations. *Science* 522-527.

Crowder, L.B., Osherenko, G., Young, O. R., Airamé, S., Norse, E. A., Baron, N., Day, J. C., Douvere, F., Ehler, C. N., Halpern, B. S., Langdon, S. J., McLeod, K. L., Ogden, J. C., Peach, R. E., Rosenberg, A. A., and J. A. Wilson, 2006. Resolving mis-matches in U.S. ocean governance. *Science* 4 Vol. 313 (5787): 617 - 618.

Dahl, A.1993. The large marine ecosystem approach to regional seas action plans and conventions:A geographic perspective. pp 15-17 In K. Sherman, L.Alexander, and B. Gold [eds.] *Large Marine Ecosystems: Stress, Mitigation,and Sustainability*, AAAS Press, Wash., DC

Davey, A.G. 1998. *National System Planning for Protected Areas.* IUCN, Gland, Switzerland and Cambridge, UK. 71 pp.

Davis, G. 2005. Science and Society: Marine Reserve Design for the California Channel Islands.Conservation Biology 19 (6): 1745-1751

Day, J.C. and J. C. Roff, (2000); *Planning for Representative Marine Protected Areas: A Framework for Canada's Oceans.* Report prepared for World Wildlife Fund Canada, Toronto.

Day, J.C, and D. d'A Laffoley, 2006. Self-assessment checklist for building networks of MPAs. WCPA IUCN.

Dayton, P., Thrush, S., Agardy, T. and R. Hofman, 1995. Environmental effects of marine fishing. *Aquatic Conservation: Marine and Freshwater Ecosystems* 5: 205-232.

Dight, I. J. 2005. Towards an ecosystem management framework for the Galapagos Marine Reserve. Abstract 40, International Marine Protected Areas Congress (IMPAC), Geelong, Australia.

Done, T.J. 2001. Scientific principles for establishing MPAs to alleviate coral bleaching and promote recovery. In: Salm, R.V. and Coles, S.L. (Editors), *Coral Bleaching and Marine Protected Areas.* Proceedings of the Workshop on Mitigating Coral Bleaching through MPA Design. Bishop Museum, Honolulu, Hawaii.

Driver, A., K. Maze, M. Rouget, A.T. Lombard, J. Nel, J.K. Turpie, R.M. Cowling, P. Desmet, P. Goodman, J. Harris, Z. Jonas, B. Reyers, K. Sink and T. Strauss. 2005. *National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia 17.* South African National Biodiversity Institute, Pretoria. www.sanbi.org

Dudley, N., Mulongoy, K.J., Cohen, S., Stolton, S., Barber, C.V. and S. B. Gidda, 2005. *Towards Effective Protected Area Systems. An Action Guide to Implement the Convention on Biological Diversity Programme of Work on Protected Areas.* Technical Series no. 18, Secretariat of the Convention on Biological Diversity, Montreal, 108 pp.

Dudley, N. and J. Parish, 2006. *Closing the Gap: creating ecologically representative protected area systems. A Guide to Conducting the Gap Assessments of Protected Area Systems for the Convention on Biological Diversity.* Technical Series 24, Secretariat of the Convention on Biological Diversity, Montreal.

Dudley, N. and S. Stolton, 2006. *Strengthening African Protected Area Networks.* UNEP-WCMC

Dunham, J. *et al.* 2002. Provincial Marine Protected Areas in British Columbia. B.C. Ministry of Sustainable Resource Management, Decision Support Services. 551 pp.

EAME. 2004. The Eastern African Marine Ecoregion Vision: A large scale conservation approach to the management of biodiversity. Eastern African Marine Ecoregion Programme, WWF: Dar es Salaam, Tanzania. 53pp.

EASAC. 2005. A User's Guide to Biodiversity Indicators. European Academies Science Advisory Council Policy Report 4, Royal Society, London. www.easac.org

Edyvane, K. 2005. NRSMPA - policies, planning and science. *Waves* 11(2): 10.

Edgar G.J., Banks S., Bensted-Smith R., Calvopin M., Chiriboga A., Garske L.E., Henderson S., Miller K.A., and S. Salazar. 2008a. Conservation of threatened species in the Galapagos Marine Reserve through identification and protection of marine key biodiversity areas. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18: 955-968.

Edgar G.J., Langhammer P.F., Allen G., Brooks T.M., Brodie J., Crosse W., De Silva N., Fishpool L., Foster M.N., Knox D., McCosker J.E., McManus R., Miller A., and R. Mugo. 2008b. Key Biodiversity Areas as globally significant target sites for the conservation of marine biological diversity. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18: 969-983.

Ehler, C. and F. Douvere, 2007. *Visions for a Sea Change.* Report of the International Workshop on Marine Spatial Planning, Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 48, IOCAM Dossier No. 4., UNESCO, Paris. 83 pp.

Enriquez-Andrade, R., Anaya-Reyna, G., Barrera-Guevara, J.C., Carvajal-Moreno, M.D., Martinez-Delgado, M.E., Vaca-Rodriguez, J. and C. Valdes-Casillas, 2005. An analysis of critical areas for biodiversity conservation in the Gulf of California Region. *Ocean and Coastal Management* 48: 31-50.

EPA/SCDP GIS Unit. 2006. Ministry of Water and Environment, elaborated by F. Attorre. UNESCO World Heritage Site nomination file, February 2006

Estrada, R., Hernandez, A., Gerhartz, J.L., Martinez, A. J., Melero, M., Bliemsrieder, M. and Lindeman, K.C. 2004. *The National System of Marine Protected Areas in Cuba.* WWF/Environmental Defense/National Center for Protected Areas.

Etienne, D. 2005. *Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region.* Presented at SBSTTA 10, Bangkok, 10 February 2005, as a side event.

FAO. 2007. *Report and documentation of the Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations. Rome,* 12-14 June 2006. FAO Fisheries report. No. 825. Rome, FAO. 332 pp.

Fernandez, M. and Castilla, J.C. 2005. Marine conservation in Chile: historial perspective, lessons and challenges. *Conservation Biology* 19: 1752-1762.

Fernandes, L., Day, J., Kerrigan, B., Breen, D., Mapstone, B., Coles, R., De'ath, G., Done, T., Marsh, H., Poiner, I., Ward, T., Williams, D., and R. Kenchington, 2005. Biophysical principles to design a network of no-take areas: the Great Barrier Reef Case Study. Abstract 11. International Marine Protected Areas Congress, Geelong, Australia.

Fortes *et al.* undated. Introducing the regional action plan (RAP) to strengthen a resilient network of effective marine protected areas in southeast Asia: 2002-2012. IUCN/WCPA/TNC. www.iucn.org/themes/wcpa/biome/marine/seasia/seasia.html#download.

Frankic, A. 2005a. Protected Areas - Conservation and sustainable use of biodiversity in the Dalmatian coast. UNDP/GEF Coast Project, Croatia. Report pp59. http://ccrm.vims.edu/staff/PAs20%final20%report.pdf

Frankic, A. 2005b. "A Protected Environment in the Adriatic Area: A Key for Sustainable Economic Development"; in: Global Marketing Briefings: Doing Business with Croatia. GMB Publishing

Francis, J., Nilsson, A. and D. Waruinge, 2002. Marine protected areas in the Eastern African Region: how successful are they? *Ambio* 31 (7-8): 503-511.

Friedlander, A., Sladek Nowlis, J., Sanchez, J.A., Appeldoorn, R., Usseglio, P., McCormick, C., Bejarano, S. and A. Mitchell-Chui, 2003. Designing effective marine protected areas in Seaflower Biosphere Reserve, Colombia, based on biological and sociological information. *Cons. Biol.* 17(6). 1769-1784.

Freiwald, A., J.H Fosså, A. Grehan, T. Koslow and J. M. Roberts. 2004. Cold-water Coral Reefs. UNEP WCMC, Cambridge, UK.

Galindo, H.M., D.B. Olson and S.R. Palumbi. 2006. Seascape genetics: A coupled oceanographic-genetic model predicts population structure of Caribbean corals. *Current Biology* 16(16): 1622-1626. http://www.sciencedirect.com/science/article/B6VRT-4KPFVNM-/2/874897b092e5fcaacaa5a7a13b2b39c3

Gardner, J., Bicego, S. and Jessen, S. 2008. Challenges and opportunities in progress towards Canada's commitment to a national network of MPAs by 2012. Report to Canadian Parks and Wildlife Society, 165 pp.

Gardner, L., Smith Abbot, J. and Woodfield-Pascoe, N. 2007. British Virgin Islands Protected Areas System Plan 2007-2017. BVI National Parks Trust. Tortola.

GEF. 2005. Strategic Partnership for the Mediterranean Large Marine Ecosystem - Regional Component: Implementation of agreed actions for the protection of the environmental resources of the Mediterranean Sea and its coastal areas. Project Document

Gell, F.R. and C. M. Roberts, 2003. Benefits beyond boundaries: the fishery effects of marine reserves. *Trends in Ecology and Evolution* 18(9): 448-455.

Geoghegan, T., A. Smith and K. Thacker. 2001. Characterisation of Caribbean Marine Protected Areas: an Analysis of Ecological, Organisational, and Socio-Economic Factors. CANARI Technical Report No. 287.

GFCI (Gulf and Caribbean Fisheries Institute). 2005. *CaMPAM Network and Forum, Five-Year Strategic Plan 2005-2009*. www.gcfi.org/campam/CaMPAM.htm (Accessed 29 April, 2005).

GFCM. 2007. Report of the Transversal Workshop on Marine Protected Areas (MPASs) (GFCM and RAC/SPA), Salammbô, Tunisia, 24 and 25 May 2007. GFCM/SAC 10/2007/Inf.15.

Gjerde, K.M., ed. (2003). Ten-year strategy to promote the development of a global representative system of high seas marine protected area networks, as agreed by Marine Theme Participants at the 5th World Parks Congress Governance Session Protecting Marine Biodiversity beyond National Jurisdiction," Durban, South Africa (8-17 September 2003). IUCN, WCPA WWF. Available at www.iucn.org/themes/marine/pdf/10ystrat.pdf

Gjerde, K.M. and C. Breide, (Eds) 2003. Towards a Strategy for High Seas Marine Protected Areas; Proceedings of the IUCN, WCPA and WWF Experts Workshop on High Seas Marine Protected Areas, Malaga, Spain. ISBN 2-8317-0732-3, 2003.

Gjerde, K.M. and G. Kelleher, 2005. High Seas marine protected areas on the horizon: legal framework and recent progress. *Parks* 15(3): 11-18.

Gibson, J., McField, M., Heyman, W., Wells, S., Carter, J. and G. Sedberry, 2004. Belize's evolving system of Marine Reserves. In: Sobel, J.A. and C. P Dalgren, (Eds). Marine Reserves: a Guide to Science, Design and Use. Island Press. Pp. 287-315.

Gladstone W, Younis M, and F. Krupp, 2003. Red Sea and Gulf of Aden Regional Network of Marine Protected Areas. www.iucn.org/themes/wcpa/wpc2003/pdfs/programme/cct/marine/redsea.pdf (Accessed Feburuary 23, 2005).

Global Oceans Forum. 2008. Policy Brief on Marine Biodiversity and Marine Protected Areas. Report to the Ninth Meeting of the Conference of the Parties of the Convention on Biological Diversity, Bonn, Germany.

Government of Canada. 2005. Canada's Federal Marine Protected Areas Strategy. Fisheries and Oceans Canada, Canada.

Government of New Zealand. 2006. Marine Protected Areas Policy and Implementation Plan. www.biodiversity.govt.nz/seas/biodiversity/protected/mpa_policy.html

Grant, S.M. 2005. Challenges of marine protected area development in Antarctica. *Parks* 15(3) 40-47.

Grant, S., Constable, A. Raymond, B. and Doust, S. 2006. Bioregionalisation of the Southern Ocean: Report of the Experts Workshop, Hobart, September 2006. WWF-Australia and ACE CRC.

Grantham, B.A., Eckert, G.L., and A. L. Shanks, 2003. Dispersal potential of marine invertebrates in diverse habitats. *Ecological Applications* 13: S108-S116.

Greco S., Notarbartolo di Sciara G., and L. Tunesi, 2004. 'Sistema Afrodite': An integrated programme for the inventorying and monitoring of the core zones of the Italian marine protected areas. Aquatic Conservation: Marine and Freshwater Ecosystems 14:119-122.

Green, A., Lokani, P., Sheppard, S., Almany, J., Keu, S., Aitsi, J., Warku Karvon, J., Hamilton, R and G. Lipsett-Moore, 2007. *Scientific Design of a Resilient Network of Marine Protected Areas*. Kimbe Bay, West New Britain, Papua New Guinea. TNC Pacific Island Countries Report No. 2/07.

Greenpeace, 2005. Marine Reserves for the Mediterranean Sea. http://www.oceans.greenpeace.org/med-marinereserves-report.

Grimsditch, G.D. and R. V. Salm, 2006. *Coral Reef Resilience and Resistance to Bleaching*. IUCN, Gland, Switzerland. 52 pp.

Gubbay, S. 2004. *Marine Protected Areas in the context of Marine Spatial Planning - discussing the links*. Report to WWF-UK, Godalming, UK. 22 pp.

Gubbay, S. 2005. Marine Protected Areas and Zoning in a System of Marine Spatial Planning. A Discussion Paper for WWF-UK.

Gubbay, S. 2006. Marine nature conservation in the pelagic environment: A case for pelagic marine protected areas? Report to WWF-UK, September 2006.

Gubbay, S., Ashworth, J., Bull, K. and Earll, R. 2008. Towards a coherent network of Marine Protected Areas. Report of a conference held on the 2-4th October, 2007, Scarborough, UK. *Natural England Research Report* No. 006.

Gugliemi, P. 2004. Marine protected areas in the Mediterranean: challenges and potential for sustainable coastal management. UNEP/MAP Forum, Cagliari, 28-29 May 2004.

Guidetti P., Milazzo M., Bussotti S., Molinari A., Murenu M., Pais A., Spanò N., Balzano R., Agardy T., Boero F., Carrada G., Cattaneo-Vietti R., Cau A., Chemello R., Greco S., Manganaro A., Notarbartolo di Sciara G., Russo G.F., and L. Tunesi, 2008. Italian marine reserve effectiveness: does enforcement matter? *Biological Conservation* 141:699-709. doi:10.1016/j.biocon.2007.12.013

Haddad, N.M., Bowne, D.R., Cunningham, A., Danielson, B.J., Levey, D.J., Sargent, S., and T. Spira, 2003. Corridor use by diverse taxa. *Ecology* 84: 609-615.

Hägerhäll, B. and H. Skov. 1998. Proposal for offshore Baltic Sea Protected Areas (BSPAs). Expert Report to HELCOM EC-NATURE. 103 pp.

Hain, S. and E. Corcoran, 2004. The Status of the Cold-Water Coral Reefs of the World. UNEP-WCMC

Halpern, B. 2003. The impact of marine reserves: do reserves work and does reserve size matter? *Ecological Applications* 13: S117-S137.

Halpern, R.S. and R.R.Warner, 2003. Matching marine reserve design to reserve objectives. *Proc. Roy. Soc. London, Series B-Biological Sciences* 270(1527): 1871-1878.

Hansen, J-H *et al.* 1996. *Circumpolar Protected Areas Network (CPAN) - Strategy and Action Plan.* CAFF, Trondheim.

Hansen, L., 2003. Increasing the resistance and resilience of tropical marine ecosystems to climate change. In: Hansen, L.J., Biringer, J.L., and J.R. Hoffman, (Editors), *Buying Time: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems.* WWF, USA, pp. 155-174.

Hanson, A.J., Agardy, T., and R. Perez Gil Salcido. 2000. Securing the Continent's Biological Wealth: Toward Effective Biodiversity Conservation in North America. Commission on Environmental Cooperation Report. CEC, Montreal.

Harborne, A.R., P.J. Mumby, C.V. Kappel, C.P. Dahlgren, F. Micheli, K.E. Holmes, J.N. Sanchirico, K. Broad, I.A. Elliott and D.R. Brumbaugh. 2008. Reserve effects and natural variation in coral reef communities. *Journal of Applied Ecology* 45(4): 1010-1018. http://dx.doi.org/10.1111/j.1365-2664.2008.01490.x

Harding, S., Randriamanantsoa, B., Hardy, T.and Curd, A.2006. Coral Reef Monitoring and Biodiversity Assessment to support the planning of a proposed MPA at Andavadoaka. Wildlife Conservation Society, New York, 2006. 100p.

Harris, A. 2007. "To live with the Sea" Development of the Velondriake Community - Managed Protected Area Network, Southwest Madagascar. *Madagascar Conservation and Development* 2(1): 43-49.

Harris, J. *et al.* 2005. SeaPLAN: a marine biodiversity conservation plan. Project Update August 2005: Brochure.

Hastings, A. and L.W. Botsford, 2003. Comparing design of marine reserves for fisheries and for biodiversity. *Ecological Applications* 13: 65-70.

Hastings, S.P., Airame, S., Senyk, N., Murray, M., and J. Ugoretz, 2005. Advancing ecosystem-based management in a complex ocean governance system: the Channel Islands Marine Reserves Experience. Abstract 35. International Marine Protected Areas Congress (IMPAC), Geelong, Australia.

HELCOM. 2005. Helsinki Commission - HELCOM HABITAT 7/2005. Nature Protection and Biodiversity Group Seventh Meeting. 5.2/1 HELCOM 2008. Status of the Network of Baltic Sea Protected Areas in 2008 especially as regards implementation of the Baltic Sea Action Plan. Agenda Item 4.2. Natural Marine and Coastal Landscapes. Nature Protection and Biodiversity Group Tenth Meeting Warsaw, Poland, 5-9 May 2008.

Herdiana, Y., Campbell, S. and Baird, A. 2008. Systematic conservation planning towards a representative areas network in Aceh, Indonesia. Abstract 23-3. International Coral Reef Symposium, Fort Lauderdale, Florida, July 2008.

Heyman, W.D. and N. Requena, 2005. Building resilience into marine reserve networks. Abstract 12. International Marine Protected Areas Congress (IMPAC), Geelong, Australia.

Hillary, A., Kokkonen, M. and L. Max, 2003. Proceedings of the World Heritage Marine Biodiversity Workshop. Hanoi, Vietnam, Feb 25- March 1, 2002.

Hockey, P.A.R. and G.M. Branch, 1997. Criteria, objectives and methodology for evaluating marine protected areas in South Africa. *S. Afr.J. Sci* 18: 369-383.

Holthus, P.F. and J.E. Maragos, 1995. Marine ecosystem classification for the tropical island Pacific. In: Maragos, J.E., Peterson, M.N.A., Eldredge, L.G., Bardach, J.E. and H.F. Takeuchi, (Eds). Marine and Coastal Biodiversity in the Tropical Island Pacific Region. Vol. 1 Species Systematics and Information Management Priorities. East-West Center, Honolulu, Hawaii. 239-278 pp.

Hooker, S.K. and L.R. Gerber, 2004. Marine reserves as a tool for ecosystem-based management: the potential importance of megafauna. *Bioscience* 54(1): 27-39.

Hoyt, E. 2005. *Marine Protected Areas for Whales, Dolphins and Porpoises: a world handbook for cetacean habitat conservation.* Earthscan, London, UK and Sterling, USA.

Hugenholtz, E. 2008. The Dutch Case - A Network of Marine Protected Areas. WWF Netherlands, Zeist. 48 pp. Emilie

Hyrenbach, D., Forney, K.A. and Dayton, P.K. (2000) Marine Protected Areas and Ocean Basin Management, *Aquatic Conservation: Marine and Freshwater Ecosystems* 10: 427-458.

ICES. 2005. Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems. ICES Advice. Vols 1-11. 1,418 pp.

ICRAN. 2005a. *Locally Managed Marine Area Network.* www.icran.org/SITES/doc/LmmaNtwrkBrochure.pdf (Accessed 16 April, 2005).

IUCN. (1996) A Regional Action Plan for the Protected Areas of East Asia. IUCN/CNPPA

IUCN. 2008. Towards achieving the 2012 MPA targets: a guide to the Azores Workshop Criteria for areas in need of protection in Areas Beyond National Jurisdiction and guidance for development of representative networks of marine protected areas.

IUCN/WCPA. (1994); *Guidelines for Protected Area Management Categories*, Gland, Switzerland.

IUCN/WCPA. (2006) Regional Action Plan for the Protected Areas of East Asia.

IUCN/WCPA. 2007. Bariloche Declaration/2nd Latin American Congress on NPs. Proc. Latin American Protected Areas Congress.

IUCN/WCPA. 2008a. *Establishing Marine Protected Area Networks-Making It Happen.* IUCN World Commission on Protected Areas, National Oceanic and Atmospheric Administration and The Nature Conservancy. Washington, D.C. 118 p.

IUCN/WCPA. 2008b. Guidelines for applying protected area management categories. 3rd draft of revised guidelines.

Jessen, S. 2008. A national MPA network for Canada by 2012: how do we get there from here? *MPA News* 9(10): 4.

Jones, G.P., McCormick, M.I., Srinivasan, M.and J.V. Eagle, 2004. Coral decline threatens fish biodiversity in marine reserves. *Proc.Nat.Acad.Sci* 101 (21): 8251-8253.

Jones, G.P., Milicich, M.J., Emslie, M.J., and C. Lunow, 1999. Self-recruitment in a coral reef population. *Nature* 402: 802-804.

Kelleher, G. and R. Kenchington. 1992. *Guidelines for Establishing Marine Protected Areas.* A Marine Conservation and Development Report. IUCN, Gland, Switzerland. 79pp.

Kelleher, G., Bleakley, C. and S. Wells, Eds 1995. *A Globally Representative System of Marine Protected Areas.* Vols 1-IV. The Great Barrier Reef Marine Authority, The World Bank, and IUCN; World Bank, Washington DC, USA.

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

Kimball L. 2003. *The Regional Role in Developing Marine Protected Area (MPA) Networks.* Unpublished paper, p 4.

King, M.C. and K.F. Beazley (2005) Selecting Focal Species for Marine Protected Area Network Planning in the Scotia-Fundy Region of Atlantic Canada, Aquatic Conservation: *Marine and Freshwater Ecosystems*, 15: 367-385.

Kitchingman, A. and S. Lai. 2004. Inferences of potential seamount locations from mid-resolution bathymetric data. In: *Seamounts: Biodiversity and Fisheries.* Fisheries Centre Research Report 12(5): 7-12.

Klaus, R.and J.R. Turner, 2004. The marine biotopes of the Socotra Archipelago. *Fauna of Arabia* 20: 45-115.

Kotb M. *et al.* 2004. Status of Coral Reefs in the Red Sea and Gulf of Aden in 2004. In Wilkinson, C (ed), *Status of Coral Reefs of the World*: 2004. http://www.aims.gov.au/pages/research/coral-bleaching/scr2004/ (Accessed 15 March, 2005)

Kramer P. and P. Richards-Kramer. 2002. Ecoregional Conservation Planning for the Mesoamerican Caribbean Reef. WWF. 147pp. http://www.wwfca.org/wwfpdfs/Mesoamerican.pdf

Krupp, F. and R. Klaus, 2000. Contributions to a zoning plan for coastal and marine areas of Socotra. In: Conservation and Sustainable Use of Biodiversity of Socotra Archipelago. Marine Habitat, Biodiversity and Fisheries Surveys and Management. Report of Phase II. Hariri, K.I. and F. Krupp (eds): 137-149. Senckenberg Research Institute; Frankfurt a.M., Germany.

Laffoley, D. d'A., (ed.) 2008. *Towards Networks of Marine Protected Areas. The MPA Plan of Action for IUCN's World Commission on Protected Areas.* IUCN WCPA, Gland, Switzerland. 28 pp.

Langhammer, P.F., Bakarr, M.I., Bennun, L.A., Brooks, T.M., Clay, R.P., Darwall, W., De Silva, N., Edgar, G.J., Eken, G., Fishpool, L.D.C., Fonseca, G.A.P. da, Foster, M.N., Knox, D.H., Matiku, P., Radford, E.A., Rodrigues, A.S.L., Salaman, P., Sechrest, W. and A.W. Tordoff, 2007. *Identification and Gap Analysis of Key Biodiversity Areas: targets for comprehensive protected area systems.* IUCN, Gland, Switzerland. 116 pp.

Laurel, B.J. and I.R. Bradbury, 2006. 'Big' concerns with high latitude marine protected areas (MPAs): trends in connectivity and MPA size. *Canadian Journal of Fisheries and Aquatic Sciences* 63: 2603-2607.

Leathwick, J., Dey, K, Julian., K. 2006. Exploration of the use of reserve planning software to identify potential MPAs in New Zealand's Exclusive Economic Zone. NIWA Client report 2006-064, NIWA, Hamilton, New Zealand.

Leck, R. 2005. Marine protected areas in Queensland: progress and challenges. *Waves* 11(2): 27.

Lemm, S. and C. Attwood, C. 2003. *State of Marine Protected Area Management in South Africa.* WWF South Africa. 123 pp.

Leslie, H. 2005. A synthesis of marine conservation planning approaches. *Conservation Biology* 19(6), 1701-1713.

Leslie, H. M. Rucklehaus, I. Ball, S. Andelman, and H. Possingham. 2003. Using siting algorithms in the design of marine reserve networks. *Ecological Applications* 13 S:185-198.

Lockwood, D., Hastings, A. and L. Botsford, 2002. The effects of dispersal patterns on marine reserves: does the tail wag the dog? *Theoretical Population Biology* 61: 297-309.

Lombard, A.T., T. Strauss, J. Harris, K. Sink, C. Attwood and L. Hutchings. 2005. *South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 4: Marine Component.* Pretoria: South African National Biodiversity Institute. (www.sanbi.org).

Lubchenco, J., S. Palumbi, S. Gaines, and S. Andelman 2003. Plugging a hole in the ocean: the emerging science of marine reserves. *Ecological Applications* 13 S:3-7.

Lundquist, C.J. and E.F. Granek, (2005) Strategies for successful marine conservation: integrating socio-economic, political, and scientific factors. *Conservation Biology* 19 (6): 1771-1778.

Mabile, S. and C. Piante, 2005. *Global Directory of Mediterranean Marine Protected Areas.* WWF-France, Foundation Paris, France. 132 pp.

Maes, F., Cliquet, A., Degraer, S., Derous, S., De Wachter, B. ? Douvere, F., Leroy, D., Schrijvers, J., van Laucker, V., Verfaillie, E., Volckaert, A., Vanden Abeele, P., and A. Vanhulle, 2005. A Flood of Space. Belgian Science Policy, Belgium. 208 pp.

Margules, C.R. and Pressey, R.L. 2000. Systematic conservation planning. *Nature* 405: 243-253.

Margules, C.R., Cresswell, I.D. and A.O. Nicholls, 1994. A scientific basis for establishing networks of protected areas. In: Forey, P.L., Humphries, C.J. and R.I. Vane-Wright, (Eds). *Systematics and Conservation Evaluation*. Clarendon Press, Oxford, UK. Pp. 327-350.

Meerman, J.C. 2005. Belize Protected Areas Policy and System Plan

Ministerio del Ambiente. (2000). Concesiones para el uso y custodia del manglar. Componentes de Gestión Ambiental en el Golfo de Guayaquil. República del Ecuador. Ministerio del Ambiente (MAE). UCP - PATRA

Ministry of Marine Affairs and Fisheries. 2005. Indonesian Initiatives towards MPA Networks. Unpub report prepared by WCPA-Marine workshop, New Orleans.

Mize, J. 2006. Lessons in state implementation of marine reserves: California's Marine Life Protection Act Initiative. www.jmize.com/uploads/36_ELR_10376.pdf

MLPA Initiative. 2007. *Guide to the Central California MPAs.* MLPA Initiative, California Resources Agency, Sacramento, California. 64 pp.

Mora, C., Andréfouet, S., Costello, M.J., Kranenberg, C., Rollo, A., Veron, J., Gaston, K.J., and R.A. Myers, 2006. Coral reefs and the global network of marine protected areas. *Science* 312 (5781): 1750-1751.

Morgan, J. 1989. Large marine ecosystems in the Pacific Ocean. pp 377-394 In K. Sherman and L. Alexander [eds.] Biomass Yields and Geography of LMEs. Westview Press, Boulder, Colo.

Morgan, L., Maxwell, S., Tsao, F., Wilkinson, T. and P. Etnoyer, 2005. *Marine Priority Conservation Areas: Baja California to the Bering Sea*. Commission for Environmental Co-operation of North America/Marine Conservation Biology Institute. Montreal, Canada. 123 pp.

MPA FAC. 2005. Protecting America's Marine Environment: a Report of the Marine Protected Areas Federal Advisory Committee on Establishing and Managing a National System of Marine Protected Areas. NOAA/US Dept of Interior, 28 pp.

MPA FAC. 2008. Towards a National System of Marine Protected Areas. Recommendations from 2006-2007. Report of the MPA Federal Advisory Committee. NOAA/US Dept of Interior.

Mumby, P.J., Edwards, A.J., Arias-Gonzalez, J.E., Lindeman, K.C., Blackwell, P.G., Gall, A., Gorczynska, M.I., Harborne, A.R.,Pescod, C.L., Renken, H., Wabnitz, C.C.C., and G., Llewellyn, 2004. Mangroves enhance the biomass of coral reef fish communities in the Caribbean. *Nature* 427, 533-536.

Mumby, P.J. 2006. Connectivity of reef fish between mangroves and coral reefs: algorithms for the design of marine reserves at seascape scales. *Biological Conservation* 128: 215-222.

Mumby, P.J., C.P. Dahlgren, A.R. Harborne, C.V. Kappel, F. Micheli, D.R. Brumbaugh, K.E. Holmes, J.M. Mendes, K. Broad, J.N. Sanchirico, K. Buch, S. Box, R.W. Stoffle and A.B. Gill. 2006. Fishing, trophic cascades, and the process of grazing on coral reefs. *Science* 311(5757): 98-101. http://www.sciencemag.org/cgi/content/abstract/311/5757/98;

Mumby, P.J., A.R. Harborne, J. Williams, C.V. Kappel, D.R. Brumbaugh, F. Micheli, K.E. Holmes, C.P. Dahlgren, C.B. Paris and P.G. Blackwell. 2007. Trophic cascade facilitates coral recruitment in a marine reserve. *Proceedings of the National Academy of Sciences* 104(20): 8362-8367. http://www.pnas.org/content/104/20/8362.abstract;

Mumby, P.J., Broad, K., Brumbaugh, D.N., Dahlgren, C.P., Harborne, A.R., Kappel, C.V., Micheli, F.and Sanchirico, J.N. 2008. Coral reef habitats as surrogates of species, ecological functions, and ecosystem services. *Cons. Biol.* 22(4): 941-951.

Mumby, P.J. *et al.* In prep. Mitigating the effects of coral bleaching through improved methods of marine reserve design. (Abstract 23-61. 11th International Coral Reef Symposium, Fort Lauderdale, Florida. July 2008).

Myers N, Mittermeier RA, Mittermeier CG, Fonseca GAB, Kent J (2000) Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858

Myers, R.A. and B.Worm (2003). Rapid worldwide depletion of predatory fish communities. Nature 423: 280-283.

Nam, J., Chang, W., Choi, J., Yook, K., Choi, H., and D. Kang, 2005. Marine Protected Areas in Korea and New Challenge toward the establishment of a Marine Peace Park. Korea Maritime Institute. Unpub. Report.

National Research Council. 2001. Marine Protected Areas: Tools for Sustaining Ocean Ecosystems. Committee on the Evaluation, Design and monitoring of marine reserves and protected areas in the United States. Ocean Studies Board, National Research Council, Washington, DC. 288 pp.

NEAFC. 2008. Press Release, released 3rd July 2008. North-East Atlantic Fisheries Commission.

Nicol, D. 2005. Tasmanian MPAs - the last ten years. *Waves* 11(2): 30.

Nilsson, P. 1998. Criteria for the selection of marine protected areas. Report 4834. Swedish Environmental Protection Agency, Stockholm, Sweden.

Noss, R.F. 1992. The Wildlands Project: land conservation strategy. Wild Earth Special Issue - The Wildlands Project. Pp. 10-15.

Notarbartolo di Sciara, G. 2005. IUCN-WCPA Scoping Meeting to support Mediterranean States to meet the 2012 WSSD target on networks of Mediterranean MPAs, Livorno, December 2004. Report of the Meeting. IUCN Centre for Mediterranean Co-operation.
www.iucn.org/places/medoffice/documentos/Report_Livorno.pdf

Notarbartolo di Sciara, G., 2007. Guidelines for the establishment and management of Marine Protected Areas for Cetaceans. UNEP(DEPI)MED WG.308/8. 24pp.

Notarbartolo di Sciara G., Agardy T., Hyrenbach D., Scovazzi T., Van Klaveren P. in press. The Pelagos sanctuary for Mediterranean marine mammals. *Aquatic Conservation: Marine and Freshwater Ecosystems.* DOI: 10.1002/aqc.855.

Obura, D.O. 2005. Resilience and climate change: lessons from coral reefs and bleaching in the Western Indian Ocean. *Estuarine Coastal and Shelf Science* 63: 353-372.

Olson D.M. and E. Dinerstein, 1998. The Global 200: a representation approach to conserving the earth's most biologically valuable ecoregions. *Conservation Biology* 12:502-15.

Ong, P.S., Afuang, L.E. and R.G. Rosell-Ambal, 2002. *Philippine Biodiversity Conservation Priorities: a Second Iteration of the National Biodiversity Strategy and Action Plan.* Manila, Philippines: DENR, Biodiversity Conservation Program-UP Center for Integrative and Development Studies, and Conservation International.

Oram, R.G., Vaitautolu, S., and U. Tulafono, 2005. American Samoa's network of marine protected areas: mechanisms to harmonize top-down and bottom-up management. Abstract 36. International Marine Protected Areas Congress (IMPAC), Geelong, Australia.

OSPAR Commission. 2006. Guidance on developing an ecologically coherent network of OSPAR marine protected areas. Biodiversity Series. OSPAR agreement 2006-3. www.ospar.org 1

OSPAR Commission. 2007a. 2006 Report on the Status of the OSPAR Network of Marine Protected Areas. Biodiversity Series. 2007/319, www.ospar.org

OSPAR Commission. 2007b. Background document to support the assessment of whether the OSPAR Network of Marine Protected Areas is ecologically coherent. Biodiversity Series. 2007/320, www.ospar.org 1

OSPAR Commission. 2007c. Guidance to assess the effectiveness of management of OSPAR MPAs: a self-assessment scorecard. Biodiversity Series. OSPAR agreement 2007-5, www.ospar.org

OSPAR Commission. 2007d. Guidelines for the Identification and Selection of Marine Protected Areas in the OSPAR Maritime Area. Reference number: 2003-17. As amended by BDC 2007 (BDC 2007 Summary Record (BDC 07/12/1) § 3.43b).

OSPAR Commssion. 2008. *Summary Record of the Meeting of the OSPAR Commission, Brest (France), 23-27 June 2008*, OSPAR 08/24/1-E.

Pagnan, J.L. 2004. Report and Recommendations on Linking CPAN and the Global Conservation Agenda. Ottawa.

Pagnan, J. and G. Legare, (Eds) 2000. "Report and Recommendations from the Circumpolar Marine Workshop", CAFF/IUCN-WCPA/PAME. Ottawa.

Palumbi, S.R. 2003. Population genetics, demographic connectivity, and the design of marine reserves. *Ecological Applications* 13(1), S146-S158.

Paris, C.B. R.K. Cowen, R. Claro, and K.C. Lindeman. (in press). Larval transport pathways from Cuban snapper (Lutjanidae) spawning aggregations based on biophysical modeling. *Mar Ecol. Prog. Ser.* **??**

Parks Victoria 2003. Victoria's System of Marine National Parks and Marine Sanctuaries: Management Strategy 2003-2010, Parks Victoria, Melbourne, Australia.

PEMSEA.2003. Sustainable Development Strategy for the Seas of East Asia: Regional Implementation of the World Summit on Sustainable Development Requirements for the Coasts and Oceans. Partnerships in Environmental Management for the Seas of East Asia, Quezon City, Philippines.

Perera, N. 2005. The status of marine and coastal protected areas in the South Asian Seas Region: meeting the 2012 Global Biodiversity Target.

Pernetta, J. (Ed). 1993. *Marine Protected Area Needs in the South Asian Seas Region.* 4 vols. The World Conservation Union.

PERSGA, 2002a. *Regional Master Plan for a regional MPA network.* Technical Series No. 1.

PERSGA, 2002b. *Survey design for proposed MPAs.* PERSGA General Publications.

PERSGA, 2003. *Regional Action Plan for the Conservation of Reefs in the Red Sea and Gulf of Aden.* PERSGA Technical Series No. 3.

PERSGA, 2004. *Final Report of the SAP MPA Component.*

Pet-Soede, L. 2006. MPAs in Indonesia: what progress has been made since 1984? *MPA News* 8(1): 3.

Phillips, C. 1996. *Conservation in practice: agreements, regulations, sanctuaries and action plans.* Chap. 18. In: Simmonds, M.P. and Hutchinson, J.D. (eds). *The Conservation of Whales and Dolphins.* Pp. 447-465. John Wiley and Sons, Ltd.

Piekäinen, H and Korpinen, S (eds.) 2007: Towards an Assessment of Ecological Coherence of the Marine Protected Areas Network in the Baltic Sea Ecoregion. Balance Interim Report No 18.

Possingham, H., I Ball and S. Andelman. 2000. Mathematical models for identifying representative reserve networks. In S. Ferson and M.A. Burgman [eds.] *Quantitative Methods in Conservation Biology*: 291-306. Springer-Verlag, NY

Pressey, R.L., Humphries, C.J., Margules, C.R., Vane-Wright, R.I and Williams, P.H. 1993. Beyond opportunism: key principles for systematic reserve selection. *Trends in Ecology and Evolution* 8(4); 124-128.

Republic of Yemen, 2000. Conservation Zoning Plan of Socotra Islands (Socotra, Samha, Darsa, Abd Al Kuri, and associated small islands rocks and rock outcrops). Presidential Decree No. 275 of the Year 2000. The Environment Protection Council UNDP-GEF Socotra Biodiversity Project YEM/96/G32.

Ricciardi, A, Jameson, S.C., McManus, E., Besançon, C., Johnson, T., Spalding, M., Kelleher, G., Boucher, T., Fish, L., Mora, C., Andréfouët, S., Costello, M.J., Kranenburg, C., Rollo, A., Veron, J., Gaston, K.J., and Myers, R.A. 2006. How Protected Are Coral Reefs? *Science* 314: 757-760.

Ritchie, K. B. and Brian D. Keller, eds. 2008. A Scientific Forum on the Gulf of Mexico: The Islands in the Stream Concept. Marine Sanctuaries Conservation Series NMSP-08-04. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD. 105 pp.

Riegl, B. and Piller, W.E. 2003. Possible refugia for reefs in times of environmental stress. *Int.J.Earth Sci. (Geol.Rundsch)* 92: 520-531.

Roberts, C.M. 1998. Sources, sinks and the design of marine reserve networks. *Fisheries* 23: 16-19.

Roberts, C.M. 2000. Selecting marine reserve locations: optimality versus opportunism. *Bull Mar Sci.* 66: 581-592.

Roberts, C.M., B. Halpern, S.R. Palumbi, and R. R. Warner. 2001. Designing marine reserve networks: Why small, isolated protected areas are not enough. *Conservation Biology In Practice* 2(3):12-19.

Roberts, C.M., McClean, C.J., Veron, J.E.N., Hawkins, J.P., Allen, G.R., McAllister, D.E., Mittermeier, C.G., Schueler, F.W., Spalding, M., Wells, F., Vynne, C. and T. Werner, (2002). Marine biodiversity hotspots and conservation priorities for tropical reefs. *Science* 295: 1280-1284.

Roberts, C.M., Andelman, S., Branch, G., Bustamente, R.H., Castilla, J.C., Dugan, J., Halpern, B.S., Lafferty, K.D., Leslie, H., Lubchenco, J., McArdle, S., Possingham, H.P., Ruckelshaus, M. and R.R. Warner, 2003a. Ecological criteria for evaluating candidate sites for marine reserves. *Ecological Applications* 13(1) Supplement S199-S214.

Roberts, C.M., Branch, G., Bustamente, R.H., Castilla, J.C., Dugan, J., Halpern, B.S., Lafferty, K.D., Leslie, H., Lubchenco, J., McArdle, S., Ruckelshaus, M. and R.R. Warner, 2003b. Application of ecological criteria in selecting marine reserves and developing reserve networks. *Ecological Applications* 13(1) Supplement S215-S228.

Roberts, C.M., Mason, L. and J.P. Hawkins, 2005. *Roadmap to Recovery: a global network of marine reserves.* Greenpeace

Rodrigues, A.S.L. *et al.*, 2003. *Global Gap Analysis: towards a representative network of protected areas.* Advances in Applied Biodiversity Series 5, Center for Applied Biodiversity Science, Conservation International, Washington D.C.

Roff, J.C. *et al.* 2003. Geophysical approaches to the classification, delineation and monitoring of marine habitats and their communities. *Aq. Conserv. Mar. Freshw. Ecosyst.* 13: 77-90.

ROPME. 2003. State of the Marine Environment Report (SOMER). ROPME/GC-11/003. Regional Organization for the Protection of the Marine Environment, Kuwait, 217pp.

Ruitenbeek J, Hewawasam I, and M. Ngoile, 2005. *Blueprint 2050: sustaining the marine environment in Mainland Tanzania and Zanzibar.* World Bank.

SACEP/UNEP. 1995: Action Plan For The Protection And Management Of The Marine And Coastal Environment Of The South Asian Seas Region.

Sala, E., Aburto-Oropeza, O., Paredes, G., Parra, I., Barrera, J.C. and P.K. Dayton, 2002. A general model for designing networks of marine reserves. *Science* 298: 1991-1993.

Salm, R.V., Clark, J.R. and E. Siirila, 2000. *Marine and Coastal Protected Areas: a Guide for Planners and Managers.* IUCN, Washington D.C., USA. 371 pp.

Salm, R.V., and S.L. Coles, (Eds) 2001. *Coral Bleaching and Marine Protected Areas.* Proc. Workshop on Mitigating Bleaching Impact through MPA Design. Bishop Museum, Honolulu, Hawaii, USA. 118 pp, (doc available from: www.conserveonline.org)

Salm, R.V., Smith, S.E. and G. Llewellyn, 2001. Mitigating the impact of coral bleaching through marine protected area design. In: Schuttenberg, H.Z. (Ed). *Coral Bleaching: Causes, Consequences and Response.* Coastal Management Report no.2230, Coastal Resources Center, Univ. Rhode Island. 102 pp.

Salm, R.V. and Y. Tessema, 1998. *Partnerships for Conservation. Report of the Regional Workshop on Marine Protected Areas, Tourism and Communities.* Diani Beach, Kenya May, 1998. IUCN Eastern Africa Regional Programme, Nairobi, Kenya. Pp. 52-56.

Sanchirico, J.N. 2005. Additivity properties in metapopulation models: implications for the assessment of marine reserves. *J. Env. Economics and Management* 49: 1-25.

SCBD. 2004. *Technical Advice on the Establishment and Management of a National System of Marine and Coastal Protected Areas.* CBD Technical Series no. 13, *ad hoc* Technical Expert Group on Marine and Coastal Protected Areas. Secretariat of the Convention on Biological Diversity, Montreal. 40 pp.

Seychelles Government 2005. Seychelles Integrated Marine Protected Area System Plan (IMPASP). National Planning Document.

Shah, N.J., K. Henri and R. Payet, 1997. National Biodiversity Strategy and Action Plan. Republic of Seychelles.

Shanks, A.L., Grantham, B.A., and M.H. Carr, 2003. Propagule dispersal distance and the size and spacing of marine reserves. *Ecological Applications* 13: S159-S169.

Shepherd, S. 2005. A summary of South Australia's marine protected areas. *Waves* 11(20: 24.

Sherman, K. 1993. *Large Marine Ecosystems as global units for marine resources management - an ecological perspective.* pp 3-14 In K. Sherman, L. Alexander, and B. Gold, [eds.] Large Marine Ecosystems. AAAS Press, Washington, DC.

Sink, K., Nel, D., Attwood, C., Lombard, M. and Harris, J.M. 2007. Systematic planning for the conservation of offshore biodiversity and resources in South Africa. Abstract. 5th WIOMSA Scientific Symposium, Durban, South Africa.

Small Island Developing States Network, 2003. *Action Strategy for Nature Conservation in the Pacific Islands Region*, 2003-2007. www.sidsnetpacific.org/Biodiversity/NatureConsActStra.pdf (Accessed 11 April, 2005).

Smith, J.L., Lewis, K. and Laughren, J. 2006. A Policy and Planning Framework for Marine Protected Area Networks in Canada's Oceans. WWF-Canada: Halifax. 105 pp.

Smyth C, Prideaux M, Davey K, and M. Grady, 2003. *Oceans Eleven: The Implementation of Australia's Oceans Policy and Ecosystem-Based Regional Marine Planning*, Australian Conservation Foundation, Carlton, Australia.

Spalding M, Fox H, Allen, GR., Davidson N, Ferdana Z, Finlayson M, Halpern B, Jorge M, Lombana A, Lourie S, Martin K, McManus E, Molnar J, Newman K, Recchia C, and J. Robertson, 2007. Marine Ecoregions of the World: a Bioregionalization of coastal and shelf areas. *BioScience* 57(7): 573-583.

Spalding, M., Fish, L.and Wood, L. in press. Towards representative protection of the world's coasts and oceans - progress, gaps and opportunities. *Conservation Letters*

Steffen, J.H. 2005. The World Heritage Convention as a tool to strengthen national MPA networks: experiences from Indonesia. Paper presented at WCPA Marine Workshop, CZ'05, New Orleans.

Stevens T.F., Jones P.J.S, Howell K. and Mee L. 2006. *Methods for managing Marine Protected Areas: Options for establishing and managing a marine protected area system in the UK.* Report for Natural England. 49 pages.

Sullivan Sealy, K. and Bustmante, G 1999. Setting Geographic Priorities for Marine Conservation in Latin America and the Caribbean. The Nature Conservancy, Arlington, Virginia.

Swearer, S.E., Caselle, J.E., Lea, D.W., and R.R. Warner (1999) Larval retention and recruitment in an island population of a coral-reef fish. *Nature* 402, 799-802.

Taylor, M.S., and M.E. Hellberg, 2003. Genetic evidence for local retention of pelagic larvae in a Caribbean reef fish. *Science* 299, 107-109.

Taylor, P., Wilks, L., and M. Carr, 2005. Designing MPAs from the bottom up - the challenges of a stakeholder process. Abstract 34. International Marine Protected Areas Congress (IMPAC), Geelong, Australia.

Tawake, A. and W. Aalbersberg, 2002. Community-based refugia management in Fiji. IAS Technical Report No. 2002/08. Institute of Applied Science, University of the South Pacific, Suva, Fiji.

Thorrold, S.R., Latkoczy, C., Swart, P.K., and C.M. Jones, 2001. Natal homing in a marine fish metapopulation. *Science* 291, 297-299.

TNC. 2008. Reef Resilience Toolkit Version 2.0 http://www.reefresilience.org/, The Nature Conservancy.

Turner, J.R. and R. Klaus, 2005. Coral reefs of the Madcarenes, Western Indian Ocean. *Phil. Trans. Roy. Soc. Series A.* 363: 229-250.

Ulloa et. al., 2006. Planeación ecorregional para la conservación marina: Golfo de California y costa occidental de Baja California. Informe final a The Nature Conservancy. Guaymas (México): Communidad y Biodiversidad, A.C., 153pp.

UNEP. 2006a. Assessment of financial sources and networking partners for coastal-marine protected areas in the Mediterranean. By A. Lopez Ornat. UNEP(DEPI)/MED WG.292/Inf.5. 19pp.

UNEP. 2006b. Ecosystems and Biodiversity in Deep Waters and High Seas. UNEP Regional Seas Reports and Studies No. 178. UNEP/ IUCN, Switzerland 2006.

UNEP. 2007. *Deep Sea biodiversity and Ecosystems: A scoping report on their socio-economy, management and governance.* UNEP-WCMC Biodiversity Series No 28 www.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series

UNEP-Caribbean Environmental Programme (UNEP-CEP). 2003. *Some Past and On-going Activities: The Specially Protected Areas and Wildlife* www.cep.unep.org/who/activities.htm (Accessed 3 May, 2005).

UNEP-Caribbean Environmental Programme (UNEP-CEP). 2000. *Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region.* www.cep.unep.org/pubs/legislation/spaw.html (Accessed 26 March, 2005)

UNEP-Caribbean Environmental Programme (UNEP-CEP) n.d. *The Specially Protected Areas and Wildlife in the Wider Caribbean Region Programme, Objectives.* www.cep.unep.org/programmes/spaw/spaw.html#Objectives (Accessed 29 April, 2005)

UNEP/GEF. 2006. Adaptation to Climate Change Impacts for Marine Protected Areas in the Gulf of California. PDFA Project proposal.

UNEP-WCMC. 2008. The State of the World's Protected Areas 2007: An Annual Review of Global Conservation Progress. UNEP-WCMC, Cambridge.

Uravitch, J., 2005. Building a national system of MPAs in the United States and considerations for the global context. Abstract 94, IMPAC.

US Federal Register, 2000. Presidential Documents, Executive Order 13158 of May 26, 2000. vol. 65, No. 105. US Government Printing Office, Washington, DC.

Verheij, V. and U. Sengebau, 2007. Palau Marine Gap Assessment. TNC, Arlington, USA.

Vieux C *et al.*, 2004. A Century Of Change In Coral Reef Status In Southeast And Central Pacific: Polynesia Mana Node, Cook Islands, French Polynesia, Kiribati, Niue, Tokelau, Tonga, Wallis and Futuna. In Wilkinson, C (ed), *Status of Coral Reefs of the World*: 2004 www.aims.gov.au/pages/research/coral-bleaching/scr2004/ p375 (Accessed 18 March, 2005)

Villa, F., L. Tunesi, and T. Agardy, 2002. Zoning marine protected areas through spatial multiple-criteria analysis: the case of the Asinara Island National Marine Reserve of Italy. Conservation Biology 16(2):515-526.

Villegas, T., R. Navarrete, L. Arriaga and S. Coello, (2005). Evaluación de factibilidad de una red de áreas costeras y marinas protegidas en Ecuador.. Ecuador. Informe de consultoría para el Banco Interamericano de Desarrollo (BID) y Ministerio del Ambiente (MAE): 143pp. Vollmer, S.V. and Palumbi, S.R. 2007. Restricted gene flow in the Caribbean staghorn coral: implications for the recovery of endangered reefs. *Journal of Heredity* 98(1): 40-50

Vollmer, S.V., and Palumbi, S.R. 2007. Restricted gene flow in the Caribbean Staghorn Coral *Acropora cervicornis*: implications for the recovery of endangered reefs. *J Heredity* 98: 40-50.

Ward, T.J. 2005. Western Australia's marine protected areas: a summary. *Waves* 11(2): 25.

Ward, T., D. Heinemann, and N. Evans, 2002. *The Role of Marine Reserves as Fisheries Management Tools.* Bureau of Rural Sciences, Canberra 192 pp.

Ward, T. and E. Hegerl, 2003. Marine Protected Areas in Ecosystem-based management of fisheries. Report to Dept. of Environment and Heritage, Commonwealth of Australia. 66 pp.

Wells, S. and J. Day, 2004. Application of the IUCN protected area management categories in the marine environment. *Parks* 14(3): 28-38.

Wells, S., Burgess, N., and A. Ngusaru, 2006. Towards the 2012 marine protected area targets in Eastern Africa. *Ocean and Coastal Management*

Wescott, G., 2005. Victoria's marine protected areas - 1978-2005. *Waves* 11(2): 29.

West, J.M. and R.V. Salm, 2003. Resistance and resilience to coral bleaching: Implications for coral reef conservation and management. *Conservation Biology* 17(4): 956-967.

White, A., Alino, P. and A. Meneses, 2005. Creating and Managing Marine Protected Areas in the Philippines. Fisheries Improved for Sustainable Harvest Project, Coastal Conservation and Education Foundation, Inc. and University of the Philippines Marine Science Institute, Cebu City, Philippines. 83 pp.

Wilkinson T., Bezaury-Creel, J., Gutierrez F., Hourigan T., Lisa Janishevski, Madden C., Padilla, M. and E. Wiken (in prep.) *Spaces: Marine Ecological Regions of North America.* Commission for Environmental Cooperation.

Wood, L. 2006. Methodological frameworks and strategies used to verify, edit and update MPA Global, including data from the World Database on Protected Areas. Unpublished report to UNEP World Conservation Monitoring Centre.

Wood, L.J., Fish, L., Laughren, J. and Pauly, D. 2008. Assessing progress towards global marine protection targets: shortfalls in information and action. *Oryx* 42: 340-351

World Bank. 2006. Scaling up Marine Management: the Role of Marine Protected Areas. Report no. 36635-GLB. Environment Department/Sustainable Development Network. World Bank, Washington D.C., USA. 100 pp.

WWF. n.d. *The Future of Across the Waters.* Mediterranean Programme Office http://www.atw-wwf.org/CBM/9.htm (Accessed 18 March, 2005)

WWF. 1998a. Mediterranean Marine Gap Analysis.

WWF. 1998b. *Marine Protected Areas: WWF's role in their future development.* WWF International Discussion Document. 56 pp.

WWF. 2003a. A Biophysical Assessment of the Philippine Territory of the Sulu-Sulawesi Marine Ecoregion. Sulu-Sulawesi Marine Ecoregion Program, WWF Philippines.

WWF. 2003b *Setting Priorities for Marine Conservation in the Fiji Islands Marine Ecoregion.* WWF

WWF. 2005 *A Regional Strategy for Marine Protected Areas in West Africa.* WWF.

WWF-EAME. 2004a. The Eastern African Marine Ecoregion Vision: a large-scale approach to the management of biodiversity. WWF Dar es Salaam, Tanzania. 53 pp.

WWF EAME. 2004b. Towards the Establishment of an Ecologically Representative Network of Marine Protected Areas in Kenya, Tanzania and Mozambique. WWF, Dar es Salaam, Tanzania. 74pp.

WWF-SSME Program. 2004. Framework for a Network of Marine Protected Areas in the Sulu-Sulawesi Marine Ecoregion. WWF Sulu-Sulawesi Marine Ecoregion Conservation Program, Quezon City, Philippines. 48 pp.

Zacharias, M.A. and J.C. Roff, 2000. A hierarchical ecological approach to conserving marine biodiversity. *Conservation Biology* 14(5):1327-1334

Zacharias, M.A. and J.C. Roff, 2001. Use of focal species in marine conservation and management: a review and critique. A*quatic Conservation: Marine and Freshwater Ecosystems* 11: 59-76

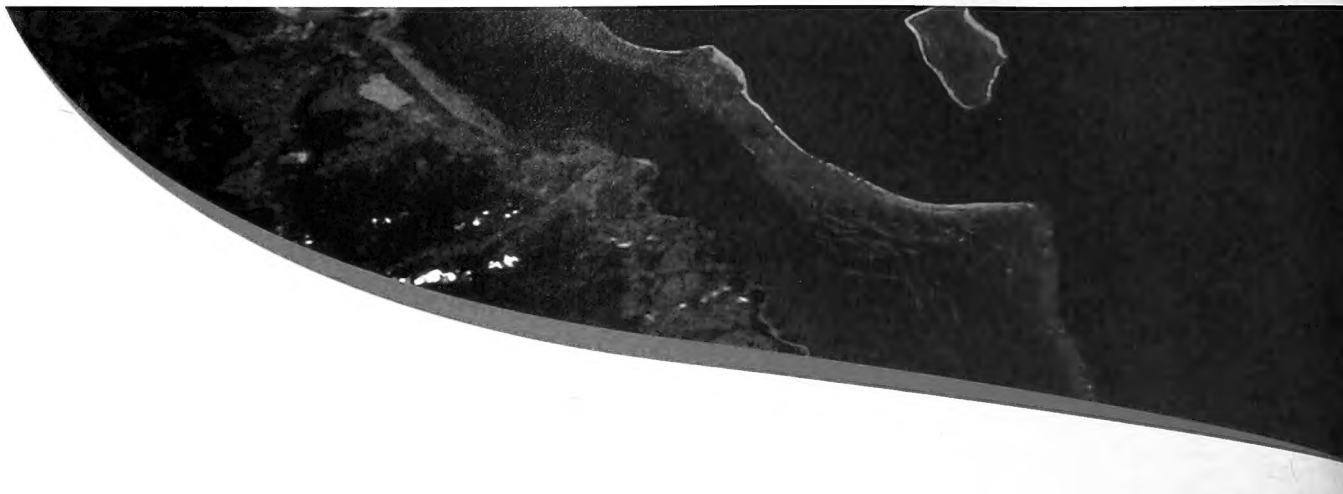
ANNEX 1: NATIONAL & SUBNATIONAL

Country	National or Subnational	NTAs or multiple use	Status
Caribbean and Americas			
Bahamas	National	NTAs only; multiple-use MPAs exist separately from the network	In design phase, with detailed studies underway; preliminary sites identified
Belize	National	NTAs and multiple use MPAs	Designed as part of national protected areas system; includes existing MPAs
British Virgin Islands	Subnational	Multiple use and NTAs	Implementation starting
Colombia Caribbean	Subnational	NTAs and multiple use MPAs	Sites identified; includes some existing MPAs
Colombia, San Andres Archipelago	Subnational	3 adjoining multiple-use MPAs with NTA zones - Seaflower MPA and Biosphere Reserve	In place
Cuba	National	NTAs and multiple use MPAs	Designed as part of national protected areas system; partially in place
Jamaica	National		Sites identified
Grenada	National		Sites identified
Chile	National	Multiple use MCPAs and NTAs	Sites identified, and some designated
Ecuador - mainland	National	Multiple use and NTAs	Being designed as part of national protected areas system;
Ecuador - Galapagos	Subnational	Single zoned multiple use MPA	In place
Peru	National		Commitment made; some preliminary discussions held
Venezuela	National		Sites identified but information not available on progress
Brazil	National	Multiple use and NTAs	Being designed as part of national protected areas system; sites identified and some in place
Mexico	National	Multiple use and NTAs	National network planned but being developed as two subnational networks - Caribbean and Pacific
Mexico - Caribbean	Subnational	Multiple use and NTAs	Being developed as part of the Meso-American Barrier Reef network
Mexico - Gulf of Californa	Subnational	Multiple use and NTAs	Under development using regional B2B network approach; sites identified and some in place
USA	National	Multiple use and NTAs	Gap analysis being undertaken at State level; preliminary list of potential sites identified

Country	National or Subnational	NTAs or multiple use	Status
USA - California	Subnational in state waters	Multiple use with NTAs	Network under development and completed in some areas
USA - California	Subnational in state and federal waters	Single multiple use MPA with network of NTAs - Channel Is. NMS	In place
USA - Florida	Subnational in state and federal waters	Single multiple use MPA with network of NTAs - Florida NMS	In place; 43 reefs identified for their resilience but this has not yet been incorporated within the zoning scheme
USA - North-West Hawaiian Islands	Subnational	Single multiple use MPA with proposed network of NTAs	Outer boundaries gazetted
Canada	National in state and federal waters	Multiple use and NTAs	Federal network currently being designed; plan to incorporate other types of MPA later
Canada - British Columbia	Subnational	Multiple use and NTAs	Provincial level network being planned
Africa and Middle East			
Tanzania	National	Multiple use and NTAs	Designed; some MPAs in place
Seychelles	National		Proposal prepared for process to develop national MPA system but has not been implemented
Mauritius- Rodrigues	Subnational	Multiple use and NTAs	Designed; some NTAs in place
MadagascarNational	Multiple use and NTAs		Some MPAs are part of the national protected area system plan
South Africa	National	Multiple use and NTAs	National system to be composed of subnational networks
South Africa - Kwazulu-Natal	Subnational	Multiple use and NTAs	Data gathering complete and analysis underway
South Africa - Agulhas region	Subnational	Multiple use and NTAs	Priority sites identified
South Africa - Prince Edward Islands	Subnational	Multiple use and NTAs	Zones and sites identified
South Africa - offshore	Subnational (EEZ)		Data gathering underway
Yemen - Socotra Archipelago	Subnational	Single zoned multiple use MPA with NTAs	In place
Asia			
Philippines	National	Multiple use and NTAs	Network to be built up from 6 sub-regional (bioregion) networks; will include existing MPAs
Philippines - South China Sea	Subnational		Preliminary work underway
Philippines - Visayas	Subnational		Preliminary work underway
Philippines - Northern Philippine Sea	Subnational		Preliminary work underway
Philippines - Southern Philippine Sea	Subnational		Preliminary work underway

Country	National or Subnational	NTAs or multiple use	Status
Philippines - Celebes Sea	Subnational		Preliminary work underway
Philippines - Sulu Sea	Subnational		Preliminary work underway
Indonesia	National	Multiple use and MPAs	Network to be built up from 'ecoregion' networks; will include existing MPAs
Indonesia - northern Aceh	Subnational		Systematic conservation plan being developed
Indonesia - Banda Sea & Tukang Besi Archipelago	Subnational		
Indonesia - Lesser Sunda	Subnational		Systematic conservation planning underway
Indonesia - Raja Ampat	Subnational		Network of seven MPAs declared
Vietnam	National	Multiple Use and NTAs	15 sites identified; several gazetted
Pacific			
Papua New Guinea - Kimbe Bay	Subnational	NTAs?	Network has been designed and is being implemented; will include existing LMMAs
Palau	National	Multiple use and NTAs	Network has been designed; will include existing MPAs
Fiji	National	NTAs	LMMAs being established, linked by a social network
Solomon Islands - Western Solomon Islands	Subnational	NTAs and some multiple use	Customary tabu areas being established, using scientific design principles
New Zealand	National	NTAs?	Policy established; network being developed through a process involving regional forums
New Zealand - Fjordland	Subnational	NTAs	Established in 2005; does not address representativity
Australia	National	Multiple use and NTAs	National system is being developed through State (up to 3 n.mi.) and Commonwealth (3-200 n.mi) subnational networks
Australia - Great Barrier Reef	Subnational	Single multiple use MPA with network of NTAs	Commonwealth jurisdiction; established and being implemented
Australia - South-east Region	Subnational	13 multiple use areas with NTAs	Commonwealth jurisdiction; designated 2007
Australia - South Australia	Subnational	Multiple Use and NTAs	Classification and design principles developed; 19 focus locations identified
Australia - Victoria	Subnational	NTAs	Declared in 2002
Australia - New South Wales	Subnational	Multiple use and NTAs	Process underway
Australia - Tasmania	Subnational	Multiple use and NTAs	Process underway

Country	National or Subnational	NTAs or multiple use	Status
Europe			
UK	National		Underdevelopment; will comprise subnetworks in England, Wales, Scotland and Northern Ireland
Germany	National	Multiple use	Proposal
Netherlands	National	Multiple use	Proposal
Croatia	National	Multiple use	Proposal



NATIONAL AND REGIONAL NETWORKS OF MARINE PROTECTED AREAS: A REVIEW OF PROGRESS

In response to the global challenge, for a systematic conservation planning approach to MPA establishment, set by the Convention on Biological Diversity and other international agreements and action plans, there are now many initiatives to develop ecologically representative MPA networks. This report describes the progress being made in 30 national and 35 sub-national ecological MPA network initiatives, using information from the literature, MPA practitioners and planners, and conservation experts. The report explores the diverse range of approaches applied, at various spatial and geographical scales, to demonstrate how MPA networks can be established in practice, and how they can be adapted to different needs and priorities.

This report aims to promote a better understanding of the underlying principals and scientific basis behind MPA network design, while disseminating experiences and lessons learned from the initiatives underway at regional national and sub-national levels. The report concludes with a series of six recommendations for the establishment of effective MPA networks, which build on these experiences to capture the complex range of considerations in this rapidly evolving field.

Regional Seas

UNEP World Conservation Monitoring Centre
219 Huntingdon Road, Cambridge
CB3 0DL, United Kingdom
Tel: +44 (0) 1223 277314 Fax: +44 (0) 1223 277136
Email: info@unep-wcmc.org Website: www.unep-wcmc.org

www.unep.org

United Nations Environment Programme
P.O. Box 30552 - 00100 Nairobi, Kenya
Tel.: +254 20 762 1234
Fax: +254 20 762 3927
e-mail: uneppub@unep.org
www.unep.org

UNEP

UNEP-WCMC Biodiversity Series No 30

ISBN 978-92-807-2975-7

November 2008 DEP/1100/CA