Managing Marine and Coastal Protected Areas

A TOOLKIT for South Asia

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2008

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Contents

Preface

The five maritime countries of the South Asia region, Bangladesh, India, Maldives, Pakistan and Sri Lanka, have extensive river deltas and diverse marine and coastal habitats that support some of the richest concentrations of biodiversity in the world and encompass globally significant mangrove, seagrass, and coral reef areas.

An estimated 400 million people, many of them poor, are directly dependant on the ocean and coastal resources for food and to generate at least part of their livelihoods. Fisheries and coastal based tourism encourages essential foreign investment, generates local employment opportunities, and contributes significantly to national economies. Coastal ecosystems can act as the first line of defence in mitigating disasters, such as cyclones, hurricanes, storm surges and tsunamis. The benefits provided by the sea are only made possible with a healthy marine and coastal environment, and as such, the maintenance of healthy coasts and seas is critical in order to sustain the social and economic development of the South Asia region and protect these significant resources on behalf of the global community.

Marine and Coastal Protected Areas (MCPAs), in their variety of forms and scales, from village level community managed areas to large scale nationally designated parks, are seen as one of the solutions to threats facing the coastal and marine environment, while contributing to the long term sustainable livelihoods of coastal communities, their cultures and their economies.

While people in the region have used MCPA-type schemes for fisheries management for hundreds, even thousands of years, the concept is a relatively recent introduction to modern society, and it is only in the past 50 years that MCPAs have grown significantly in number. There has been a steady increase in the total coverage of MCPAs in the region. However, South Asia lags behind other regions, and indeed global targets with respect to the number of MCPAs, with fewer MCPAs covering a smaller portion of the sea, as reported by IUCN's World Commission on Protected Areas.

Disturbingly, many MCPAs that have been established across the South Asian region are not effectively managed. The reasons for this are many, including the complex tenure and institutional management issues connected with the governance of coastal and marine areas as well as the failure of planners to adequately value the goods and services provided by coastal and marine ecosystems, and invest in them accordingly. Other issues, such as limited training for ground staff, and poor access to simple and practical information, have further hampered MCPA management. In South Asia, the lack of capacity has been one of the key constraints to the establishment and effective management of MCPAs.

There are many publications and manuals on MCPAs, but few of these tools are suitable and targeted to assist and support MCPA site managers in their efforts – whether in government institutions, NGOs, or the private sector such as hoteliers and dive operators. It is in response to this perceived gap that IUCN, ICRAN, UNEP, SACEP, CORDIO and partner organisations, through the generous funding of the European Union, Ministry of Foreign Affairs, Finland and Mangroves for the Future, collaborated in order to prepare an MCPA Toolkit for South Asia. This Toolkit will assist MCPA managers and practitioners to access current and consolidated information and guidance relating to all stages of MCPA establishment and management issues faced in day-to-day operations.

In the light of the shared regional commitments to protect the critical, and globally significant marine and coastal resources of South Asia, we encourage fellow government agencies and institutions within the region to promote the use and wide dissemination of this important tool. The ultimate value of this Toolkit in developing the capabilities of national resource trustees and MCPA ground staff for effective management in the face of the global environmental challenges we face depends on its uptake and application.

Marine and Coastal Protected Areas (MCPAs) require support from a host of managers, wardens, rangers, community members, policy makers and others to ensure their successful operation and management. These MCPA managers are tasked with having to deal with a multitude of different situations, issues and problems on a daily basis, often in remote locations, without easy reference to sources of information or help. The issues encountered may range from purchasing a boat, managing staff, annual planning, monitoring fish populations in the MCPA, building an information centre, consulting local villagers, to writing a proposal to secure funding. This is not an easy job and requires a diverse array of skills. Recognising this, partners involved in the IUCN/NORAD Western Indian Ocean Marine Biodiversity Conservation Project published a Toolkit in 2004 to support MCPA managers in their efforts. The Toolkit was developed with a focus on the Western Indian Ocean (WIO), and received wide support and acclaim. While prepared originally for the WIO, the guidance and resources contained within the Toolkit are relevant to other tropical regions and to MCPA managers and natural resource trustees across the globe.

Consultation in South Asia through the UNEP/EU South Asia MCPA Project recognised that MCPA managers in the region face similar challenges in locating and accessing current and consolidated practical information on MCPA management. Therefore, it was agreed among partners that the WIO Toolkit could be built on to address this, by revising and updating its content and ensuring wide dissemination and training.

Managing Marine and Coastal Protected Areas: A Toolkit for South Asia (South Asia Toolkit) has been prepared over the course of one year. Experts from across the region have provided invaluable support to this initiative by contributing critical information, edits, and new case studies to update the original 78 theme sheets of the WIO Toolkit, and highlight South Asia success stories and specific regional and local management challenges. A further three sheets have also been added on key issues such as livelihoods enhancement and resilience. Compilation, review and editing have been led by the IUCN Ecosystems and Livelihoods Group (ELG), IUCN Global Marine Programme (GMP) and the International Coral Reef Action Network (ICRAN) on behalf of UNEP. In all, more than 50 international and regional experts have been involved in the process.

A regional training workshop for MCPA managers in South Asia was conducted in Maldives, 4-7 June 2008, to introduce the draft South Asia Toolkit, develop the skills of participants through interactive management training scenarios, and provide an opportunity for the intended target audience to review content, structure and usefulness of the South Asia Toolkit. Feedback received was used for further improvement of this resource. Finally, the South Asia Toolkit was peer reviewed by a panel of regional and international experts, to ensure regional relevance and accuracy of the information.

The South Asia Toolkit has been designed to support MCPA managers in this region by providing them with a hands-on guide to a diverse array of topics, ranging from Environmental Impact Assessment, Financial Planning, Conflict Resolution, Mangrove Restoration, to Mariculture. The South Asia Toolkit addresses management issues relevant to all types of MCPAs, from community based, locally managed areas, nationally gazetted parks, to areas designated under international conventions and agreements, and provides information on the key issues encountered by MCPA managers, with a focus on the situation in the South Asian region.

The geographical scope of the South Asia Toolkit comprises Bangladesh, India, Maldives, Pakistan and Sri Lanka; the five maritime nations of the region. It incorporates evaluation feedback from both WIO and South Asia user experiences, and represents a significant review of global information. Theme sheets draw on case studies and experiences from within the South Asian region and internationally, to help illustrate each topic and exchange lessons learned in management.

This second edition of the Toolkit contains 81 theme sheets, 3 of which have been prepared to respond to gaps in the WIO Toolkit edition as identified by users. Although comprehensive, there are likely further gaps and emerging issues that have not been covered here, some of which were beyond the scope of this resource. The Toolkit is arranged in two parts: The Management Process and Conservation and Sustainable Use, and has been designed in a ring-binder format for easy access to theme sheets and to facilitate the incorporation of additional key resources under each topic by users.

It is now widely accepted that MCPAs in their various guises are an important tool for the protection of coastal and marine biodiversity. There is also a growing body of evidence that MCPAs can generate substantial income through tourism, and serve as a vital management tool for coastal fisheries, including facilitating recovery of over-exploited stocks. This is particularly relevant in regions such as South Asia, where coastal people still widely depend on marine resources for their subsistence and livelihoods. Effectively managed MCPAs have a key role in alleviating poverty. We hope this Toolkit can be pivotal in assisting MCPA managers in their important role as custodians of South Asia's marine biodiversity.

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IUCN ELG

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Senior Programme Officer
ICRAN

How to use the Toolkit

STRUCTURE

The Toolkit consists of a ring-binder containing double-sided 'theme sheets' and a series of introductory pages. The binding is loose leaf so that the theme sheets can be copied, faxed, individually laminated, and used separately for specific purposes. It is strongly recommended that if sheets are removed from the Toolkit, they should be copied first and the original replaced immediately. The Toolkit is intended to be a dynamic document and additional theme sheets and other materials can also be added.

The Toolkit has three parts:

Introductory section — This comprises seven main parts, including maps of the maritime nations of South Asia, and a regional overview showing the location of all MCPAs, which is supported by a table with details of dates of their establishment and size. Addresses and contact details for each MCPA, an annotated list of global and regional conventions and initiatives relevant to MCPAs (referred to frequently in individual theme sheets), guidelines for Internet searches and details for obtaining some of the more frequently cited sources of further information are also provided. The final sheet of the introductory section provides a description of the process of producing the Toolkit with a detailed acknowledgement of all the individuals and institutions that collaborated and assisted on the development of the South Asia Toolkit, and the original WIO Toolkit from which the South Asia Toolkit materials were adapted.

Part 1. The Management Process — Seven sections contain theme sheets on management topics or inputs (human, financial, organisational and technical) required to effectively manage an MCPA and ensure that it meets its objectives:

A. Legislative and institutional framework
B. Participatory processes
C. Planning and reporting
D. Human resources
E. Finances
F. Equipment and infrastructure
G. Monitoring, evaluation and research

Part 2. Conservation and Sustainable Use — Four sections provide theme sheets on topics related to the results or outputs of MCPA management:

H. Habitats and species
I. Fisheries
J. Tourism, recreation and education
K. Coastal development and shipping

THEME SHEET CONTENT

Each sheet covers a theme relevant to MCPA management in the South Asia region. The text aims to provide:

- An introduction to the subject and a description of the key issues relevant to MCPA management;
- Some ideas and guidance on what the MCPA might do in relation to the topic;
- References to publications and Internet websites;
- Where relevant, a short case study from an MCPA within the South Asian region, or globally, which illustrates a particular point in the theme sheet and discusses experience and lessons learnt.

Surveys conducted in 2004, prior to the development of the Toolkit for the Western Indian Ocean (WIO) indicated that MCPA personnel required assistance in obtaining information on different subjects. Consultations with stakeholders in the South Asian region in 2006 also highlighted a need for compiled, accessible information on a range of subjects to assist in the daily challenges of MCPA management in remote locations. The theme sheets therefore focus on providing details on how to obtain the information needed. This is largely in two formats: printed documentation, with key references listed; and electronically, from the Internet, with key websites provided. Guidance on how to maximise use of the internet is provided within this introductory section. Some theme sheets cover very specific technical subjects whilst others simply provide an introduction to more complex issues, and some subjects are covered in more depth than others. Each theme sheet stands alone, but contains cross-references to other relevant sheets. The theme sheets have been adapted from those within the WIO Toolkit and reviewed by numerous regional and international experts to provide a South Asian context. They nevertheless represent only general guidance to the theme in question and should not be taken as the definitive management guide. Use should always be made of the additional sources of information that are provided.

Website

The Toolkit will be available on the IUCN Global Marine Programme website (**www.iucn.org/marine**). All the theme sheets can be viewed or downloaded as pdf files. New material and updates will be posted to the website on a continuing basis.

The following maps and tables depict the location and diversity of protection measures for marine and coastal environments across the South Asian region. Officially designated protected areas falling within the coastal zone (<50m elevation or 100km from the coast) are listed for each maritime country alongside information (where known), on establishment date, total area, designation or convention, and IUCN category (sheet A1 provides an explanation of IUCN Categories). A blank space indicates that the information is not available. Geo-referenced data points are used to display the specific location, and spatial boundary information of the listed protected areas on national and regional scale maps. Proposed protected areas, which have not yet been officially designated, are not included for any country. In some instances, wholly terrestrial sites have been removed from the tables following guidance from stakeholders.

This information was compiled based on the holdings of the World Database on Protected Areas (WDPA), hosted by UNEP World Conservation Monitoring Centre, and MPA Global Database, with additional input from regional stakeholders, and the Mangroves for the Future MCPA gap analysis. A full list of thematic data sources is provided. Every effort has been made to ensure the accuracy of the information. Notice of any errors, amendments or the creation of new MCPAs should be provided to UNEP-WCMC to facilitate the continued updating of the WDPA data holdings (protectedareas@unep-wcmc.org).

For further information on MCPAs in South Asia please visit:

The World Database on Protected Areas: http://www.unep-wcmc.org/wdpa/

MPA Global Database: http://www.mpaglobal.org

IUCN Directory of Protected Areas in South Asia

LEGEND

Maps compiled by UNEP-WCMC using ESRI ArcGIS software.
Coordinate System: Geographic
Date printed: 01 September 2008

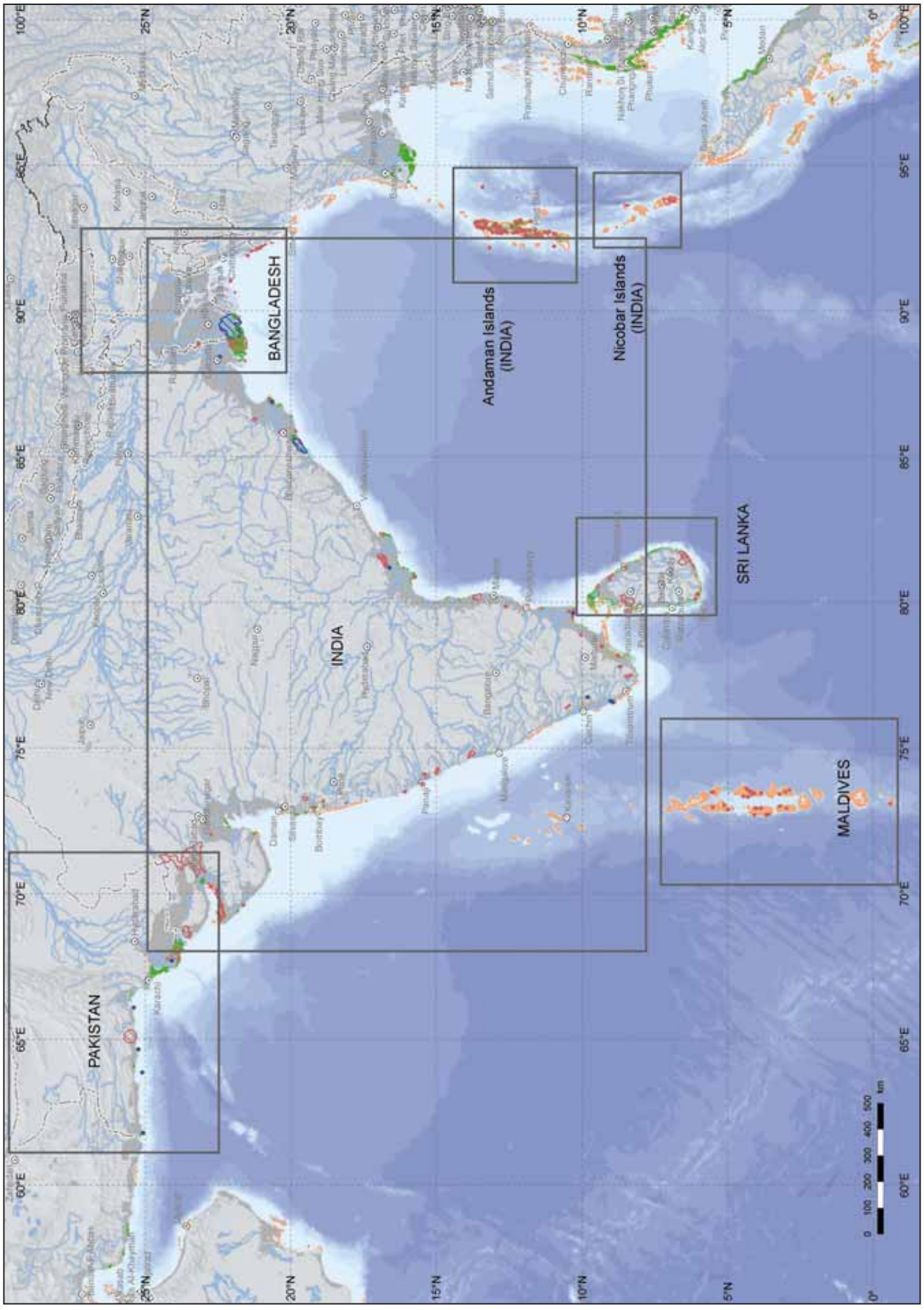
The contents of all maps do not necessarily reflect the views or policies of UNEP-WCMC or contributory organisations. The designations employed and the presentations do not imply the expressions of any opinion whatsoever on the part of UNEP-WCMC or contributory organisations concerning the legal status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

The Millennium Assessment defines the coastal zone as a narrow band of terrestrial area, dominated by ocean influences of tides and marine aerosols. In physical terms this is accepted as a maximum of 100km in land or 50m elevation – whichever is closer to the sea (MA Marine and Coastal Synthesis, 2006).

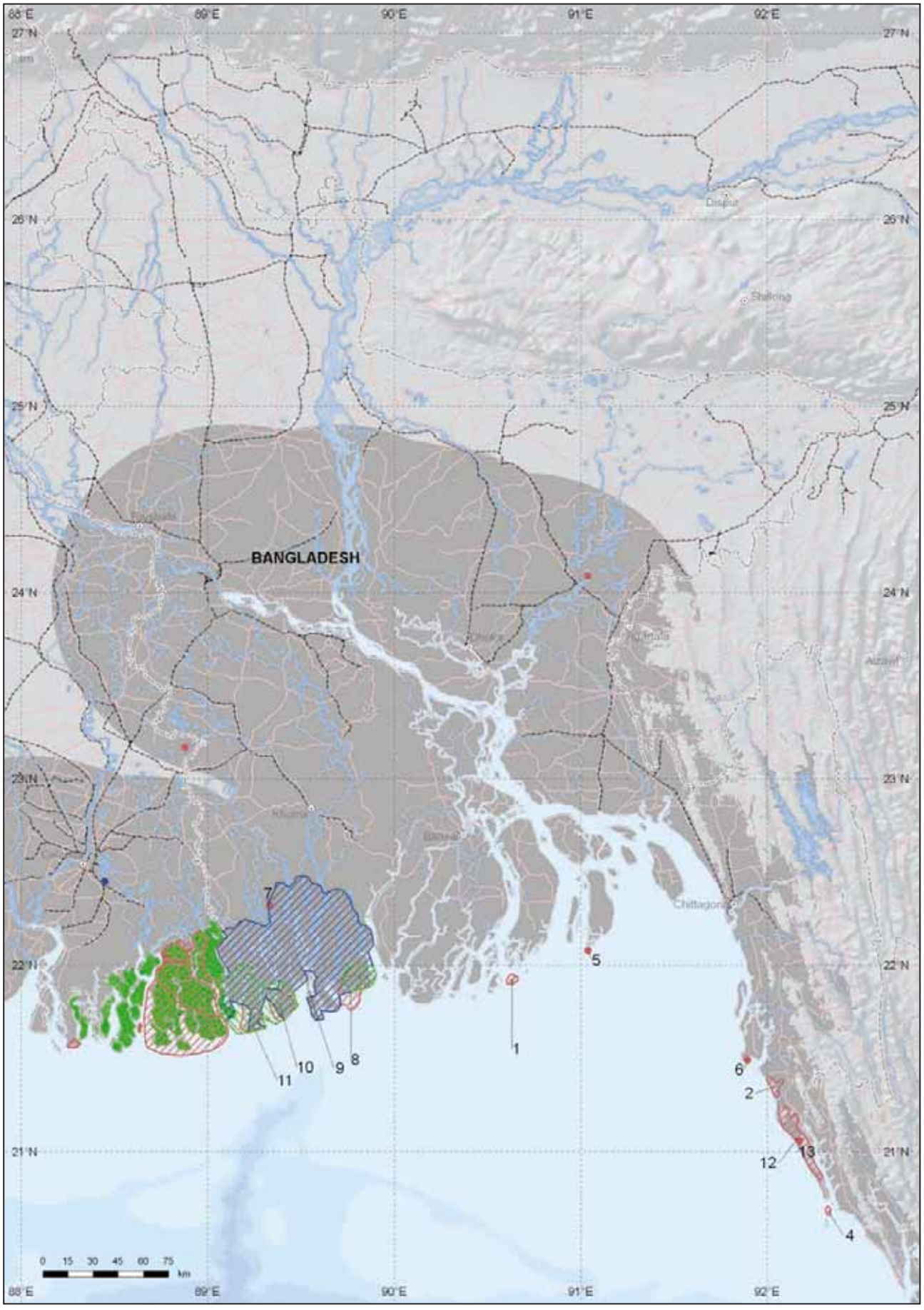
Sources of thematic datasets

Data Set	Source
Protected Areas	World Database on Protected Areas (WDPA) in November 2007, supplied by UNEP World Conservation Monitoring Centre (UNEP-WCMC) (WDPA custodian). This dataset was reviewed by in-country experts through MFF and South Asia MCPA Project activities and feedback incorporated.
Mangroves	Mangroves data mainly from Mangrove forest distributions and dynamics (1975-2005) of the tsunami-affected region of Asia, by C. Giri, Z. Zhu, L.L.Tieszen, A. Singh, S. Gillette, J.A.Kelmelis, Journal of Biogeography (J.Biogeogr.) (2007) with additional data from: 1) extraction from version 3.0 of the global polygon dataset compiled by UNEP World Conservation Monitoring Centre (UNEP-WCMC) in collaboration with the International Society for Mangrove Ecosystems (ISME), 1997. This dataset was reviewed by in-country experts through MFF activities and where possible any feedback incorporated.
Coral	Andréfouët, S., F. E. Muller-Karger, J. A. Robinson, C. J. Kranenburg, D. Torres-Pulliza, S. A. Spraggins, and B. Murch. 2005. Global assessment of modern coral reef extent and diversity for regional science and management applications: a view from space. In Y. Suzuki, T. Nakamori, M. Hidaka, H. Kayanne, B. E. Casareto, K. Nadaoka, H. Yamano, M. Tsuchiya, and K. Yamazato, editors. Tenth International Coral Reef Symposium. Japanese Coral Reef Society, Okinawa, Japan. CDROM. Pages 1732-1745. Version 7.0 of the global 1km raster dataset compiled by the UNEP World Conservation Monitoring Centre (UNEP-WCMC), (2003) in Shapefile format. Data for Sri Lanka, Maldives, India (Andaman and Nicobar islands only) obtained from the Millennium Coral Reef Mapping Project, Institute for Marine Remote Sensing, University of South Florida (IMaRS/USF) and Institut de Recherche pour le Développement (IRD/UR 128, Centre de Nouméa).
Seagrass	Seagrasses extracted from version 2.0 of the global polygon and point dataset compiled by UNEP World Conservation Monitoring Centre (UNEP-WCMC), (2005). Review by in-country experts was undertaken and feedback incorporated.
Bathymetry	Reproduced from the GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of the International Oceanographic Commission (of UNESCO) and the International Hydrographic Organisation, 2003

Legend for maps


BANGLADESH
Andaman Islands (INDIA)
Nicobar Islands (INDIA)
INDIA
SRI LANKA
MALDIVES
PAKISTAN

Bangladesh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BANGLADESH
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km

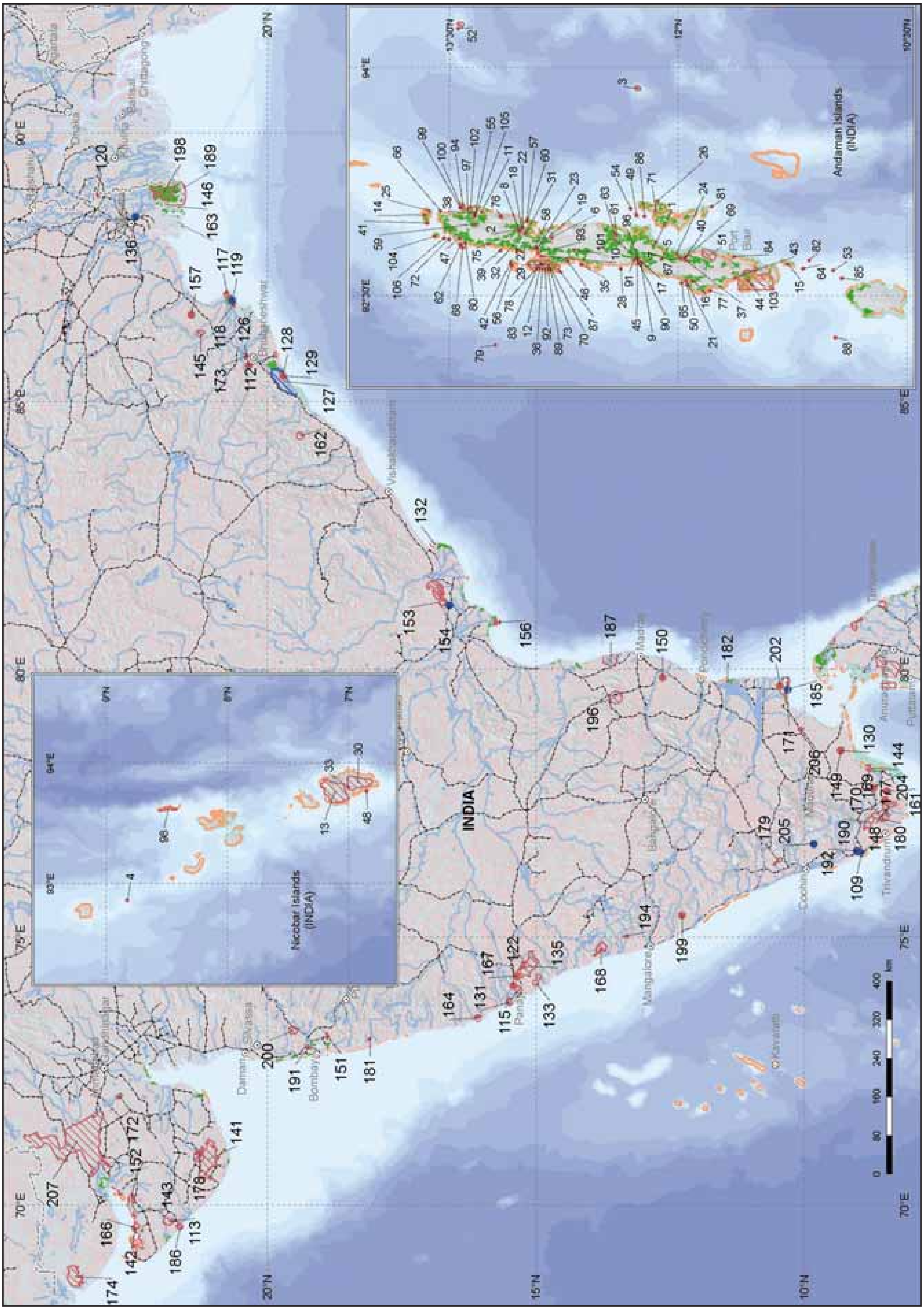
Bangladesh - list of details

Map Number	Site Name	National Designation	International Designation (e.g. RAMSAR)	Establishment Date	Area Total (Hectares)	IUCN Category	Comments
1	Char Kukri-Mukri	Wildlife Sanctuary		1981	40	IV	Coastal mangrove habitat
2	Himchari	National Park		1980	1,729	V	
3	Marine Reserve	Marine Reserve		2000	69800		*
4	Narikel Jinjira Dwip (St Martins Island) & Coral Reef	Ecologically Critical Area (ECA)		1999	590 + Coral reef		Coral reef habitat
5	Nijhum Dweep	National Park		2001	16,352	unset	
6	Sonadia Island	Ecologically Critical Area (ECA)		1999	4,916		Barrier Island, sand dunes and mangrove habitat
7	Sundarbans (10km Periphery)	Ecologically Critical Area (ECA)		1999			Mangrove habitat *
8	Sundarbans East	Wildlife Sanctuary		1977	31,226	IV	Mangrove habitat
9	Sundarbans Reserved Forests	Wetlands of International Importance/ World Heritage Convention		1992	601,700		
10	Sundarbans South	Wildlife Sanctuary		1977	36,970	IV	Mangrove habitat
11	Sundarbans West	Wildlife Sanctuary		1977	71,502	IV	Mangrove habitat
12	Teknaf	Game Reserve		1983	11,615	unset	Hill forest
13	Teknaf Peninsula (Cox's Bazar - Teknaf Sea Beach)	Ecologically Critical Area (ECA)		1999	10,465		World's longest sea beach

* Location unknown, therefore not present on map

MCPAs of South Asia - Maps (Contd.)

India



INDIA

There are 9 National Parks and 95 notified national parks/sanctuaries in the Andaman and Nicobar (A&N) Islands, of India. These have been listed separately from mainland protected areas below:

ANDAMAN & NICOBAR ISLANDS

Map Number	Site Name	State/ Province	National Designation	International Convention/ Agreement (e.g. RAMSAR)	Establishment Date	Area Total (Hectares)	IUCN Category	Comments
1	Arial Island	A&N	Sanctuary		1977	5	IV	
2	Bamboo Island	A&N	Sanctuary		1977	5	IV	
3	Barren Island	A&N	Sanctuary		1977	810	IV	
4	Battimalv Island	A&N	Sanctuary		1977	223	IV	
5	Belle Island	A&N	Sanctuary		1977	8	IV	Part of the Mahatma Ghandi Marine National Park
6	Bennett Island	A&N	Sanctuary		1977	346	IV	
7	Bingham Island	A&N	Sanctuary		1977	8	IV	
8	Blister Island	A&N	Sanctuary		1977	26	IV	
9	Bluff Island	A&N	Sanctuary		1977	114	IV	
10	Bondoville Island	A&N	Sanctuary		1977	255	IV	
11	Brush Island	A&N	Sanctuary		1977	23	IV	
12	Buchanan Island	A&N	Sanctuary		1977	933	IV	
13	Campbell	A&N	National Park		1992	42,900	II	Part of the Great Nicobar Biosphere Reserve
14	Chanel Island	A&N	Sanctuary		1977	13	IV	
15	Cinque islands	A&N	Sanctuary		1977	951	IV	
16	Clyde Island	A&N	Sanctuary		1977	54	IV	
17	Cone Island	A&N	Sanctuary		1977	65	IV	
18	Curlew (B.P) Island	A&N	Sanctuary		1977	16	IV	
19	Curlew Island	A&N	Sanctuary		1977	3	IV	
20	Cuthbert Bay	A&N	Sanctuary		1977	582	IV	*
21	Defence Island	A&N	Sanctuary		1977	1,049	IV	
22	Dot Island	A&N	Sanctuary		1977	13	IV	
23	Dottrell Island	A&N	Sanctuary		1977	13	IV	
24	Duncan Island	A&N	Sanctuary		1977	73	IV	
25	East Island	A&N	Sanctuary		1977	611	IV	
26	East of Inglis Island	A&N	Sanctuary		1977	355	IV	
27	Egg Island	A&N	Sanctuary		1977	5	IV	
28	Elat (flat) Island	A&N	Sanctuary		1977	936	IV	
29	Entrance Island	A&N	Sanctuary		1977	96	IV	
30	Galathea	A&N	National Park		1992	11,000	II	Part of the Great Nicobar Biosphere Reserve
31	Gander Island	A&N	Sanctuary		1977	5	IV	
32	Goose Island	A&N	Sanctuary		1977	1	IV	
33	Great Nicobar	A&N	Biosphere Reserve		1986	88,500	VI	
34	Gurjan	A&N	Sanctuary					*
35	Hump Island	A&N	Sanctuary		1977	47	IV	
36	Interview Island	A&N	Sanctuary		1977	13,387	IV	
37	James Island	A&N	Sanctuary		1977	210	IV	
38	Jungle Island	A&N	Sanctuary		1977	52	IV	
39	Kwangtung Island	A&N	Sanctuary		1977	57	IV	
40	Kyd Island	A&N	Sanctuary		1977	800	IV	

India - list of details

41	Landfall Island	A&N	Sanctuary		1977	2,948	IV	
42	Latouche Island	A&N	Sanctuary		1977	96	IV	
43	Lohabarrack	A&N	Sanctuary		1977	2,221	IV	
44	Mahatma Gandhi Marine	A&N	National Park		1983	28,150	II	
45	Mangrove Island	A&N	Sanctuary		1977	39	IV	
46	Mask Island	A&N	Sanctuary		1977	78	IV	
47	Mayo Island	A&N	Sanctuary		1977	10	IV	
48	Megapode Island	A&N	Sanctuary		1977	12	IV	**
49	Middle Button Island	A&N	National Park		1987	64	II	Part of Rani Jansi Marine National Park
50	Montgomery Island	A&N	Sanctuary		1977	21	IV	
51	Mount Harriett	A&N	National Park		1987	4,662	II	
52	Narcondam	A&N	Sanctuary		1977	681	IV	
53	North Brother Island	A&N	Sanctuary		1977	75	IV	
54	North Button Island	A&N	National Park		1987	44	II	Part of the Rani Jhansi Marine National Park
55	North Island	A&N	Sanctuary		1977	49	IV	
56	North Reef Island	A&N	Sanctuary		1977		IV	
57	Oliver Island	A&N	Sanctuary		1977	16	IV	
58	Orchid Island	A&N	Sanctuary		1977	10	IV	
59	Ox Island	A&N	Sanctuary		1977	13	IV	
60	Oyster Island 1	A&N	Sanctuary		1977	8	IV	
61	Oyster Island 2	A&N	Sanctuary		1977	21	IV	
62	Paget Island	A&N	Sanctuary		1977		IV	
63	Parkinson Island	A&N	Sanctuary		1977	34	IV	
64	Passage Island	A&N			1977	62		
65	Patric Island	A&N	Sanctuary		1977	13	IV	
66	Peacock island	A&N	Sanctuary		1977	62	IV	
67	Pitman Island	A&N	Sanctuary		1977	137	IV	
68	Point Island	A&N	Sanctuary		1977	307	IV	
69	Potanma Islands	A&N	Sanctuary		1977	16	IV	
70	Ranger Island	A&N	Sanctuary		1977	426	IV	
71	Rani Jhansi Marine	A&N	National Park		1996	25,614	II	
72	Reef Island	A&N	Sanctuary		1977	174	IV	
73	Roper Island	A&N	Sanctuary		1977	146	IV	
74	Ross Island	A&N	Sanctuary					*
75	Rowe Island	A&N	Sanctuary		1977	1	IV	
76	Saddle Peak	A&N	National Park		1987	3,254	II	
77	Sandy Island	A&N	Sanctuary		1977	158	IV	
78	Sea Serpent Island	A&N	Sanctuary		1977	78	IV	
79	Shark Island	A&N	Sanctuary		1977	60	IV	
80	Shearme Island	A&N	Sanctuary		1977	785	IV	
81	Sir Hugh Rose Island	A&N	Sanctuary		1977	106	IV	
82	Sisters Island	A&N	Sanctuary		1977	36	IV	
83	Snake Island 1	A&N	Sanctuary		1977	73	IV	
84	Snake Island 2	A&N	Sanctuary		1977	3	IV	
85	South Brother Island	A&N	Sanctuary		1977	124	IV	
86	South Button Island	A&N	National Park		1987	3	II	Part of the Rani Jhansi Marine National Park
87	South Reef Island	A&N	Sanctuary		1977	117	IV	
88	South Sentinel Island	A&N	Sanctuary		1977	161	IV	

89	Spike Island 1	A&N	Sanctuary		1977	42	IV	
90	Spike Island 2	A&N	Sanctuary		1977	1,170	IV	
91	Stoat Island	A&N	Sanctuary		1977	44	IV	
92	Surat Island	A&N	Sanctuary		1977	31	IV	
93	Swamp Island	A&N	Sanctuary		1977	409	IV	
94	Table (Delgarno) Island	A&N	Sanctuary		1977	229	IV	
95	Table (Exeelsior) Island	A&N	Sanctuary					*
96	Talabaicha Island	A&N	Sanctuary		1997	321	IV	
97	Temple Island	A&N	Sanctuary		1977	104	IV	
98	Tillangchong Island	A&N	Sanctuary		1977	1,683	IV	
99	Tree Island	A&N	Sanctuary		1977	3	IV	
100	Trilby Island	A&N	Sanctuary		1977	96	IV	
101	Tuft Island	A&N	Sanctuary		1977	29	IV	
102	Turtle Islands	A&N	Sanctuary		1977	39	IV	
103	Wandur	A&N	Marine National Park		1983	28,150	II	
104	West Island	A&N	Sanctuary		1977	640	IV	
105	Wharf Island	A&N	Sanctuary		1977	11	IV	
106	White Cliff Island	A&N	Sanctuary		1977	47	IV	

* Location unknown, therefore not present on map

** The 2004 Indian Ocean Tsunami caused major morphological changes to the land area of the A&N Islands, which may result in some inaccuracies on this map while the changes are explored and recorded.

MAINLAND INDIA

Map Number	Site Name	National Designation	International Convention/Agreement (e.g. RAMSAR)	Establishment Date	Area Total (Hectares)	IUCN Category	Comments
107	Achra	Sanctuary					*
108	Aliabet Island	Sanctuary					*
109	Ashtamudi Wetland		Wetlands of International Importance (Ramsar)	2002	61,400		
110	Attiveri	Sanctuary		1994	223	IV	*
111	Balai	Sanctuary					*
112	Balukhand Konark	Sanctuary		1984	7,172	IV	*
113	Barda	Sanctuary		1979	19,231	IV	
114	Barda (extension)	Sanctuary					*
115	Bhagwan Mahavir	Sanctuary		1967	14,852	IV	
116	Bherjan-Borajan-Podumoni	Sanctuary		1999	722		*
117	Bhitarkanika	National Park		1998	14,500	II	
118	Bhitarkanika	Sanctuary		1975	67,200	IV	
119	Bhitarkanika Mangroves		Wetlands of International Importance (Ramsar)	2002	65,000		
120	Bibhutibhusan	Sanctuary		1980	64	IV	
121	Black Buck	Sanctuary					*
122	Bondla	Sanctuary		1969	800	IV	
123	Bordoibam-Bilmukh	Sanctuary		1996	1,125	IV	*
124	Burachapori	Sanctuary		1995	4,406	IV	*
125	Cambay	Sanctuary					*
126	Chandaka	Sanctuary		1982	17,579	IV	
127	Chilika Lake		Wetlands of International Importance (Ramsar)	1981	116,500		
128	Chilka (Nalaban)	Sanctuary		1987	1,553		

India - list of details

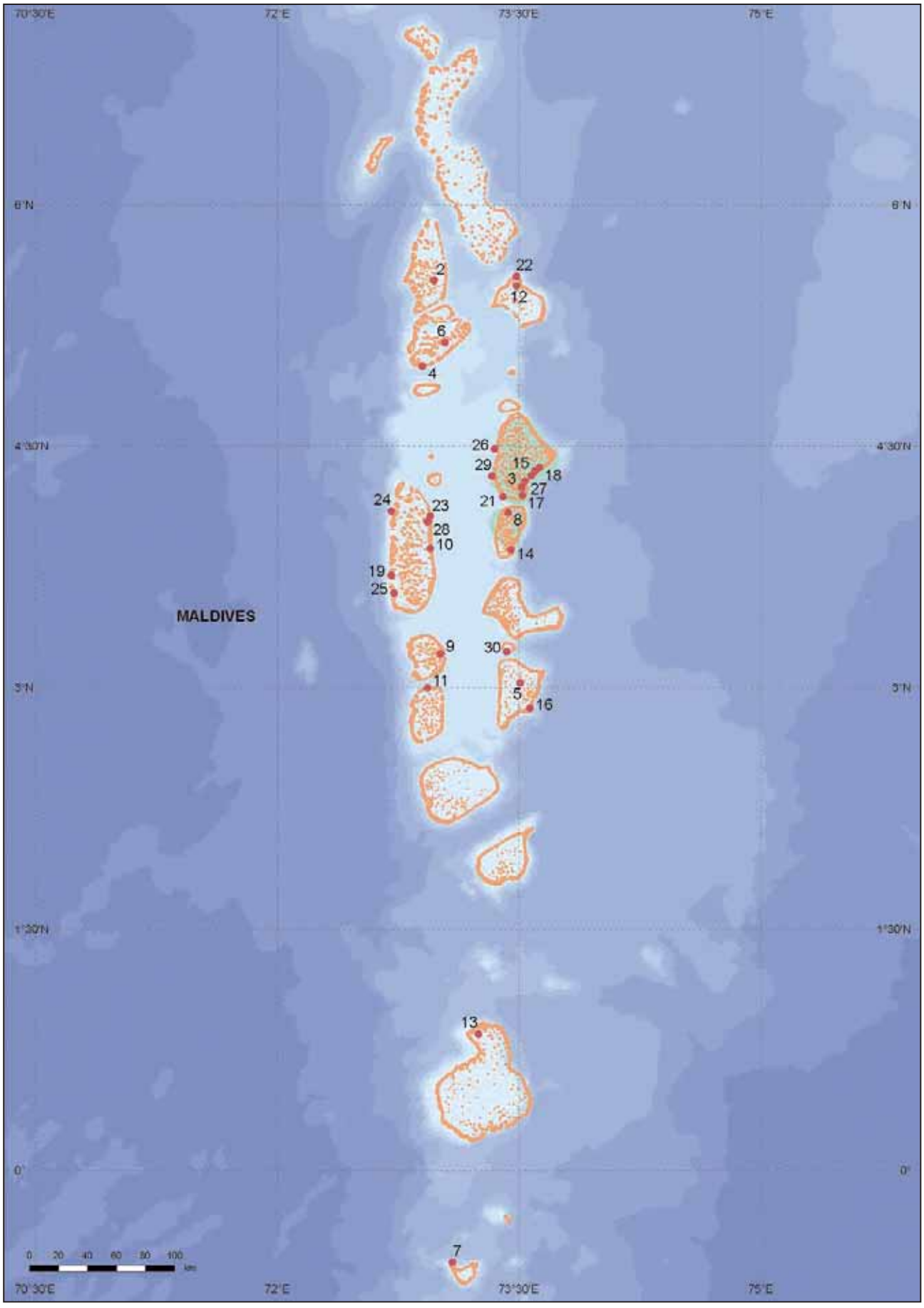
129	Chilka-Nanda Island	National Park					
130	Chitrangudi	Sanctuary		1989	48	IV	
131	Chorao Island	Sanctuary		1988	178	IV	
132	Coringa	Sanctuary		1978	23,570	IV	
133	Cotigao	Sanctuary		1968	8,565	IV	
134	Dadra and Nagar Haveli	Sanctuary		2000	9,216	IV	*
135	Dandeli	Sanctuary		1987	47,502	IV	
136	East Calcutta Wetlands		Wetlands of International Importance (Ramsar)	2002	12,500		
137	Gaga	Sanctuary		1988	333	IV	*
138	Gaga Great Indian Bustar	Sanctuary		1988	33	IV	*
139	Gahirmatha (marine)	Sanctuary		1997	143,500	IV	*
140	Gahirmatha North	Sanctuary					*
141	Gir	Sanctuary		1965	115,342	IV	
142	Gujarat	National Park		1995	16,289	II	
143	Gulf of Kutch	Marine National Park		1980	16,289	II	
144	Gulf of Mannar	Bird Reserve/ Marine National Park/ National park	UNESCO Biosphere Reserve	1989	1,050,000	VI	
145	Hadgarh	Sanctuary		1978	19,106	IV	
146	Haliday Island	Sanctuary		1978	595	IV	
147	Honvavar	Sanctuary					*
148	Kalakad	Wildlife Sanctuary		1978	22,358	IV	
149	Kanjirankulam	Sanctuary/Bird Reserve		1989	104	IV	
150	Karikili	Sanctuary/Bird Reserve		1998	61	IV	
151	Karnala	Sanctuary		1968	448	IV	
152	Khijadia	Sanctuary		1981	605	IV	
153	Kolleru	Sanctuary		1953	67,300	IV	
154	Kolleru Lake		Wetlands of International Importance (Ramsar)	2002	90,100		
155	Kori Creek	Sanctuary					*
156	Krishna	Sanctuary		1989	1,989	IV	
157	Kuldiha	Sanctuary		1984	27,275	IV	
158	Kuldiha extention	Sanctuary					*
159	Kumarkon	Sanctuary					*
160	Kundapur	Sanctuary					*
161	Kuthankulam	Sanctuary		1994	129	IV	
162	Lakhari Valley	Sanctuary		1985	18,587	IV	
163	Lothian Island	Sanctuary		1978	3,800	IV	
164	Malvan	Sanctuary		1987	2,912	IV	
165	Mandvi	Sanctuary					*
166	Marine	Sanctuary		1980	29,503	IV	
167	Mollem	Sanctuary		1967	13,300	IV	
168	Mookambika	Sanctuary		1974	24,700	IV	
169	Mundanthurai	Wildlife Reserve		1977	56,738	IV	
170	Mundanthuria-Kalakad	National Park		1996	40,000	Unset	
171	Muthupet Mangrove Forest Reserve	Sanctuary		1967	1,726	IV	
172	Nal Sarovar	Sanctuary		1969	12,082	IV	
173	Nandankanan	Sanctuary		1979	1,416	IV	

India - list of details

174	Narayan Sarovar	Sanctuary		1995	44,423	IV	
175	National Chambal	Sanctuary		1979	28,000	IV	*
176	Navpada	Sanctuary					*
177	Neyyar	Sanctuary		1958	12,800	IV	
178	Paniya	Sanctuary		1989	3,963	IV	
179	Peechi Vazhani	Sanctuary		1958	12,500	IV	
180	Peppara	Sanctuary		1983	5,300	IV	
181	Phansad	Sanctuary		1986	6,979	IV	
182	Pichavaram	Sanctuary/Forest Reserve		1935	1,100	IV	
183	Pilarkhan	Sanctuary					*
184	Pitti (Bird Island)	Sanctuary		2000	1	IV	*
185	Point Calimere Wildlife and Bird Sanctuary	National Park	Wetlands of International Importance (Ramsar)	2002	38,500		
186	Porbandar Lake	Sanctuary		1988	9	IV	
187	Pulicat Lake	Sanctuary		1980	15,367	IV	
188	Rocky Beach	Sanctuary					*
189	Sajnakhali	Sanctuary		1976	209,112	IV	
190	Sanctuary	Sanctuary		1984	10,032	IV	
191	Sanjay Gandhi	National Park		1983	8,696	II	
192	Sasthamkotta Lake		Wetlands of International Importance (Ramsar)	2002	373		
193	Sohara	Sanctuary					*
194	Someshwara	Sanctuary		1974	8,840	IV	
195	Someshwara (extension)	Sanctuary					*
196	Sri Venkateswara	Sanctuary		1985	15,332	IV	
197	Sriharikota Island	Sanctuary					*
198	Sundarbans	National Park	UNESCO Biosphere Reserve	1984	133,010	Ia	
199	Talacauvery	Sanctuary		1987	10,559	IV	
200	Tansa	Sanctuary		1970	30,481	IV	
201	Turtle	Sanctuary		1989	700	IV	*
202	Udayamarthandapuram Lake	Sanctuary/Bird Reserve		1991	45	IV	
203	Vaduvoor	Sanctuary/Bird Reserve		1991	123	IV	*
204	Vellanadu	Sanctuary		1987	1,641	IV	
205	Vembanad-Kol Wetland		Wetlands of International Importance (Ramsar)	2002	151,250		
206	Vettangudi	Sanctuary		1977	38	IV	
207	Wild Ass	Sanctuary		1973	495,371	IV	

* Location unknown, therefore not present on map

Maldives


70°30'E
72°E
73°30'E
75°E
8°N
4°30'N
3°N
1°30'N
0°
MALDIVES
2
22
12
6
4
26
29
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18
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24
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28
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25
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30
11
5
16
13
7
0 20 40 60 80 100
km

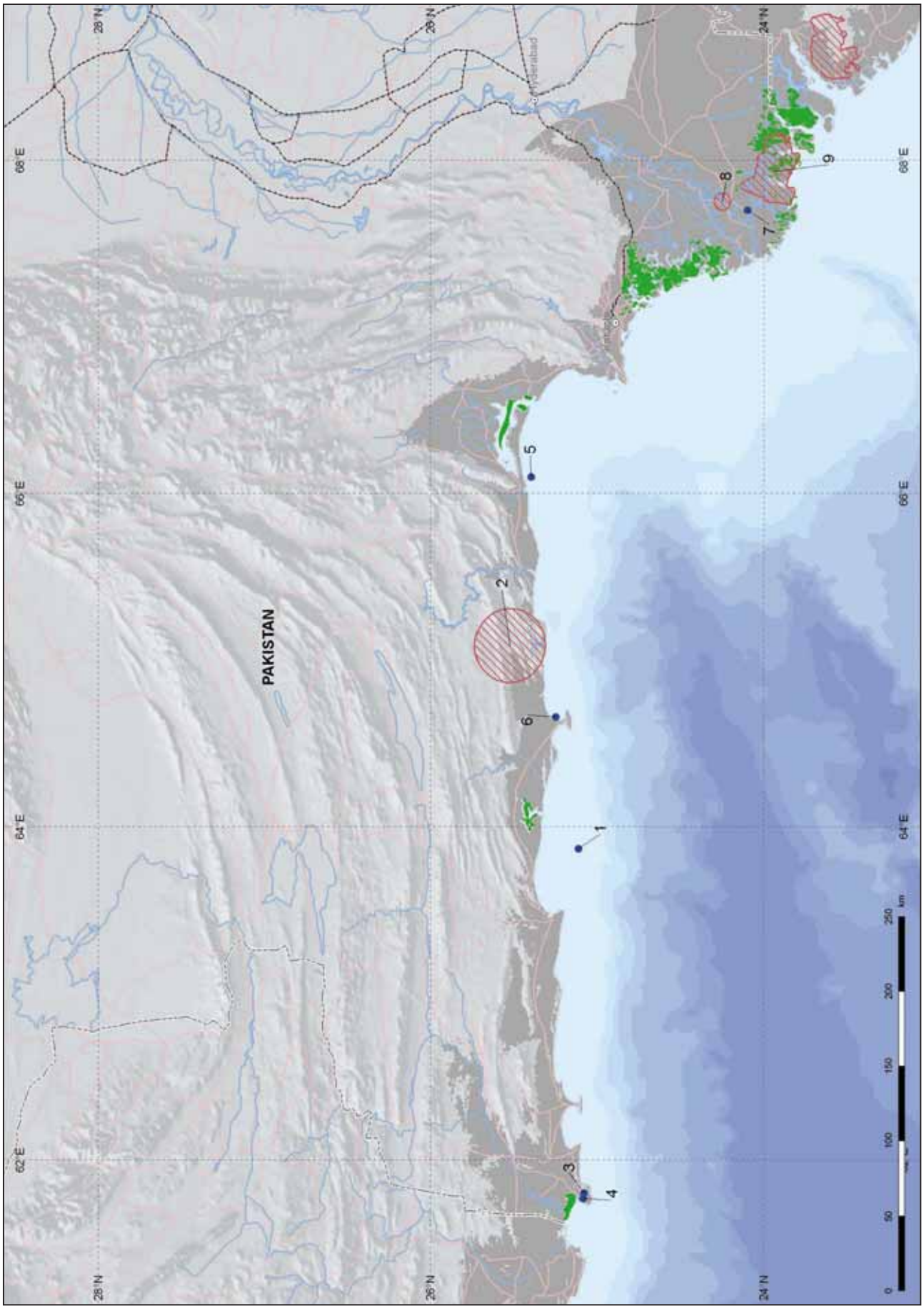
Maldives - list of details

MALDIVES

Map Number	Site Name	National Designation	International Designation (e.g.RAMSAR)	Establishment Date	Area Total (Hectares)	IUCN Category	Comments
1	AA. Hurasdhoo	Island		2006		Unset	*
2	Anemone City	Dive Site		1995		Unset	
3	Banana Reef	Dive Site		1995		Unset	*
4	B.Olhugiri	Island		2006		Unset	
5	Devana Kandu	Dive Site		1995		Unset	
6	Dhigali haa	Dive Site		1999		Unset	
7	Eedhigali Kilhi - Koattey sarahadhu	Coastal area		2004		Unset	*
8	Embudu Channel	Dive Site		1995		Unset	
9	Filitheyo Kandu	Dive Site		1999		Unset	
10	Fish Head	Dive Site		1995		Unset	
11	Fushi Kandu	Dive Site		1999		Unset	
12	Fushivaru Thila	Dive Site		1999		Unset	
13	GA. Hithaadhoo	Island		2006		Unset	
14	Guraidhoo Channel	Dive Site		1995		Unset	
15	H.P Reef	Dive Site		1995		Unset	
16	Hakura Thila	Dive Site		1999		Unset	
17	Hans Place	Dive Site		1995		Unset	
18	Huraa Kulhi	Mangrove Reserve		2006		Unset	
19	Kadu Rah Thila	Dive Site		1995		Unset	
20	Kari Beyru Thila	Dive Site		1999		Unset	
21	Kuda Haa	Dive Site		1995		Unset	
22	Kuredhu Express	Dive Site		1995		Unset	
23	Lions Head	Dive Site		1995		Unset	
24	Maaya Thila	Dive Site		1995		Unset	
25	Madivaru	Dive Site		1999		Unset	
26	Makundhoo Kandu	Dive Site		1995		Unset	
27	Nasimo Thila	Dive Site		1999		Unset	
28	Orimas Thila	Dive Site		1995		Unset	
29	Rasfari	Dive Site		1995		Unset	
30	Vattaru Kandu	Dive Site		1999		Unset	

* Location unknown, therefore not present on map

Pakistan


PAKISTAN
1
2
3
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5
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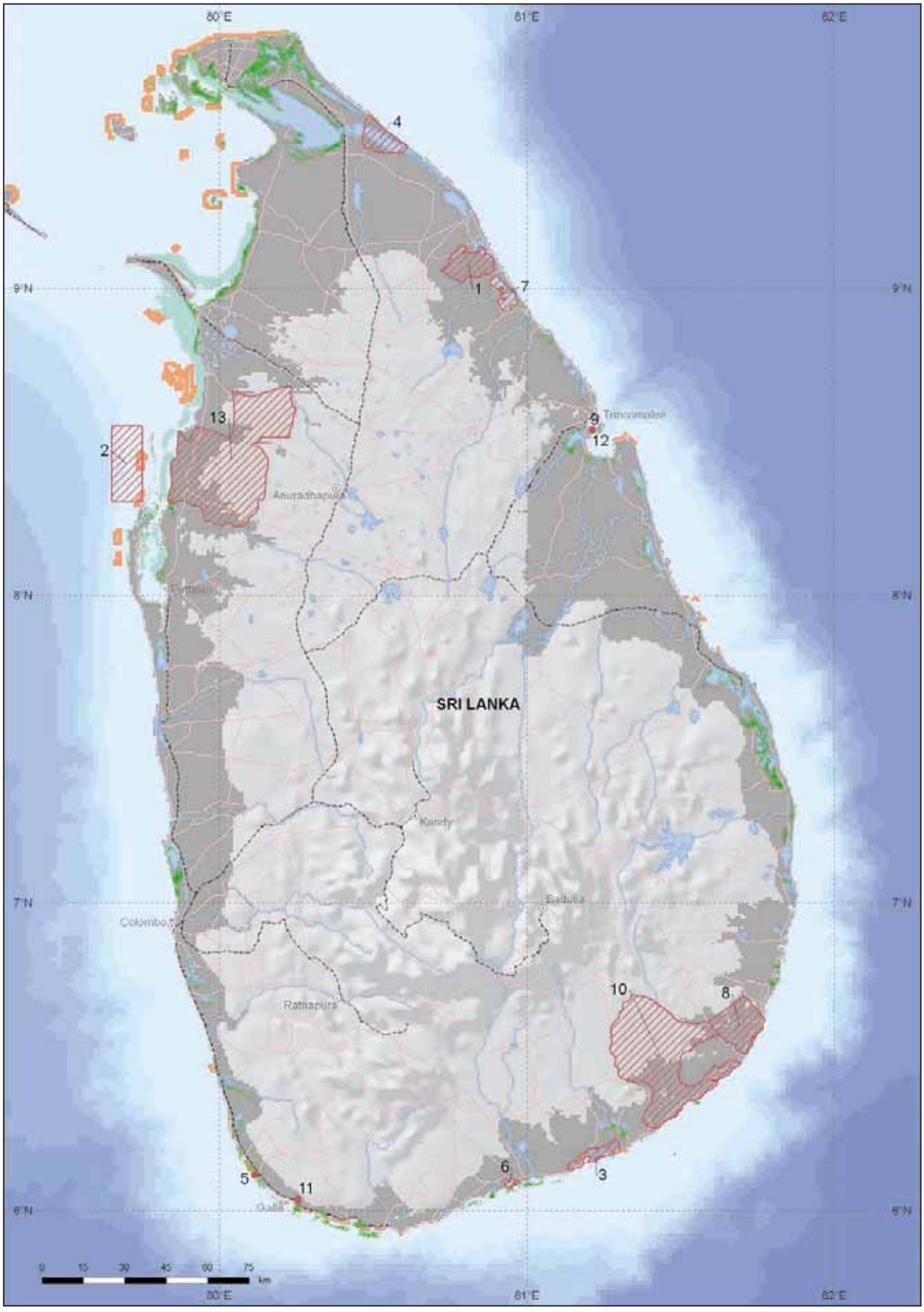
9
28°N
26°N
24°N
62°E
64°E
66°E
68°E
0
50
100
150
200
250 km

Pakistan - list of details

PAKISTAN

Map Number	Site Name	State/ Province	National Designation	International Designation (e.g. RAMSAR)	Establishment Date	Area Total (Hectares)	IUCN Category	Comments
1	Astola Island (Haft Talar)	Balochistan	Proposed for MPA	Wetlands of International Importance (Ramsar)		600		
2	Hingol	Balochistan	National Park		1997	619,043	II	
3	Jiwani Coastal Wetland	Balochistan		Wetlands of International Importance (Ramsar) part of North Arabian eco-region	2001	4,600		19km coastline. Important nesting habitat for Green Turtles and marine mammals
4	Jiwani turtle beaches	Balochistan		Wetlands of International Importance (Ramsar) part of North Arabian eco-region	2001			8km coastline. Important nesting habitat for Green Turtles
5	Miani Hor	Balochistan		Wetlands of International Importance (Ramsar)	2001	55000		Estuary/lagoon, mangrove habitat
6	Ormara turtle beaches	Balochistan		Wetlands of International Importance (Ramsar)	2001	2400		Turtle nesting habitat
7	Indus Delta	Sind		Wetlands of International Importance (Ramsar)	2002	472800		
8	Keti Bunder North	Sind	Wildlife Sanctuary		1977	8,948	IV	Mangrove habitat and important roosting and feeding ground for seabirds
9	Keti Bunder South	Sind	Wildlife Sanctuary		1977	23,046	IV	Mangrove habitat and important roosting and feeding ground for seabirds

Sri Lanka


80°E
81°E
82°E
9°N
8°N
7°N
6°N
SRI LANKA
Trincomalee
Anuradhapura
Kandy
Colombo
Ratnapura
Galle
Badulla
1
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12
13
0 15 30 45 60 75
km

Sri Lanka - list of details

SRI LANKA

Map Number	Site Name	National Designation	International Convention/ Agreement (e.g. RAMSAR)	Establishment Date	Area Total (Hectares)	IUCN Category	Comments
1	Andankulam	Forest Reserve			15,177	Unset	Borders a coastal lagoon
2	Bar Reef	Marine Sanctuary		1992	30,670	IV	Coral reef and sea grass habitats
3	Bundala	National Park	UNESCO MAB/Wetlands of International Importance (Ramsar)	1969	6,216	IV	Large forest area bordering the sea. Beach and intertidal area.
4	Chundikullam	Sanctuary		1938	11,150	IV	
5	Hikkaduwa	National Park		1998	45	IV	Entirely marine - incorporates coral reef habitat
6	Kalametiya Lagoon	Sanctuary		1984	712	IV	Estuary and adjacent wetland/ riverine environment
7	Kokilai	Sanctuary		1951	2,995	IV	Wetlands and lagoon habitat
8	Kumana	Bird Sanctuary		1970	18,148	II	Forest with wetland area bordering the sea. Incorporates coast and intertidal area
9	Paravi Doopath (or Pigeon Island)	National Park		1974	5	IV	Includes large and small Pigeon Islands and surrounding coral reefs
10	Ruhuna (Yala)	National Park		1938	97,878	II	Forest area bordering the coast in the south east
11	Rumassala	Marine Sanctuary			1,707		Coral reef habitat
12	Sober Island	Sanctuary		1963	65	IV	
13	Wilpattu	National Park		1938	131,693	II	Large forest area bordering the sea. Incorporates beach and intertidal areas

Addresses and contact information for MCPAs

The contact details of government agencies that are directly responsible for MCPA management in each country are given below. It should be noted, however, that often activities carried out under the jurisdiction of other government ministries and departments (e.g. Fisheries, Tourism, and Urban Planning) have significant impacts on MCPAs, thus, the MCPA management should maintain good communication with a range of government agencies, depending on the needs of their site.

BANGLADESH	
Relevant government authority concerned with MCPA management:	Ministry of Environment and Forests: Department of Environment
Address:	Paribesh Bhaban E/16 Agargaon Sher-e-Bangla Road Dhaka 1207 Bangladesh
Contact details:	Tel: +880 2 8112461 Fax: +880 2 9118682 Email: **info@doe-bd.org**
Website:	Ministry of Environment and Forests - **http://www.moef.gov.bd/** Department of Environment - **http://www.doe-bd.org/**

INDIA	
Relevant government authority concerned with MCPA management:	Ministry of Environment and Forests: Wildlife Division
Address:	CGO Complex Lodhi Road New Delhi - 110 003 India
Contact details:	Tel: +91 11 24361896, 24360605, 24360570, 24360519
Website:	Ministry of Environment and Forests - **http://envfor.nic.in/** Directory of Wildlife Protected Areas in India **http://www.wii.gov.in/envis/envis_pa_network/index.htm**

MALDIVES	
Relevant government authority concerned with MCPA management:	Ministry of Environment Energy and Water
Address:	3rd Floor, Fen Building Ameenee Magu Malé 20375 Republic of Maldives
Contact details:	Tel: +960 333 1696 Fax: +960 333 1694 Email: **secretariat@meew.gov.mv**
Website:	Ministry of Environment, Energy and Water - **www.meew.gov.mv**

PAKISTAN	
Relevant government authority concerned with MCPA management:	Ministry of Environment
Address:	Enercon Building Ataturk Avenue Behind State Bank of Pakistan Sector G-5/2 Islamabad Pakistan
Contact details:	Tel: +92 51 9205510
Website:	Ministry of Environment - **http://www.pakistan.gov.pk/**

SRI LANKA	
Relevant government authority concerned with MCPA management:	Ministry of Environment and Natural Resources: Department of Wildlife Conservation
Address:	No.382 Dilco Court New Kandy Road Malabe Sri Lanka
Contact details:	Tel: +94 11 2560380 or 2560314
Website:	Department of Wildlife Conservation - **http://www.dwlc.lk**

This sheet describes the main international conventions or treaties relating to MCPAs and conservation of marine biodiversity in South Asia, as well as some of the more relevant international programmes and initiatives.

LEGALLY BINDING CONVENTIONS

Convention on Biological Diversity (CBD) and the **Jakarta Mandate on Marine and Coastal Biological Diversity** — Lays out measures to be taken by Parties for conservation and sustainable use of biodiversity, including the establishment of a system of protected areas, or areas where special measures need to be taken to conserve biodiversity. The Jakarta Mandate, an associated instrument, lays out specific requirements for marine biodiversity conservation and identifies five key areas: integrated marine and coastal area management; the sustainable use of living resources; Marine and Coastal Protected Areas; and mariculture and alien species. COP7 of the CBD adopted the target of developing networks of MCPAs by the year 2012. The CBD is supported by a number of different funding mechanisms, including the Global Environment Facility (GEF) and National Environment Funds. **http://www.cbd.int/**

The Ramsar Convention on Wetlands — Addresses conservation and wise use of wetlands and covers freshwater and marine (to 6m depth at low tide) wetlands. Allows for designation of sites of 'international importance' that meet criteria covering representative, rare, unique wetland types or those especially important for conserving biodiversity. Sites must be managed but may be subject to 'wise' use and do not require formal protected area legal status. The Ramsar Convention is not a regulatory regime and has no punitive sanctions for violations of or defaulting upon treaty commitments – nevertheless, its terms do constitute a solemn treaty and are binding in international law in that sense. The Ramsar Small Grants Fund provides resources for projects that contribute to the implementation of the Convention's Strategic Plan. **www.ramsar.org**

World Heritage Convention — Provides for the protection of outstanding examples of the world's cultural and natural heritage. Parties may nominate protected areas that have outstanding values and that meet the specified criteria as World Heritage Sites. Funding under the International Assistance facility can be accessed under the Convention. **http://whc.unesco.org**

United Nations Convention on the Law of the Sea (UNCLOS) — Gives coastal states jurisdiction over their inland waters, territorial seas (out to 12 nm from the coast) and exclusive Economic Zone (EEZ) (200 nm or 370 km from the coast) provided they do not infringe the right of innocent passage by foreign ships. UNCLOS has a number of funding opportunities as well as a fellowship programme for government employees and academics involved in ocean law or maritime affairs. **http://www.un.org/depts/los/index.htm**

International Convention for the Prevention of Marine Pollution from Ships (MARPOL) — Covers pollution of the marine environment by ships from operational or accidental causes (e.g. oil spills, ballast water discharge, sewage, solid waste). Allows for the establishment of Particularly Sensitive Sea Areas (PSSAs) in which shipping is regulated. **www.imo.org**

Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO) — Mandated to enhance cooperation among member countries, other countries and organisations in the region and provide technical and management advisory services for sustainable coastal fisheries development and management in the Bay of Bengal region. The BOBP-IGO agreement has been formally signed by the governments of Bangladesh, India, Maldives and Sri Lanka. **http://www.bobpigo.org/**

NON-BINDING PROGRAMMES AND INITIATIVES

World Summit on Sustainable Development (WSSD) Plan of Implementation — The Plan promotes sustainable development in relation to conservation and the environment, and sets several targets including the establishment of representative networks of MCPAs worldwide by 2012. **http://www.un.org/jsummit/**

UNESCO Man and the Biosphere Programme (MAB) — Promotes sustainable use and conservation of biodiversity by improving the relationship between people and their environment. Central to the programme is an initiative to develop a global network of 'biosphere reserves'. The South and Central Asia MAB Network encourages the establishment of regional and thematic sub-networks, and includes Bangladesh, India, Maldives, Pakistan and Sri Lanka. MAB provides small grants for young scientists and UNESCO can provide advice and occasionally seed funds to initiate local efforts; these can help broker projects or to set up durable financial mechanisms. **www.unesco.org/mab and http://www.unesco.org/mab/doc/statutes_sacam.pdf**

UN-OCEANS (UN Oceans and Coastal Areas Network) — An inter-agency coordination mechanism on ocean and coastal issues within the United Nations system, its goals are to promote the coherence of United Nations system activities on oceans and coastal areas with the mandates of the General Assembly, and the priorities contained in the Millennium Development Goals, the Johannesburg Plan of Implementation and governing bodies of all members of UN-OCEANS. **http://www.oceansatlas.org/www.un-oceans.org/Index.htm**

FAO Code of Conduct for Responsible Fisheries — Provides guidance on sustainable fisheries management, and recommends that all critical fisheries habitats be protected. **www.fao.org**

The South Asian Seas Action Plan (SASAP) — One of the UNEP Regional Seas Conventions, covering protection of the marine and coastal environment in the South Asian region. SASAP focuses on Integrated Coastal Zone Management (ICZM), oil-spill contingency planning, human resource development and the environmental effects of land-based activities. Although there is no regional convention yet, SASAP follows existing global environmental and maritime conventions and considers the Law of the Sea as its umbrella Convention. **http://unep.org/regionalseas/programmes/nonunep/southasian/default.asp**

South Asian Association for Regional Cooperation (SAARC) — Provides a platform for the peoples of South Asia to work together in a spirit of friendship, trust and understanding. It aims to accelerate the process of economic and social development in Member States. The **SAARC Coastal Zone Management Centre** (SCZMC) seeks to promote cooperation in planning, management and sustainable development of the coastal zones. **http://www.saarc-sec.org/main.php and http://www.sczmc.org/**

International Coral Reef Initiative (ICRI) — A partnership of nations and organisations aimed at stopping the global degradation of coral reefs and related ecosystems. The Call for Action and the Indian Ocean Regional Strategy both specifically recommend the establishment of MCPAs. **www.icriforum.org**

International Coral Reef Action Network (ICRAN) — A global network of the world's leading coral reef management, science, and conservation organisations, working together, and with local communities, to halt and reverse the decline in health of the world's coral reefs. **www.icran.org**

South Asia Cooperative Environment Programme (SACEP) — Aims to promote regional cooperation in South Asia in the field of environment, both natural and human, in the context of sustainable development and on issues of economic and social development that also impinge on the environment and vice versa; to support conservation and management of natural resources of the region and to work closely with all national, regional, and international institutions, governmental and non-governmental, as well as experts and groups engaged in such cooperation and conservation efforts. **http://www.sacep.org/**

South Asia Coral Reef Task Force (SACRTF) — Established in 2007 to actively participate in, and support, the effective implementation of existing national regulations, action plans and strategies for the management of coral reefs and associated ecosystems; and to promote the development of strategic linkages for enhanced regional cooperation, and the establishment of an effective, networked system of marine and coastal protected areas in the South Asian region.

Mangroves for the Future (MFF) — A partner-led initiative to promote investment in coastal ecosystem conservation for sustainable development. It provides a collaborative platform among the many different agencies, sectors and countries who are addressing challenges to coastal ecosystem management and livelihood issues, to work towards a common goal. **http://www.mangrovesforthefuture.org/**

Locally Managed Marine Areas (LMMA) Network — A network of practitioners focusing on the management of LMMAs (which are defined as areas of nearshore waters actively being managed by local communities or resource-owning groups, or being collaboratively managed by resident communities with local government and/or partner organisations). The network does not include sites in South Asia yet, but is active in Southeast Asia, Melanesia, Micronesia, Polynesia and the Americas. **http://www.lmmanetwork.org/**

Other useful conventions and programmes

- **Convention on International Trade in Endangered Species of Wild Fauna and Flora** (CITES). **www.cites.org**
- **Convention on the Conservation of Migratory Species of Wild Animals** (CMS or Bonn Convention) Includes Indian Ocean marine turtle conservation agreement. **www.cms.int**
- **FAO International Plan of Action** (IPOA) for Sharks and IPOA for Seabirds. **www.fao.org**
- **Global Programme of Action for the Protection of the Marine Environment from Land-based Activities** (GPA). **www.gpa.unep.org**
- **International Convention for the Control and Management of Ship Ballast Water and Sediments. http://globallast.imo.org**
- **UN Framework Convention on Climate Change** (UNFCC) - aims to reduce emissions of greenhouse gases. **http://unfccc.int**
- **Small Island Developing States** (SIDS). **www.sidsnet.org**
- **International Convention for the Regulation of Whaling. http://www.iwcoffice.org/commission/convention.htm**
- **Asian Important Bird Areas** (IBA). **http://www.birdlife.org/action/science/sites/asian_ibas/**
- **Large Marine Ecosystems** (LME). **http://www.lme.noaa.gov/Portal/**
- **Global Coral Reef Monitoring Network** (GCRMN). **http://www.gcrmn.org/**

The Internet is a valuable resource with a wealth of information for MCPA managers, and there is an abundance of coastal and marine related sites developed by a range of different individuals or organisations including governments, companies and NGOs. The information is made available on 'web pages', which are located at a specific address called a 'website'. **Websites** are viewed by a computer programme called a 'browser', of which of two popular ones are Internet Explorer and Mozilla Firefox. Exploring the web is called 'web-surfing' or 'surfing'. Every website has a unique address, known as an **URL**. The address generally starts with **www** and ends with certain letter combinations. Domains can be registered (owned) by governments, organisations or individuals. Normally, the letter combinations **.com** and **.biz** are used by companies and individuals, with **.org** and **.net** used by non-governmental and international organisations, and **.ac** and **.edu** by academic and educational institutions (in countries other than the USA .edu is usually followed by the country suffix – see below). National governments, government agencies and ministries usually use **.gov.** Sometimes an address ends with a suffix denoting its country such as **.bd** (Bangladesh), **.lk** (Sri Lanka), **.mv** (Maldives), **.in** (India) or **.pk** (Pakistan).

GENERAL PROCEDURE FOR FINDING INFORMATION

The Internet is a mine of information, but often the information being sought is hidden amongst thousands of irrelevant websites. To visit a known website, open the web browser, connect to the Internet, and type in the website address. It is very important to use precisely the correct spelling, including full stops (i.e. dots) and any underscores, forward slashes etc. Any typing error will prevent the web browser from locating the website. Where **http://** is written in front of **www** in a website address, it signifies the protocol or language used by computers. Frequently-used website addresses can be stored in the browser memory, typically under the heading 'Favourites'. This means that the address does not need be typed in each time a user wishes to access the website.

Internet users searching for sites for which no details are known, should use 'Search Engines' and 'Directories'. Web directories are organised website listings put together by human reviewers. By comparison, a search engine indexes websites and allows users to search its database for sites on particular subjects. Hundreds of search engines are available on the Internet, in many languages. However no single search engine has a complete index of all existing websites. Some of the main English language search engines are Google (**www.google.com**), and AltaVista (**www.altavista.com**). Directories such as MSN (**www.msn.com**) and Yahoo (**www.yahoo.com**) list sites organised by subject. If you are looking for information on a specific subject, Google Scholar (**www.scholar.google.com**) provides a search of scholarly literature across many disciplines and sources, including theses, books, abstracts and articles and is a useful resource.

The site **http://directory.google.com** may also prove useful, being a 'search engine of search engines', comprising a database of hundreds of search engines, covering a wide range of topics in different languages. For example, a typical subject-specific search engine, held in this database and of use to MPAs is **www.globalislands.net.** Within the Toolkit, there are some website addresses that appear very long and complicated, such as: **http://www.icsf.net/icsf2006/jspFiles/mpa/casestudies.jsp.** These are short cuts that direct the browser to a specific page of the website producing the information, in this case, International Collective in Support of Fish Workers (www.icsf.net). The specific location of a page on a website changes frequently unfortunately. Thus, if a website address does not work, users should try accessing the main organisation, and searching through their index and contents to find the right page. When searching for a specific item such as a publication or report, many websites have their own search programmes that reduce search time.

It should be remembered that the Internet is largely an unmonitored resource with no strict quality control. This means that anyone can upload information without verification or peer review. It is important to recognise this and realise that not all sources can be trusted for their accuracy. Always review the origin of the information source before utilising or incorporating information (e.g. using information for management actions, or for education/awareness raising purposes). Always double check information obtained from independent websites with reputable sources (e.g. academic institutions, established organisations, or peer reviewed journals).

USEFUL TIPS

Surfing the Internet for information can be very time consuming especially when connection speeds are slow, as is often the case in the more remote parts of the South Asia region. The following are some tips to help speed up information retrieval:

- Use the correct spelling. Some search engines like Google will deduce a spelling mistake and suggest alternative words, others will not.
- Be specific and group key words. Typing 'marine protected areas' rather than 'protected areas' will result in a much smaller and more relevant set of websites.
- Use quotation marks around a group of words to search for the group in that particular order.
- Use more than one group of words, in separate quotation marks. This makes the search even more specific, e.g. 'marine protected areas' and 'eco-tourism'.
- Use capital letters for names and proper nouns, e.g. 'Reunion' will access information on the country, whereas 'reunion' will also include meetings of old friends and colleagues!
- If searching for a specific website, type the name but omit the 'www' and '.com', which are not regarded as search engine terminology.
- Try out the advanced features of the search engine.
- Advanced search filter options, such language, text, video or images can again reduce the unwanted material.
- Try out features of the Internet browser, such as the 'Find on Page' command, to locate the specific reference to the content being searched for. This feature can help determine quickly if a website is useful or not and save a lot of time.

OTHER INFORMATION SOURCES

The Internet is increasingly becoming the one-stop-shop for information needs, but there is still a large volume of information that is not yet available on line. Even major journals and newsletters are only archived on the Internet from a certain year onwards, and older issues may only be available in printed format. Many of the smaller monographs or periodicals from specialised, local institutes may not be available online and these may contain information on local conditions and have historical records related to the site level that the MCPA manager is concerned with. For more specialised information needs, the MCPA manager should approach national academic centres, universities, research institutes and libraries for material that may not be available online.

Obtaining further information

This sheet shows how to obtain some of the more frequently cited publications, reports and other sources of information.

IUCN – International Union for Conservation of Nature
Most IUCN publications, including the IUCN/WCPA Best Practice Protected Area Guidelines Series and others specifically on MPAs are available from the IUCN Publications website (**http://cms.iucn.org/resources/publications/index.cfm**). Alternatively, regional publications may be obtained by contacting the regional/country offices as well as the global offices:

IUCN Global Marine Programme, Rue Mauverney 28, CH-1196 Gland, Switzerland. Tel: + 41 22 999 02 17, Fax: + 41 22 999 00 25

IUCN Asia Regional Office, 63, Sukhumvit, Soi 39, Prompong, Klongtan Nuae, Wattana Bangkok 10110, Thailand.
Tel: + 66 2 662 4062/64, Fax: + 66 2 662 4387, iucn@iucnt.org

IUCN Ecosystems and Livelihoods Group, Asia, 4/1 Adams Avenue, Colombo 3, Sri Lanka. Tel: + 94 11 2559634/5, Fax: + 94 11 2559637

IUCN Bangladesh Country Office, House 11, Road 138, Gulshan 1, Dhaka 1212, Bangladesh. Tel: + 880 2 9890395, Fax: + 880 2 9892854

IUCN India Country Office, 20 Anand Lok (2nd Floor), New Delhi 110049, India. Tel/Fax: + 91 11 26257742

IUCN Pakistan Country Office, 1, Bath Island Road, Karachi 75530, Pakistan. Tel: + 92 21 5861540/3, Fax: + 92 21 5861448, 5835760

IUCN Sri Lanka Country Office, 53, Horton Place, Colombo 7, Sri Lanka. Tel: + 94 011 2694094, 2682418, Fax: + 94 011 2682470

WWF – World Wide Fund for Nature
WWF publications and resources can be obtained by contacting the following offices:

WWF India, 172 -B Lodhi Estate, New Delhi 110 003, India.
Tel: +91 11 41504821.

WWF- Pakistan PO Box: 5180, Ferozepur Road Lahore 54600, Pakistan. Tel: + 92 042-111 993 725, Fax: + 92 42 5862358

WIOMSA – Western Indian Ocean Marine Science Association
The WIO Toolkit for MPA Managers, other publications and the Western Indian Ocean Journal of Marine Science, are available from: Western Indian Marine Science Association (WIOMSA), P .O. Box 3298, Zanzibar, Tanzania. Tel: + 255 24 2233427; Fax: + 255 24 2233582; Email: secretary@wiomsa.org.
Website: **www.wiomsa.org**

UNEP – United Nations Environment Programme
For information on UNEP publications contact http://www.unep.org/publications:

UNEP Regional Office for Asia and the Pacific (ROAP), 2nd Floor, United Nations Building, Rajdamnern Nok Avenue, Bangkok 10200, Thailand. Tel: + 662 288 1870/4 Fax: + 662 280 3829;
Email: **uneproap@un.org**

Publications specific to the Global Programme of Action: Contact Global Programme of Action for the Protection of the Marine Environment from Land-based Activities; Email: gpa@unep.nl
Website: www.gpa.unep.org

UNEP-World Conservation Monitoring Centre (WCMC) hosts the World Database on Protected Areas with key data on MPAs. UNEP WCMC, 219 Huntingdon Road, Cambridge CB3 0DL, United Kingdom. Tel: + 44 1223 277314; Fax: +44 1223 277136;
Email: **info@unep-wcmc.org** Website: **www.unep-wcmc.org**

UNDP – United Nations Development Programme
The website of the United Nations Development Programme (UNDP) has a number of useful materials on project management, monitoring and evaluation, and GEF projects: www.undp.org (use the website's 'search' tool).

TRAFFIC
The TRAFFIC network produces publications relating to trade in wildlife, available from: TRAFFIC International, 219c Huntingdon Road, Cambridge, CB3 ODL, UK. Tel: + 44 (0) 1223 277427 Fax: + 44 (0) 1223 277237; Email: **traffic@traffic.org**

TRAFFIC South Asia - India, c/o WWF India Secretariat, 172-B, Lodi Estate, New Delhi 110003, India, Tel: + 91 11 41504786; Fax: + 91 11 43516200; E-mail: **trafficind@wwfindia.net**

TNC – The Nature Conservancy
Produces several publications on protected areas, particularly on topics related to sustainable financing:
The Nature Conservancy, Worldwide Office, 4245 North Fairfax Drive, Arlington, VA 22203-1606, USA. Tel: + 1 (703) 841-5300;
Website: **www.nature.org**

FAO – Food and Agriculture Organisation
Many member countries have sales agents for FAO – check the website www.fao.org. FAO's series of Technical Publications on fisheries issues and catalogue is available from: FAO Fisheries library, Viale delle Terme di Caracalla, 00100 Rome, Italy.
Tel: + 39 06 57052174;I Fax: + 39 06 57052476;
Email: **fi-library@fao.org** or **publications_sales@fao.org**

WorldFish Center
Produces a range of resources and materials on fishery-related issues, including the database Fishbase: The World Fish Center, PO Box 500, GPO, 10670 Penang, Malaysia (Street address: Jalan Batu Maung, 11960 Bayan Lepas, Penang, Malaysia). Tel: + 60 4 6261606; Fax: + 60 4 6265530; Website: **www.worldfishcenter.org**

WorldFish also hosts ReefBase, a global coral reef database.
Website: **www.reefbase.org**

WRI – World Resources Institute
Produces EarthTrends – the Environmental Information Portal (http://earthtrends.wri.org), which contains a variety of protected area information. Other WRI publications, such as Reefs at Risk available from:
World Resources Institute, 10G Street, NE, Suite 600, Washington, D.C., USA. Tel: + 1 202 7297600; Fax: + 1 202 7297610

AIMS – Australian Institute of Marine Science
Produces many reports and guides related to the monitoring and management of tropical marine ecosystems. Australian Institute of Marine Sciences, PMB No 3, Townsville Mail Centre, Townsville, Q 4810, Australia. Website: **www.aims.gov.au**

CRC Reef Research Centre for the Great Barrier Reef World Heritage Area
This research centre produces many technical reports and information sheets that can be ordered or viewed via their website. CRC Reef Research Centre, James Cook University, Townsville 4811, Australia. Website: www.reef.crc.org.au

IUCN WCPA – World Commission on Protected Areas
The WCPA is the world's premier network of protected area expertise. WCPA works by helping governments and others plan protected areas and integrate them into all sectors; by providing strategic advice to policy makers; by strengthening capacity and investment in protected areas; and by convening the diverse constituency of protected area stakeholders to address challenging issues. **http://www.iucn.org/about/union/commissions/wcpa/index.cfm**

Coral-List – NOAA's Coral Health and Monitoring Program listserver provides a forum for discussions and announcements by coral reef researchers interested in reef health and conservation. Subscription details on the website: **http://coral.aoml.noaa.gov/mailman/listinfo/coral-list**

GBRMPA – Great Barrier Reef Marine Park Authority
The GBRMPA manages the Great Barrier Reef in Australia, the largest coral reef MPA in the world. It produces a wide range of technical and educational materials which can be viewed via their website or obtained in hard copy. Great Barrier Reef Marine Park Authority, 2-68 Flinders Street, PO Box 1379, Townsville, Queensland 4810, Australia. Tel: + 61 7 4750 0700. Website: **www.gbrmpa.gov.au**

Coastal Resources Center, University of Rhode Island
Produces many publications and other resources on coastal management: Coastal Resources Center, University of Rhode Island, Narragansett, RI 02882, USA. Tel: + 1 401 8746224,
Fax: + 1 401 7894670, Email: **info@crc.uri.edu**
Website: **www.crc.uri.edu**

MPA News (Newsletters, general references and other useful sources) – published monthly through the School of Marine Affairs, University of Washington, Seattle. Subscriptions are free and issues can be received electronically or in paper form. To subscribe, send an email to **panews@u.washington.edu.**
The website **www.mpanews.org** allows automated searches by keyword through back issues of the newsletter.

Marine Protected Areas of the United States –
A comprehensive resource centre for MPA information, MPA network development, management effectiveness etc., including information on education and training. Website: **www.mpa.gov**

Protected Areas Learning Network (PALNet) – a web-based interactive service, backed by IUCN and WCPA scientists and practitioners, and partner individuals and organisations, which aims to help protected area managers to access and generate new knowledge and raise their professional capacity by sharing and exchanging field based experience and rapidly developing science. **http://www.parksnet.org**

National Oceanic and Atmospheric Administration – Explore the NOAA website, using the search function, for MPA associated publications, websites and activities supported by the NOAA programme. Website: **www.noaa.gov**

UN Atlas of the Oceans – an Internet portal that provides an information system for use by policy makers, scientists and resource managers, covering a wide range of coastal and marine management topics. Website: **www.oceansatlas.com**

UNESCO OceanPortal – a web-based directory of ocean data and information related web sites, aimed at helping scientists and other marine experts locate information. Website: **http://ioc.unesco.org/oceanportal/**

Global Islands Network – the website for this non-profit organisation, aimed at helping with sustainable development in island nations, has a range of useful publications and resources. Website: **www.globalislands.net**

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BACKGROUND TO THE PRODUCTION

Managing Marine Protected Areas: A Toolkit for the Western Indian Ocean (WIO Toolkit) was commissioned by IUCN-EARO in August 2003. It was published in English in 2004 by IUCN, in collaboration with the Western Indian Ocean Marine Science Association (WIOMSA), United Nations Environment Programme (UNEP), World Wildlife Fund for Nature (WWF), and the Coastal Zone Management Centre (CZMC). The WIO Toolkit received wide acclaim, and was identified as a potential model for replication in other regions.

Following consultations in the South Asian region it was determined that the adaptation of the WIO Toolkit for the South Asia context would respond to regional needs, bringing together simple, easy to read information on a wide range of themes related to Marine and Coastal Protected Area (MCPA) management, and forming a key resource for promoting continuity in management capacity at existing MCPA sites across the region.

The adaptation of theme sheets for the South Asia context was coordinated by Gaya Sriskanthan (IUCN ELG), and Nicola Barnard (ICRAN). IUCN ELG facilitated the comprehensive review process and all editing and publishing. The format and content of the toolkit was maintained in line with the WIO Toolkit and the advice of the original authors and editorial team (Sue Wells, Matt Richmond, Peter Llewellyn (Samaki Consultants), Heidi Savelli Söderberg, Julie Church (IUCN), Julius Francis (WIOMSA), Domingos Gove (CDS-ZC, MICOA), Nyawira Muthiga (WCS), Magnus Ngoile (NEMC), Amani Ngusaru (WWF), Remi Ratsimbazafy (WWF), Melita Samoilys (IUCN), Dixon Waruinge (UNEP)). The technical reviewers for the South Asia Toolkit are listed below.

CARTOONS, GRAPHICS & PHOTOGRAPHS

The design of the South Asia Toolkit, maintained in line with the WIO Toolkit (produced by Matt Richmond & Sarah Markes), was coordinated and updated by Gaya Sriskanthan and Shehani Peris (IUCN ELG). Adam Lutta is thanked for his dedication and excellent cartoons. The SEA Trust is thanked for allowing the use of the marine biodiversity pie-chart (sheet H5) and FAD illustration (sheet I4), and Jared Crawford is acknowledged for the idea behind the cartoon used on the MCPA goals and objectives (sheet A2). The photos used in this Toolkit were provided freely by numerous individuals, with names indicated by each picture. All photographers are thanked for allowing their use. National and regional maps of MCPAs in South Asia were provided by the UNEP – World Conservation Monitoring Centre (WCMC) and draw on the World Database of Protected Areas (WDPA), MPA Global Database, and the efforts of UNEP-WCMC, IUCN, and Mangroves for the Future in the region to collate and validate this data. Thanks to Shehani Peris (IUCN ELG) for carrying out exhaustive searches of available databases and to the participants of the Toolkit training workshop in Maldives, July 2008 for their feedback on the national MCPA lists.

CONTRIBUTORS & REVIEWERS

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Anas Masoud WWF (Menai Bay project), Tanzania – rev. F7.

Thabit Masoud Care International, Tanzania – rev. B4.

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Types and categories of MCPAs A1

There are many 'types' of MCPAs (e.g. community, multiple use, World Heritage Sites and Biosphere Reserves), managed for different purposes and in diverse ways. This sheet provides a basic understanding of these and describes the IUCN system of categorising protected areas according to their objectives.

Terminology does not directly affect the day-to-day management of a Protected Area (PA) but it is important to note that countries and organisations use terms in different ways. IUCN and other international organisations have developed internationally recognised definitions and classification systems to help in communicating and sharing information.

PROTECTED AREA DEFINITIONS

IUCN defines a PA as: *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.*

This definition is used to select sites for the UN List of PAs, numbering over 100,000 PAs. This is a subset of the larger World Database on Protected Areas (WDPA), managed by UNEP-WCMC.

A Marine Protected Area (MPA) is defined more specifically by IUCN as: *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.* Other definitions can be found in the literature, but the IUCN one tends to be the most widely accepted.

The Ad Hoc Technical Expert Group (AHTEG) of the Convention on Biodiversity (CBD) defines Marine and Coastal Protected Areas (MCPA) 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.*

The phrases applied to both MCPAs and MPAs 'reserved by legislation/ law or other effective means' mean that areas set up under traditional law or through voluntary agreements can be termed MCPAs.

Note that MCPAs in one country may have different objectives and be managed differently from those with the same name in another. Sometimes sites that are not perceived as meeting IUCN's definition of a PA (e.g. are not nationally or internationally recognised as official PAs) are considered by the stakeholders themselves as PAs. These include some fisheries management areas (e.g. Fish Sanctuaries used in Bangladesh, established under the Bangladesh Fish Act, 1950 for seasonal protection of fishes and their habitats) where regulation of exploitation is the primary objective, and some areas under integrated coastal management programmes that may be very similar to multiple-use PAs. This does not affect the management of an area, but PA practitioners should be aware of it.

IUCN PROTECTED AREA CATEGORIES

In 1994 IUCN published a system to categorise PAs based specifically on management objectives with the aim of providing:

- A tool for promoting the development of a representative system of PAs;
- A framework for collecting data;
- International standards for comparison across countries; and
- A means of promoting international understanding (a 'common language').

The IUCN system comprises six categories, all of which have equal importance (see table below). Categories Ia-III cover the stricter forms of PA. Categories IV and V are for PAs where cultural values and sustainable resource use are important additional management objectives. Category VI allows for many uses, although two thirds of the area should remain in its natural state. Countries are responsible for assigning categories for their PAs, using the IUCN guidelines. These categories are not legally binding and only serve as management guidelines. However, some countries have incorporated the categories into their national legislation (e.g. Australia, Afghanistan), making them legally binding at the national level.

MCPAs can be difficult to categorise. They may be administered by a different agency from terrestrial PAs, which may not be familiar with IUCN procedures (for example, if it is a Fisheries Department). Furthermore, MCPAs do not always appear to fit comfortably into the existing categories system, particularly multiple use MCPAs and no-take areas. In some cases (e.g. Australian marine reserves) different categories are applied to different zones.

TRANSBOUNDARY MCPAS

IUCN defines a transboundary PA as one that *straddles one or more borders between states, sub-national units such as provinces and regions, autonomous areas and/or areas beyond the limit of national sovereignty or jurisdiction.* Thus transboundary MCPAs essentially

IUCN categories (I-VI) with South Asian examples (where they exist).
Ia. Area managed mainly for science, or as a Strict Nature Reserve (Yala Strict Nature Reserve – Sri Lanka).
Ib. Area managed mainly for wilderness protection.
II. Area managed mainly for ecosystem protection/recreation (Hingol National Park – Pakistan).
III. Area managed mainly for conservation of specific natural features; often called a National Monument.
IV. Area managed mainly for conservation through management intervention, e.g. habitat management areas (Sundarbans East, South and West Sanctuaries - Bangladesh).
V. Area managed mainly for land/seascape conservation and recreation (Himchari National Park – Bangladesh).
VI. Area managed mainly for sustainable use of natural ecosystems, e.g. multiple-use PA.

adjoin each other across an international boundary, although the part on each side of the boundary is generally set up and managed nationally. A formal agreement is usually drawn up between the countries involved, and a coordinating mechanism established (e.g. a unit or commission). Mechanisms for joint enforcement activities, research and monitoring, and other management issues will then be established. There are not many transboundary MCPAs in South Asia. The Sundarbans (shared between Bangladesh and India) and the Runn of Kutch-Kachch Desert (shared between Indian and Pakistan) are two of the few examples. There is currently little active cooperative management of transboundary MCPAs in the South Asia region. However, some small scale activities have been carried out, such as a joint tiger census for the Sundarbans between Bangladesh and India.

INTERNATIONAL DESIGNATIONS

Some MCPAs have, in addition to their national designation, international status as a PA. This is binding if the designation is made through an international agreement that the country has acceded to or ratified. This provides international recognition of the MCPA, which may help when fund-raising and seeking other forms of assistance. In some cases, designation may open up opportunities for direct financial aid. World Heritage (WH) Sites are established under the World Heritage Convention (http://whc.unesco.org), which was drawn up to conserve the world's cultural and natural heritage. Countries must be a party to the Convention, which is a binding treaty, if they wish to nominate a site, and the site must already have some form of legal protection. The nomination procedure involves preparation of a detailed document explaining how the site meets the criteria laid out in the Convention, and notably its 'Outstanding Universal Value'. Following nomination the PA is subject to a rigorous review procedure. At present there are only two natural coastal WH sites in South Asia, the Sundarban Wildlife Sanctuaries of Bangladesh, and the Sundarbans National Park of India. The Andaman and Nicobar Islands of India, Trincomalee Bay and Pigeon Islands of Sri Lanka, and the atoll systems of Maldives have been identified as potential marine WH sites.

Ramsar Sites are established under the Ramsar Convention on Wetlands (www.ramsar.org), a binding treaty, which defines a wetland to include "areas of marine water the depth of which at low tide does not exceed 6m". Ramsar Sites do not require formal legal protection as the focus is on 'wise use', and so they are often not part of a national PA system, however some Ramsar sites are also PAs. There are number of coastal and marine Ramsar sites in South Asia, including the Sundarbans (Bangladesh only), Bhitarkanika Mangroves (India), Jiwani (Pakistan), and Bundala, Maduganga and Anawilundawa (Sri Lanka).

Biosphere Reserves are established under UNESCO's Man and the Biosphere (MAB) Programme, which is a non-binding programme. They make up a network of PAs with a key aim of reconciling conservation and sustainable use with socio-economic development and maintenance of cultural values. They usually have to have a national designation. Biosphere reserves in the South Asia with marine and coastal components include the Gulf of Mannar Biosphere Reserve (India), the Sundarbans (India only) and Bundala Biosphere Reserve (Sri Lanka). Details at www.unesco.org/mab.

Thus, there is currently no mechanism for managing PAs beyond national jurisdiction. There is a global recognition for the protection of species and habitats on the high seas, which by definition do not fall under national, territorial jurisdictions. However, al though there is much support for the concept of high seas PA, there is currently no global, legal framework defining mechanisms for the creation and protection of such PAs, nor defining where international responsibilities would lie.

NATIONAL DESIGNATIONS

In addition to the internationally endorsed PA categories, many countries have their own national designations for the management of areas that are recognised under national policies or legislation. For example, the Bangladesh Environment Conservation Act (BECA), 1995 has provisions for Ecologically Critical Area (ECA) declarations in certain cases where an ecosystem is considered to be threatened and in a critical state (e.g. St Martin's Island). In Sri Lanka there are provisions under the national Coastal Zone Management Plan for Special Area Management (SAM), which support the participatory management of ecologically, socially and economically important coastal areas. These national level designations may actually overlap or complement internationally recognised PAs. In the case of the SAM site in Hikkaduwa, Sri Lanka, the area under management encompasses Hikkaduwa National Park.

KEY POINTS FOR THE MCPA

- **MCPA managers and other relevant staff should develop a general understanding of the IUCN category system and how their MCPA fits into this system.**
- **If the MCPA might be suitable for nomination for an international designation, communicate this to the relevant government agency.**
- **If the MCPA has international status, use this to raise funds, improve capacity, and manage the site more effectively.**

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MCPA goals and objectives

A2

The goals and objectives of an MCPA must be clearly understood if management is to be successful and achievements measured. This means that they should be defined and worded in such a way that they can be monitored. This sheet gives the general principles involved in developing goals and objectives.

Management of protected areas is increasingly being carried out in the style referred to as 'management by objectives'. This means that it is proactive, i.e. designed to achieve a specific aim and set of results, rather than reactive, or simply responding to issues that arise. This management style requires that MCPA managers and personnel look critically at the goals and objectives of the MCPA (which are often very general), and develop a clear understanding of the values and importance of the site, and thus the reasons why it was protected. There are four important steps in 'management by objectives':

1. Establish clear, concise objectives;
2. Develop realistic plans for achieving these objectives (see sheet C3);
3. Monitor performance and achievement (see sheet G9);
4. Implement corrective (or adaptive) management.

Project logframes (see sheet C4) also use the terminology of goals and objectives. It is important not to confuse the MCPA's goals and objectives with those of specific projects that it is involved with, although they may coincide.

GOALS

Sometimes also called visions, aims or long-term objectives, these are general summaries of the desired future state of an MCPA. Goals should be:

- Visionary – a positive statement outlining the desired long-term state of the MCPA.
- Broad – a broad and general statement that captures the vision of the MCPA.
- Brief – short and succinct so that it can be remembered and easily communicated.

Achieving a broad consensus around the goals of an MCPA is critical, especially when MCPAs are in areas where the resources they aim to protect are widely used by local people and may make an important contribution to their livelihoods. The process of discussing and establishing agreed goals with different stakeholders may take time but will contribute significantly to the chances of successful management of an MCPA. IUCN/WCPA-Marine has compiled generic goals (Pomeroy *et al.*, 2004), based on a global survey of Marine Protected Areas: five for biodiversity (e.g. 'ecosystems and species protected'); one for socioeconomic issues (e.g. 'to provide enhanced benefits for the community'; and one for governance (e.g. effective conservation management structures and strategies maintained'). Particularly in South Asia, where many coastal resource users live in conditions of relative poverty, establishing goals that balance biodiversity, socioeconomic and governance concerns will be important.

An example of long-term objectives (which are referred to as 'Visions' and 'Missions' in this particular case) from Bundala National Park, Sri Lanka is given below:

Vision: To be conserved as an International Ramsar Wetland Site, with its unique ecosystem rich in biodiversity, especially providing refuge to threatened and migratory species through community participation.

Mission: An adaptive participatory management system is implemented at the Bundala National Park that conserves its biodiversity especially in reference to the wetland, while providing services to visitors and communities, conforming to conservation concepts, and information on the significance of wetland ecosystems.

OBJECTIVES

Sometimes called purposes, these are the specific statements that describe how the goal will be reached. They should relate to the key values of the MCPA (i.e. important species or ecosystems) or to major areas of management activity (e.g. tourism, education). The objectives help managers with planning, measuring progress and evaluating success, but this is difficult if they are poorly expressed or provide only vague guidance (e.g. they are sometimes worded more like goals). Two or more objectives are usually required to reach the goal, and should be:

- Specific and easily understood and agreed upon by all stakeholders;
- Written in terms of what will be accomplished, not how to go about it;
- Achievable, being quite clear when the objective has been reached;
- Achievable within a reasonable, defined time period. This should not usually exceed 10 years, although longer may be required for long-lived, slow reproducing species (e.g. turtles and dugongs), or the recovery of degraded habitats with slow recruitment (e.g. coral reefs);
- Measurable and able to be validated, thus making it easier to set up a monitoring programme;

- Realistic, practical and appropriate within the local context. For example, an objective to exclude resource use in an MCPA would be impractical if local communities depend on this area for food.

WCPA-Marine has compiled generic objectives to help MCPAs develop their own. These comprise:

26 Biophysical Objectives (e.g. Focal species abundance increased or maintained);

21 Socioeconomic Objectives (e.g. Enhanced benefits for the community provided);

21 Governance Objectives (e.g. Management planning and process effective).

Bundala National Park has five objectives, three covering biodiversity and natural values, one covering awareness raising, and one covering socioeconomic issues:

1. To restore and manage the Bundala wetland ecosystem;
2. To restore and manage the terrestrial ecosystems;
3. To effectively administer and protect the habitats and archaeological sites of the Bundala National Park;
4. To provide visitor services including dissemination of information on wetland ecosystems; and
5. To empower the local community to participate in and benefit from the conservation of Bundala National Park.

DEVELOPING GOALS AND OBJECTIVES

In order to ensure that a full understanding of the ecological and socioeconomic values of an MCPA is used in the development or revision of the goals and objectives, the process should be participatory and involve consultation with all stakeholder groups. Often particular effort will be required to ensure the participation of poorer and more marginalised stakeholders, but ensuring that they are engaged in the process is critical as they will often be among those who have most to 'lose' (in the short-term at least) from measures to protect marine resources (see sheet B5 and B6).

Many of the objectives of MCPAs in Asia are worded more as goals, and would benefit from being made more specific (the example of Komodo National Park with General Objectives and Detailed Management Objectives illustrates objectives that are based on a good understanding of the values of the protected area). The generic objectives developed for MCPAs by WCPA-Marine, and by Hockey & Branch (1997) for South African Marine Protected Areas may be helpful when revising or developing those for other MCPAs. However, it is essential that the process uses a careful analysis of the specific values and management issues at the site in question.

Sometimes, the need to make objectives 'measurable' leads to objectives being defined with quantitative targets, e.g. 'Over the next 3 years mean coral cover throughout the MCPA to increase by 5%' or 'Over the next three years, income from MCPA tourism to increase by 4% a year', or 'Average ecological knowledge of visitors to increase by 50% within 5 years'. This approach is not recommended as, even when it is based on good information, unforeseen events could make such objectives unrealistic and inappropriate (e.g. the first example may not be ecologically feasible or statistically measurable and the second example is vulnerable to changes in the global economic situation). Further, such specific parameters may be difficult to measure (e.g. in the third example, there effective techniques for quantifying 'ecological knowledge of visitors' but these can be time and resource consuming). Statements like this may be useful as targets to encourage good performance in an MCPA, but objectives are best left open-ended (e.g. 'Income from MCPA tourism to show a significant increase within 3 years').

The goals and objectives are generally laid out in the legislation or agreement used in setting up the MCPA (see sheet A4), and defined in more detail in the management plan (see sheet C3). They should be assessed at intervals (preferably when the management plan is reviewed) to see if they need revising or updating. If they have been formalised through legislation, this may not be immediately possible, but it may be useful to identify any weaknesses for future revision opportunities.

Once the objectives have been determined, the MCPA can be categorised according to the IUCN system (see sheet A1), and a monitoring and evaluation programme can be developed (see sheet G1), using indicators specifically selected for measuring the objectives.

KEY POINTS FOR THE MCPA

- **Ensure that MCPA personnel and stakeholders have a good understanding of the current goals and objectives of the MCPA.**
- **Ensure that monitoring programmes are in place or being developed to measure whether the MCPA's objectives are being met.**
- **Consider whether it would be appropriate to reword goals and objectives, e.g. for the next revision of the management plan and, if so, initiate a process to do this, bringing in external assistance if required.**
- **Be aware that significant revisions to goals and objectives may require corresponding revisions to the MCPA design and management.**

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Organisational structures A3

MCPAs are managed under a variety of arrangements, of which the three most common are centralised, community-based (or locally managed) and collaborative (or co-managed) management. The differences relate mainly to the degree of stakeholder participation in the process and the location of the management authority and responsibility, but can also relate to the main objectives of management. This sheet describes the range of structures involved, and provides advice on related issues such as advisory committees and co-management arrangements.

The management structure sets out the relationships between all the bodies and groups involved in the management of an MCPA. This is often illustrated in an organisational chart or organogram showing lines of authority and responsibility. Each of the bodies on the chart should have a person in charge and clearly defined functions and powers, usually described in terms of reference (TOR) for the body, or the job descriptions for the individuals involved.

MCPA MANAGEMENT AUTHORITIES

The organisational structure of an MCPA varies according to the national political, legislative, cultural and socioeconomic framework, but even within a country, MCPAs may have different arrangements. The government body responsible for MCPAs is sometimes the same agency as for terrestrial protected areas, but sometimes several agencies may be able to establish MCPAs. In India, for example, the Ministry of Forest and Wildlife is responsible for managing protected areas, although responsibility is delegated to state level institutions that are directly responsible for managing protected areas within state boundaries. In Sri Lanka, National Parks and Sanctuaries are the responsibility of the Department of Wildlife Conservation, but the Department of Fisheries and Aquatic Resources has established several Fishery Managed Areas that allow regulation of fishing effort, and a number of mangrove areas have been declared Conservation Forests by the Forest Department. However, if Fisheries Departments have no mandate to manage activities undertaken in the terrestrial areas where these impinge on the management of the MCPA, problems may arise. Equally, if the role of a Fisheries Department is primarily to improve fisheries production, there can be a conflict of interest if it is also responsible for marine biodiversity protection. To tackle this issue in Sri Lanka, the declaration of Fisheries Reserves under the Fisheries and Aquatic Resources Act, 1996 (under the authority of the Fisheries Ministry) must be carried out in consultation with the Minister in charge of the conservation of wildlife (under the authority of the Environment Ministry).

This will be an important issue for the MCPA management authority to address by developing effective coordination between government agencies. In large protected area management authorities, the various tasks and responsibilities may be delegated to different departments or divisions, and it will be important for the MCPA staff to fully understand the structure. The existence of a legally mandated MCPA decision-making and management body, responsible for implementing the management plan, will lead to more professional management of the MCPA. However, this should not imply that only state institutions can have the authority to manage MCPAs. Community management bodies can also be given the status and the mandate to manage MCPAs. If managing bodies have decision making powers this is more effective than if it has to respond to directives from some higher authority. Local governments may also sometimes be responsible for MCPA establishment, and their participation in the structure is, in any case, essential. They can often be more responsive to local needs and changing circumstances. However, since the national government usually has overall jurisdiction over marine waters, it generally has to be involved at some level.

DELEGATION OF MCPA MANAGEMENT

MCPAs are increasingly being set up with the management authority delegated to, or in the hands of, committees or management groups comprising government agencies and local stakeholders. In many countries outside South Asia, MCPA management is gradually being delegated to NGOs, local community groups or the private sector. This is beneficial where the government lacks capacity for protected area management or where land tenure is not in government hands.

Some MCPAs may be the responsibility primarily or entirely of local communities with no local or national government support. Such protected areas are, however, often difficult to maintain, although community-level local by-laws can partially help to provide legal backing. Some atolls in Maldives have traditional management systems that control access to resources and these have been incorporated into fisheries law to provide more legal backing. However, it is not always necessary to have official law to back up local traditions, and sometimes it can be counterproductive. In some cases, when restrictions are given formal status and enforced by the State, compliance can actually deteriorate because the community looses its stake and interest in supporting protection measures.

Although not the case in South Asia, in some other regions, the private sector is responsible for management. An example of such management from another region can be seen in Zanzibar, where the management of Chumbe Reef Sanctuary is delegated to a private company, Chumbe Island Coral Park Ltd. An agreement has been drawn up between the government and the company specifying the role of the company and a representative Advisory Committee has been established. Such delegated organisations are generally responsible for personnel, revenue collection, day-to-day management, environmental education and visitor management. Maldives has gone part way towards this, forging strong partnerships with the private sector through the declaration of resort islands under the Tourism Act, which has seen private companies shoulder some responsibility for sound environmental management. This model is valuable to nations with a large area, a comparatively low population and thus limited capacity in government, such as Maldives.

COMMITTEES AND BOARDS

Many or most MCPAs have a Board of Directors or Advisory Committee to assist with decision making, and this sometimes has executive powers. These bodies should represent key stakeholder groups, including local communities, scientists and academic institutions, the private sector and the various government agencies involved. Such boards and committees should be established as early on in the planning process as possible, and certainly at the

beginning of development of the management plan (see sheet C3). Members are usually appointed by the MCPA administration, the central or state government, or by a government authority such as a Minister, and their role, functions and procedures should be clearly defined in TORs or even in law. Depending on their legal or other structure, these bodies can have important roles in consultation, evaluation, reviewing progress and approving management plans, and authorising budgets and other specific expenditures. They should interact regularly, and it is often the responsibility of the MCPA authorities to organise and convene meetings. Many meetings and interactions demand participatory and conflict resolution skills since they may involve divergent parties and viewpoints (see sheets B1 and B2).

In South Asia, such boards or advisory groups have not been established for many MCPAs, but efforts are being made to address this. The Gulf of Mannar Biosphere Reserve Trust (GMBRT) is an example of an MCPA governed by an independent governmental statutory body whose role is to implement management activities and to play more than just an advisory role. On a different level, Community Coordination Committees have been established for the Hikkaduwa National Park and the Bar Reef Marine Sanctuary in Sri Lanka with a view to improving coordination and collaboration between government agencies and stakeholder groups in order to facilitate better management decision making.

Many MCPAs also have other committees for specific purposes. Village level advisory committees are very important in some MCPAs, where communities play an important role in decision-making. Where possible, it is advisable to use existing bodies of this kind, rather than establishing new committees that will take up time and may risk duplicating the activities of others.

ENFORCEMENT

The management structure may affect how enforcement and compliance activities are undertaken. Sometimes enforcement is carried out by MCPA personnel, but other government personnel with 'powers of arrest' may have to be co-opted to arrest offenders (see sheet G2). Links with the judiciary (e.g. police, magistrates), as well as government planning bodies and research institutes are important and should feature on the full organisational chart. Where appropriate, TOR should be drawn up describing their role in MCPA management and relationship to other stakeholders.

KEY POINTS FOR THE MCPA

- **Ensure that the appropriate authority is created for the management of the MCPA with the correct levels and breadth of membership.**
- **Be fully conversant with the organisational structure including policy and legal instruments.**
- **Interact regularly with all bodies and ensure that formal meetings are organised on a regular basis or as provided for in the MCPA statutes and legislation, and develop skills for effectively managing them.**
- **Ensure speedy follow-up on decisions made at such meetings, circulate minutes promptly and promote continuous dialogue on a day-to-day basis.**
- **Build networks with other relevant agencies such as land use or physical planning.**
- **Address gaps in mechanisms for the implementation of MCPA regulations.**

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It is important that MCPA personnel understand the regulatory framework relevant to their work, including the laws and regulations specific to the MCPA, other national legislation relevant to its management, and the international law that provides the overall context. The general regulatory framework for an MCPA is therefore described in this sheet.

INTERNATIONAL LAW

The overall framework within which MCPAs are established and managed is provided by international law, in the form of multi-lateral treaties (see introductory sheet on conventions), including:

- United Nations Convention on the Law of the Sea, which gives coastal states jurisdiction over:
  - their inland waters and territorial seas (out to 12 nm from the coast); and
  - an Exclusive Economic Zone (EEZ) (200 nm or 370 km from the coast) provided they do not infringe the right of innocent passage by foreign ships.
- Convention on Biological Diversity, which requires that Parties establish protected areas.

It should be remembered that some MCPAs were developed before these international frameworks were put in place, particularly traditional, community based MCPAs. This is particularly the case for coastal wetlands that are Ramsar sites.

NATIONAL POLICY

It is important to understand the difference between legislation and policy. Policies are non-binding, guiding principles, usually for specific sectors (e.g. fisheries, forestry) that outline the government's intentions in relation to international obligations and national development. Legislation should then be drawn up to permit implementation of the policy. Many countries are revising their policies related to the environment and natural resources to reflect new thinking and the obligations of international agreements. It often takes considerable time to amend legislation, which means that national laws may lag behind the stated policy of the government. In many cases, laws and policies can be inconsistent with each other, even to the extent of the key objectives. In such instances, they should be examined and revised in line with conservation and livelihood objectives, and best practice in the field of MCPA management.

NATIONAL REGULATORY FRAMEWORKS

National protected area legislation varies widely between countries according to the form of government, public administrative structures, extent of decentralisation, and lines of jurisdiction and decision-making. However, there are certain principles in common and most countries have a two-tier system, with primary and secondary measures.

Although MCPAs can be set up without a legal foundation, these may not be sustainable as there will be no basis for defending the existence of the MCPA against other interests and no basis for enforcement if a prohibited activity takes place. In some countries, MCPAs can be established under traditional or customary law (see sheet B4), but this is rare in South Asia. There are few examples for MCPAs, but many inland fisheries in Bangladesh, India and Sri Lanka are managed through community groups and fisheries cooperatives. Efforts are currently underway to experiment with community reserves and no- take areas in coastal and marine areas in the Lakshadweep Islands, India.

Legislation

Several different terms – e.g. Acts, Statutes, Laws, Ordinances – are used in South Asian countries to refer to the primary legal instruments governing a sector or issue that are adopted by the legislative branch of the government. The primary legislation for protected areas should prescribe the objectives and operational parameters for the national protected areas system, of which MCPAs are a part. It should establish the fundamental requirements for protected area planning, establishment, management and financing, including the categories and zones that may be used, requirements for involvement of stakeholders in protected area establishment and management and the types of restrictions that may apply, among other things. It should allow for additional measures to be introduced to deal with unforeseen circumstances and for the development of regulations that should specify management options including licences, concessions, user fees, duties of MCPA staff and responsibilities of communities. Legislation can be used to define the boundaries and the specific activities allowed and prohibited within the MCPA in general, or within different zones. It can also be used to delegate management to a government, authority, or to communities, e.g. under co-management arrangements.

Sometimes, terrestrial and marine protected areas are established under the same primary legislation (e.g. India under the Wildlife Protection Act, Sri Lanka under the Fauna and Flora Protection Ordinance, and Bangladesh under the Wildlife (Preservation) (Amendment) Act). The advantage of this is that it recognises that many protected areas include both terrestrial and marine ecosystems,

and that there are basic similarities between both types. However, such legislation is often oriented more towards terrestrial protected areas and does not fully address MCPA needs. There may be several pieces of primary legislation allowing for MPCA declaration. For example, MCPAs and particularly no-take zones can often be declared under fisheries legislation.

There may be benefits in introducing and implementing MCPAs under several pieces of primary legislation that go beyond wildlife protection. In India, for example, spatial and temporal restrictions in the marine environment are better accepted under official and traditional fisheries regulations. However, the same concept when introduced by a Forest Department (which is in charge of implementing wildlife legislation) is met with a great deal of resistance and mistrust.

In several countries, the term 'Marine Protected Area' or 'Marine and Coastal Protected Area' is not used in the text of the legislation. While this is per se not problematic as far as management is concerned, it does have an impact on the overall allocation of funding for MCPAs and also clouds the general understanding of each country's efforts in establishing and protecting these areas. If the term "MCPA" is not defined in primary legislation, the creation of MCPAs should at least be explicitly provided for in national policy and legislation. If primary legislation does not specifically define MCPAs, it should at least provide a definition of "protected area" that includes MCPAs (see section on protected area categories in sheet A1).

In federal systems such as India and Pakistan, States can enact laws that operate as primary legislation, even though they are ultimately subordinate to federal legislation. In centrally-governed systems such as Bangladesh, Sri Lanka and Maldives, all primary legislation is enacted at the central level. What most countries in South Asia have done for protected areas is to enact enabling primary legislation that establishes the parameters within which certain activities are then further regulated through implementing rules and regulations.

Implementing rules and regulations

This refers to the rules and regulations that are developed under the primary legislation and that provide the detailed provisions required for full implementation and enforcement. Different countries use different terms – "rules", "regulations", "notifications", and "decrees", among others – for these regulatory instruments that are usually issued by ministries or other authorities in the executive branch of the government to implement legislation. Regulations may address how the MCPA affects:

- Activities for which there may be pre-existing permits, e.g. navigation, fishing and mangrove harvesting;
- Pre-existing activities for which no permit is required, e.g. use of the beach;
- Private rights, e.g. ownership of the foreshore or private/ communal fisheries.

An example of implementing rules and regulations and their relationship to supporting legislation can be seen in the case of Rekawa lagoon in Sri Lanka. The area of the lagoon and its periphery was gazetted as a Fishery Management Area in 1998 under Section 32 of the Fisheries and Aquatic Resources Act No.2 of 1996. Under the same Act, fishery management regulations for the lagoon were passed in 1999 for the sustainable utilisation of the lagoon's resources.

The territorial sea-bed is usually state property, but depending on each country's national legislation the foreshore between high and low water marks and the adjacent coastal land can be privately owned, which can create difficulties for MCPAs. For example, marine based MCPAs may have no control over turtle nesting areas above the high water mark. There may also be private or customary and traditional fishing rights in inshore waters. Careful consultation is thus required before regulations are introduced (see sheets B1 and B2). If the MCPA belongs to the government, any private rights are usually acquired or extinguished before the MCPA is created. Private rights could be an issue in community managed MCPAs or MCPAs that are created without legal support.

In certain circumstances, such as in India and Sri Lanka, the legislation – in this case the Indian Wild Life Protection Act (India), and the schedules of the Fauna and Flora Protection Ordinance (Sri Lanka) – also contains a list of 'scheduled' species which are protected under law. In this manner, the animal is afforded protection outside of MCPAs. This is vital for the protection of migratory species such as sea turtles and dolphins.

OTHER LEGISLATION RELEVANT TO MCPAs

Depending on the level of decentralisation in a country, legislation can often be passed at the local level (e.g. district or village by-laws), and it may be possible to establish MCPAs in this way. However, where local government agencies do not have jurisdiction seaward of the low water mark, locally managed MCPAs will need central or state government support if legal backing is required.

Many other pieces of national legislation are relevant to an MCPA and essential for its effective management (e.g. for fisheries, forestry and mangroves, shipping, waste disposal, mining, tourism, wildlife and EIA). Managing an MCPA can be difficult if the mandates of these government agencies take precedence over the mandate of the authority managing the MCPA. Unless the primary legislation resolves this, such conflicts can undermine the effectiveness of the MCPA.

Enforcement includes all of the options available to implement a law and its regulations, including fines and confiscation. In certain cases, the penalties and prosecution options may be more stringent and more effective in legislation other than the law governing the MCPA, e.g. customs laws. Options can then be made available to empower officers under those laws to implement the MCPA related laws too. Such an option exists within the Indian Wildlife Protection Act, 1972. Harmonisation of MCPA legislation with fisheries legislation and implementing regulations is particularly essential. An MCPA manager must also have a good understanding of national legislation related to employment (MCPA personnel), the judiciary (court procedures), and financial activities (management of the MCPA's finances and fundraising). Managers should be familiar with the powers of arrest, which are normally specified in the law that governs the MCPA. These laws should specify which authority exercises police powers in the MCPA, while associated regulations may go into more detail about how that power can be exercised. In many cases, violations of laws and regulations governing MCPAs are subject to administrative penalties and are not prosecuted in the courts.

KEY POINTS FOR THE MCPA

- MCPA staff should understand all relevant legislation; copies should be readily accessible and the regulatory framework should be described in the management plan.
- In the case of newly formed MCPAs, officials in charge should pay special attention to clauses that relate to the rights of local communities and the settlement of claims and necessary procedures for participation of all stakeholders. This will reduce chances of conflict in future.
- MCPA staff should help stakeholders and visitors to understand both the primary legislation and the regulations, and widely disseminate information about it interpreted in simple language, (e.g. in posters or leaflets). A good understanding of the laws and regulations will help to reduce violations, facilitate better participation and create more trust between the implementing agency and local communities.
- The authority with overall responsibility for protected areas should assess the adequacy of the regulatory framework and identify improvements that are needed. There is usually a delay between enacting the legislation and issuing implementing regulations, which can make enforcement difficult. If regulations are lacking, MCPA staff should work with the management agency to help accelerate the process.
- The authority responsible for the MCPA should ensure that key personnel learn about the most relevant international agreements, so that they understand the role of the MCPA in helping the country meet its international obligations.

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CASE STUDY

Legislation for MCPAs and Fisheries Management in Maldives

In Maldives, biodiversity management of marine and coastal resources falls under the auspices of two major legal instruments: (1) the Fisheries Law and (2) the Environment Protection and Preservation Act (EPPA). The Ministry of Fisheries and Agriculture is legally responsible for the management of all issues and activities related to marine living resources in Maldives. The Fisheries Law of Maldives governs the management of all fisheries activities in Maldives, while Fisheries Regulations drawn under the Fisheries Law give details and updates related to fisheries regulations in the form of notifications and written regulations. Certain types of fishing have been prohibited through such regulations. Under the Fisheries Law special areas or species can be protected from exploitation or export if the need arises. The Fisheries Law has also incorporated traditional resource management systems practiced in some atolls in Maldives and recognises the traditional rights of communities to regulate and restrict access to reefs.

The EPPA was created in 1993. This Act recognises natural resources as a part of the country's national heritage that need to be protected and preserved, and provides guidelines and a mandate for natural resource management and the establishment of marine protected areas and nature reserves. Since the mid-1990s, 30 sites have been declared Protected Areas under the jurisdiction of the Ministry of Environment under the EPPA. Due to the difficulty of effectively managing reef fisheries, the Ministry of Fisheries and Agriculture has recently proposed the declaration of two large areas as strict reserves, mainly to assist recruitment of the fisheries. In addition, a number of islands of ecological significance, for example, as seabird roosting and nesting sites, are under active consideration for protection.

This case study is illustrative of a common scenario in South Asia, whereby fisheries management legislation, which is quite separate from environmental or explicit MCPA legislation, can also serve a similar function in supporting MCPA-like management. Although the EPPA is the main, explicit instrument for supporting the creation of protected areas, the Fisheries Law can also be seen to serve a similar function, in enabling the creation of strict reserves, albeit for different institutional motives (e.g. fisheries management in contrast to the protection and preservation of the country's natural heritage). MCPA managers should be aware of the interaction of different legal mechanisms, originating from different departments or ministries, as they may have equal significance in the management of MCPAs.

Integrated coastal management A5

Integrated coastal management (ICM) is a framework for coastal ecosystem management and has been adopted in many countries worldwide. This sheet explains how MCPAs are more effective as part of an ICM framework and why ICM programmes should include MCPAs.

All MCPAs are affected by activities taking place outside their boundaries, including industry, agriculture and forestry, aquaculture, urban and port development and other forms of construction, and shipping. These activities may have as great an impact on the MCPA as those taking place within its boundaries. The tight connections between MCPAs and adjacent land and water, through currents, migratory species, larval dispersal, nutrient exchange and other processes, require that MCPAs are incorporated within an overall coastal management regime for the country. The recommended global approach to MCPAs, promoted by the Convention on Biological Diversity, is a framework comprising three management levels, of which the third specifies ICM, as follows:

- A core network of fully protected MCPAs or no-take zones (see sheet I1) protecting critical biodiversity areas;
- A larger network of multiple-use MCPAs maintaining vital ecosystem functions and processes;
- An overall national MCPA system embedded within a national ICM programme.

ICM and MCPAs are sometimes perceived incorrectly as alternative approaches, but both are essential for effective management of the oceans. ICM can also be referred to as Integrated Coastal Zone Management (ICZM), Coastal Zone Management (CZM), Integrated Coastal Area Management (ICAM), and even Integrated Coastal Area and River-Basin Management (ICARM). Anyone of these terms relates to management approaches that are based on the same principles as ICM, and they can be used interchangeably. ICM is essentially a form of land use planning targeted at coastal areas, which provides the framework for management of the coastal and marine environment, with MCPAs as the key component for protecting biodiversity and maintaining ecological processes. ICM focuses primarily on managing coastal development, while MCPAs focus on biodiversity conservation issues. Integrated coastal management practice is currently being developed throughout the South Asia region. In most countries, the development of legislation requiring coastal States to prepare coastal management plans is relatively recent. In others, such as Sri Lanka, coastal management has been a concern since 1963. Sri Lanka and Bangladesh now have proposals for national level programmes including draft legislation that supports ICM. Local level ICM activities are underway in many Asian countries, such as Bali, Indonesia; Chonburi, Thailand; Danang, Vietnam; Sihanoukville, Cambodia; in addition there are numerous district level ICM initiatives throughout South Asia. Many address the need to incorporate MCPAs into general management of the coastal zone. Global guidelines on integrating MCPAs and ICM are also in preparation.

THE ROLE OF ICM

ICM can be defined as the process by which multiple use of the coastal and marine environment is managed so that a wide range of needs are catered for, including both biodiversity protection and sustainable use, allowing all stakeholders (including government, NGOs, different economic sectors and local communities) to participate and benefit. ICM programmes are generally based on coordinating bodies or committees comprising representatives of all the sectors involved in coastal development. Regular meetings should be held to ensure that information is exchanged about sectoral development issues and appropriate collaborative action taken where needed. Representatives of MCPA management agencies or of the MCPAs themselves (depending on the level of the committee) should participate. ICM regulatory mechanisms can then be brought in to address activities that might have a negative impact on the MCPA and over which the MCPA has no control, such as:

- Pollution from industrial and domestic sources;
- Agricultural run-off that might cause nutrient enrichment and/or increased turbidity;
- Solid waste from sources such as municipal dumps;
- Port development and coastal engineering, such as dredging and land reclamation;
- Mining in coastal areas or upstream of rivers that influence the MCPA;
- Construction activities, whether industrial, urban, residential or tourism;
- Watershed and river basin development activities that may affect coastal waters.

ICM programmes also play a facilitating role where there is lack of harmony between national MCPA legislation and sectors such as fisheries or forestry, and can help to promote effective implementation of EIA recommendations.

THE ROLE OF MCPAS IN ICM

MCPAs, and preferably a national MCPA system or network, are essential components of ICM programmes, because they protect the biodiversity and ecological processes on which human use of the coastal zone depends. Thus they can be a major contributor to sustainable development and have an economic benefit. MCPA management must also be coordinated and integrated with management activities outside the boundaries and linked to development programmes that address the needs of local people.

J. Samarakoon

A fisheries harbour in Hambantota, Sri Lanka

CASE STUDY

ICM in Sri Lanka

The Sri Lankan Coast Conservation Act No 57 of 1981 (and its amendments, 1988) provide the legal foundation for activities within the coastal zone. As mandated by the Act, the Coastal Conservation Department developed a Coastal Zone Management Plan (CZMP) for the management of the coastal zone and this document is updated every five years.

The 2004 CZMP set out a comprehensive list of interactions required for the management of the coastal zone in an integrated, holistic manner for the conservation and prudent use of its resources while supporting sustainable development. The CZMP highlights the fact that the future approaches for coastal habitat management should be geographically specific and based on clearly understood links between human activities and changes in natural systems. It further states that care has to be taken to ensure that all policies and actions for conservation of coastal habitats comply with the National Physical Development Plan (NPDP), the National Environmental Action Plan (NEAP), the National Biodiversity Conservation Action Plan (NBCAP), and other national planning initiatives.

The CZMP addresses key issues related to managing coastal erosion, conserving coastal habitats, controlling coastal water pollution, Special Area Management (SAM), managing sites of special significance and public access, regulatory mechanisms, and integrating coastal fisheries aquaculture with coastal zone management. SAM actions articulated under the CZMP include the management of MCPAs. The Hikkaduwa SAM site in the south of Sri Lanka, for example, includes the MCPA Hikkaduwa National Park, which is viewed as an integral component of the broader SAM site, with management being acted out at the SAM level, as opposed to only the MCPA level. As can be seen in this example, an integrated ICM approach to management incorporates MCPAs within the wider scope of management of the coastal zone. In accordance with this, the integrated plan works cross-sectorally, ensuring that it is coherent with sectoral plans, and specifying that the goals of policies and plans concerning MCPAs (e.g. the NBCAP and NEAP) are considered at the same time as those dealing with more general development (e.g. the NPDP).

Source: http://www.coastal.gov.lk/czmp%20english.pdf

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Environmental impact assessment A6

An Environmental Impact Assessment (EIA) is an essential tool for identifying the environmental, social and economic impacts of a project in advance, so that damage can be prevented or mitigating action taken. MCPA managers must be aware of EIA requirements, which are often mandatory, for developments both within and outside the MCPA boundaries. This sheet outlines the principles and issues involved.

An EIA aims to predict environmental, social and economic impacts at an early stage in project planning and design, find ways to reduce adverse impacts, shape projects to suit the local environment, and recommend suitable options to decision-makers. It should identify and evaluate beneficial and adverse impacts, the most environmentally suitable, cost effective and practical option as well as alternatives, and should provide recommendations for mitigation of negative impacts, monitoring and auditing project implementation. MCPA managers need to understand the principles of EIA and may need to actively engage in an EIA, and should make use of the extensive literature and EIA training opportunities that are available.

An EIA is normally funded by the developer and carried out by consultants or a government agency, using a multidisciplinary team. The EIA must be professional, independent and transparent in order to be accepted by all stakeholders. This is often difficult where legislation is still being developed if civil society is weak, and when conflicts of interest exist, because those involved in the EIA also have an interest in the project. Developers frequently complain about the costs (which are small compared with the full project) and any associated delays, but the benefits of a well-conducted EIA far outweigh any inconveniences.

Several South Asian countries including India, Sri Lanka, Maldives, Bangladesh and Pakistan have legal requirements or general procedures for EIA. In India, the Ministry of Environment and Forests (MoEF) is the nodal Impact Assessment Agency responsible for the enactment of environmental legislations in the country. The Environment Research Centre of the Ministry of Environment, Energy and Water is the central agency for EIA in the Republic of Maldives, and maintains a knowledge-base on national EIA activities, assessment processes, and EIA consultants. The Fauna and Flora Protection Ordinance in Sri Lanka requires that any development activity proposed within one mile of the boundary of any National Reserve should receive the prior written approval of the Director of Wildlife Conservation. The Ordinance was amended recently to mandate that the project proponent should furnish an Initial Environmental Examination (IEE) of the EIA report in accordance with the National Environmental Act. Legislation related to MCPA management does not always have a mandate for EIAs. For example, the Wildlife Protection Act of India does not have a provision for making EIAs mandatory within the boundaries of an MCPA. Whether relevant laws require EIAs or not, development activities, and even project activities (e.g. relocation of nesting sites, species), within the MCPA should be subjected to some kind of EIA.

The terms environmental assessment (EA) and EIA are used by different organisations for essentially similar activities. Strategic Environmental Assessment (SEA) is equally important but concerns the cumulative impact of many projects, and thus involves assessing policies, plans and procedures, rather than specific development activities.

COMPONENTS OF AN EIA

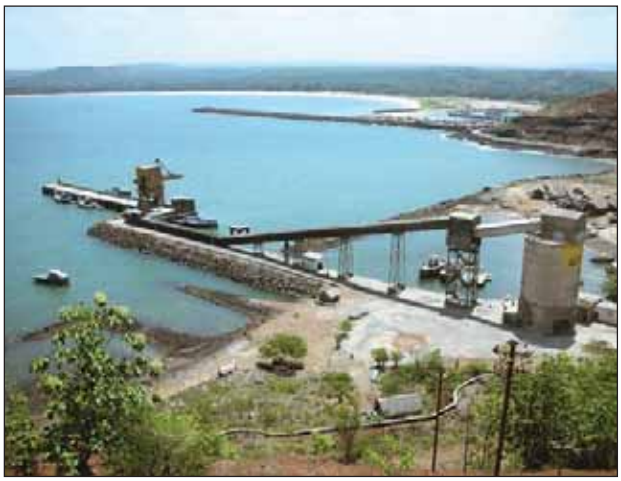
Although each country will have its own established and officially endorsed EIA process, the basic steps that should be taken when carrying out an EIA are given below.

Screening – Establishes whether an EIA is required and at what level. It involves checking the proposal against a set of standard criteria, and is often dependent on local legislation and/or the requirements of a donor agency.

Scoping – Once the need for an EIA has been agreed, the key social and scientific concerns, the individuals involved, and the point at which changes due to the project are unacceptable must be identified. A preliminary assessment of potentially suitable sites, technical options and alternatives is also made. Scoping should involve the developer, planning or environmental agencies, local communities and other stakeholders. The results of scoping determine the focus, depth and terms of reference for the EIA.

Assessment and selection of best option(s) – This is the EIA itself. Various techniques can be used including baseline data collection, field visits and stakeholder consultations. The EIA team must document the construction, operation and maintenance plans of the proposed project and the impact of these on the ecological and socioeconomic environment, and identify alternative sites, solutions and techniques as well as their impacts.

Identification of mitigation measures – This may require modifying the proposal, substituting an alternative technology or abandoning certain aspects of the project. If it appears that the project cannot go ahead without adverse impact, it should be rejected. If further studies will help with a decision, it should be recommended that the application be deferred until the information is obtained.



J. Samarakoon

Significant coastal developments, such as this cement factory pier in Mirya Bay, Maharashtra, India, should be subjected to EIAs

Preparation of an Environmental Impact Statement (EIS) – This is the report of the findings. It should be clear and concise, include a non-technical summary for the public and media, and a more detailed section on the technical aspects of the assessment.

Reviewing and decision-making – This process must be clear and consistent, involving an impartial evaluation that includes the public and government agencies. Standard criteria should be used for making the final decision.

Monitoring – This is essential to ensure that preventative and mitigative actions are carried out properly and that the recommendations of the EIA and conditions of approval are followed. An Environmental Monitoring Plan is often included and may be a condition of the donor.

KEY POINTS FOR THE MCPA

- Make sure that EIA requirements for developments within the MCPA, and in relation to protected areas in general and sensitive habitats, are fully known and complied with.
- Monitor and keep abreast of plans for developments outside the MCPA that might have a negative impact, and lobby for EIAs to be carried out where required.
- Ensure that expert advice is obtained if the MCPA is involved in any EIA activities.
- Encourage public review of EIA reports; ideally carry out a formal public hearing process and allow for adequate opportunity for community involvement in the process; ensure that the reports are made readily available in local languages.
- Ensure adequate time is allocated so that all the key issues are covered, and further studies can be conducted and analysed if needed.
- Identify an appropriate mechanism to review the compliance of the proponent with the recommendations of the EIA to ensure that the scope and extent of the development is not modified after the project is approved.

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CASE STUDY

EIA for Sethusamudram Ship Channel Project in India – EIAs and Transboundary Issues

India does not have, within her own territorial waters, a continuous navigable route around the peninsula due to the presence of a shallow (1.5 to 3.5m depth) ridge called 'Adam's Bridge' between Pamban Island on the south-eastern coast of India and Talaimannar in Sri Lanka. Through the Sethusamudram Ship Channel Project (SSCP), a channel will be dredged to allow ships sailing between the east and west coasts of India straight passage, instead of having to circumnavigate Sri Lanka, reducing the distance of travel by 424 nautical miles (780 km) and up to 30 hours in sailing time. The channel, although constructed in Indian territorial waters, is located close to the boundary that separates Sri Lanka and India, and thus its construction has transboundary implications The Sethusamudram Corporation Limited has been established by the Government of India as a 'Special Purpose Vehicle' and entrusted with the task, in collaboration with the nodal agency, the Tuticorin Port Trust. The project involves dredging of 82 million cubic metres of sand and requires an EIA to identify the potential impacts and create a management plan for their mitigation.

The EIA study conducted by the National Environmental Engineering Research Institute on SSCP has been beset by controversy for a number of reasons. One of the complaints raised was the fact that the EIA was focused only on impacts on ecosystems and livelihoods in Indian territorial waters, even though the project had significant implications for the biologically rich ecosystems and the fishery resources of Sri Lanka. As a result of Sri Lanka's concerns, the two governments held several bilateral discussions. The Indian delegation shared the EIA report and the project report with the Sri Lankan delegation and an expert group of scientists was established by the government of Sri Lanka to undertake a review of the Indian reports and also to conduct field surveys in Sri Lankan territory.

The two governments have realised the importance of setting up a joint mechanism for the assessment and monitoring of the impacts of SSCP on both the Sri Lankan and Indian sides of the Gulf of Mannar in order to mitigate the potential damage to this important ecosystem, which provides livelihoods to thousands of fishers in both countries.

Source:

Ministry of Foreign Affairs 2007. Views of Sri Lanka on the Sethusamudram Project. Report of the Expert Advisory Group of Sri Lanka on the Sethusamudram Ship Channel Project.

Participatory techniques B1

A participatory (collaborative) approach is now recommended when establishing and managing protected areas, experience having shown that this leads to greater success. There are numerous methodologies and an extensive literature related to this topic. This sheet provides some general guidance on the key tools that can be used.

The success of an MCPA depends to a large extent on the active involvement of the stakeholders in all aspects, from planning through to implementation, monitoring and evaluation. Shared responsibility and ownership are key to effective participation, but are not always easily achieved. MCPA staff may not have been trained in participatory methods or fully understand their importance.

Levels of participation range from passive (stakeholders informed by unilateral announcements by administration and or management), to informed and active (people are given information, are consulted and may play some active role), through to interactive and decision-making (stakeholders play a major role or even lead an initiative). For some MCPAs a passive level of participation may be appropriate, but MCPA managers should aim for as interactive a role as possible. The MCPA management should provide active support for the formal participation of stakeholders in MCPA management decision making if there is stakeholder demand to do so. This could involve facilitating the inclusion of stakeholder representatives in MCPA management structures or supporting co-management arrangements (see sheet A3). However, participation does not mean that everyone must be involved in everything, as this would be costly and inefficient. Use should be made of representatives from elected committees or interest groups.

An essential first step is to identify the stakeholders, i.e. those who use and depend on the MCPA, whose activities affect it or who have an interest in it. They may include government agencies, NGOs, local users and residents, universities and researchers, the private sector (tourism, coastal developers), the MCPA staff, and even those living far from the MCPA (e.g. migrant fishers and overseas visitors).

To ensure adequate participation it is important to establish the following:

- Who has an impact on the MCPA area?
- Who will be affected by the MCPA?
- Who needs to have input, be involved and how?
- Who has the key information?
- What are the most appropriate languages and methods for communication?

COMMONLY USED APPROACHES

Most MCPA managers in South Asia will be familiar with participatory techniques even if the terminology is not known. These can be adapted and built on to suit any particular situation. Detailed methodologies for carrying out these techniques can be found in specialised guidelines (see Sources of further information), such as the Socioeconomic Manual for Coral Reef Management (Bunce et al. 2000).

Stakeholder analysis – Identification of main stakeholders who have a vested interest in or responsibility for the resource or MCPA.

Natural group or informal interviews – Casual conversations with groups of people in their natural surroundings; these provide a broad overview of key issues.

Focus group interviews – Semi-structured discussions with groups of people with common interests or characteristics. Participants are chosen using either statistical or non-statistical sampling methods (e.g. cross section of ages; different villages). The method is useful for identifying and describing group perceptions, attitudes and needs.

Semi-structured interviews with key informants – Interviews using a checklist of topics instead of a detailed questionnaire. The interviewee is encouraged to speak generally on each topic without interruption by the interviewer, who may prompt on items that have been overlooked. This gives opportunities for issues unforeseen by the interviewer to be raised.

Observational walks and boat trips – These are undertaken through an area with a group of local people, and are useful for identifying social and environmental issues (e.g. livelihood issues, evidence of environmental degradation). They are also valuable for a manager's induction phase and for participatory monitoring, and often help locals to get a new perspective on resources.

Participatory mapping – Large sketches/maps of the area, created with local materials, are discussed in a group, and used to gather data on both natural resources and social issues, and to get stakeholders to air their views. Data can be incorporated into more formal maps through ground truthing and GPS recording. GIS tools can be used to support participatory mapping (see sheet C1).

Venn diagrams – The use of overlapping shapes to illustrate and summarise relationships, conflicts and issues amongst different stakeholders. Stakeholder groups can draw on the ground, or use pre-cut paper shapes. The final overlapping diagram is captured on paper by the interviewer. This technique can be used during a focus group discussion.

Gender analysis – The study of gender relations and roles and how they might be affected by an intervention, e.g. establishment of an MCPA, or introduction of a new fishery (see sheet B3).

Participatory Rural Appraisal (PRA) – A general term for one or a combination of the above activities. Using several methods help to corroborate (or 'triangulate') the findings. Can be used to identify stakeholders, critical issues and priorities.

Issue-action analysis – The process of identifying specific remedial actions for each management issue, and assigning a responsible person or organisation for implementation.

People's Action for Development

Community visioning using visioning trees in Tamil Nadu, India

Co-management – Designated protected areas where decision making power, responsibility and accountability are shared between governmental agencies and other stakeholders, are referred to as co-managed protected areas (see sheet A3). Such protected areas tend to focus in particular on the inclusion of indigenous peoples as well as local and mobile communities that depend on that area culturally and/or for their livelihoods.

Participatory monitoring and evaluation – Involvement of stakeholders in monitoring of physical, organisational and management aspects (see sheets in section G).

KEY POINTS FOR THE MCPA

- **Support the formal participation of key stakeholder groups through supporting their inclusion in formal management structures (see sheet A3).**
- **Seek specialist support from practitioners with experience in working with communities if attempting to develop co-management arrangements.**
- **Arrange for training in participatory techniques for MCPA staff. Participatory techniques demand greater effort and skills of the interviewers, and training is essential to ensure reliable data collection.**
- **Use participatory methods in daily interactions to strengthen relations between stakeholders and MCPA staff and to encourage stakeholders to participate.**
- **Build an attitude of respect for stakeholders' knowledge. Ensure that participatory activities incorporate the views and needs of all stakeholder groups (youths, women, older generations etc).**

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www.odi.org.uk/nrp ODI Natural Resource Perspectives – short papers on natural resource management, local livelihoods and community based management.

www.iucn.org/themes/pmns IUCN/Ramsar/WWF Participatory Management Clearinghouse (PMC) Website – aims to share information on participatory management of natural resources and disseminates IUCN field experience.

CASE STUDY

Developing Full Community Participation in the Gulf of Mannar Biosphere Reserve, India

The Gulf of Mannar Biosphere Reserve (GMBR) conservation planning process was carefully designed to incorporate community level mechanisms that would facilitate local participation in the management of the Reserve. Given the key objectives of the GBMR to reduce human pressures on biodiversity by supporting sustainable livelihoods, a community and government partnership approach to sustainable development and biodiversity conservation in the area is essential.

In 2002, a project was initiated to address sustainable livelihoods in the GMBR. A micro-credit system was introduced to unburden poor community members from prohibitive debts and generate viable livelihood opportunities that reduce reliance on exploitative fishing practices. Through the project, Eco-Development Committees (EDCs) were established in coastal communities to facilitate the formal participation of the community in the conservation planning process. EDCs prepared a collective long term conservation plan for the GMBR, and a specific "micro-plan" for their immediate area to address specific conservation and sustainable development issues. Local NGOs supported EDCs in the development and adoption of viable alternative employment options. A range of PRA tools and participatory approaches were employed to engage with communities during this process. During a period of four years, a total of 54 "micro plans" were designed and implemented. These plans continue to be developed to more explicitly address conservation issues such as the management of commercially and ecologically important species and habitats, and a revolving fund is available to support self help groups in alternative livelihood initiatives and further training.

The establishment of organised entities within the community, in this case EDCs, can facilitate the active participation of stakeholders in the MCPA management process, both at the inception, and by providing opportunities for formal input into ongoing management decisions. The identification of alternative livelihood options should be pursued in tandem to support fishers or other stakeholders whose livelihoods are adversely affected by conservation measures put in place due to the formation of an MCPA.

Source: http://data.undp.org.in/factsheets/ene/oct06/GulfofMannar.pdf

Conflict resolution B2

Conflict is common in MCPA situations where there are many interests. If not addressed adequately, conflict will undermine the management of the MCPA. Managers are generally wise to face conflict with and among user groups, and to work for a solution as this can lead to resolutions that enhance management and please – or appease – varied stakeholders. This sheet outlines key principles and some of the techniques available.

A variety of conflicts may arise in relation to an MCPA, most often connected to resource allocation and to the need to rationalise the MCPA's biodiversity objectives with its sustainable livelihood objectives (see sheets B5 and B6). The participatory approach (see sheet B1), which is frequently recommended now in the context of protected area management, is based on the idea of achieving consensus among parties with different interests and objectives. This often requires resolving conflicts. Examples of conflicts include:

- Economic (e.g. between hoteliers and the management authority over entrance fees, when the hoteliers feel that an increase in fees will reduce the number of tourists visiting an area);
- Tenure (e.g. between park managers and local communities who use the area as well as depend on MCPA resources for their livelihoods);
- Spatial and/or temporal (e.g. between fishers and dive operators wishing to use the same area);
- Governance related (e.g. local and traditional customs versus 'new' MCPA authorities);
- Political and/or legal (e.g. allowing entry to, and use of an area by certain stakeholder groups but not others, conflicting government policies that contradict each other);
- Personality based conflicts are generally very subtle but can be very powerful (e.g. individuals not cooperating with each other due to personal dislike of the other).

In a conflict situation, one or more stakeholders are generally perceived as gaining (in terms of power or resources) at the expense of the others. Often, conflict arises because of perceptions of inequity rather than actual inequity. Alternatively, given on the ground management of an MCPA, conflict can arise when certain stakeholders are not allowed to participate holistically or in a manner that local communities and park managers can benefit from in the long term. While conflicts may drive individuals and groups apart, conflict resolution presents an opportunity to create new, better, and more creative solutions for dealing with problems. It should, however, be remembered that law enforcement is also an important role of an MCPA and, where MCPA legislation is being disregarded, there may be a need for firm action. In some cases this can be the trigger for a conflict resolution process itself (see sheet G2).

There are various conflict resolution methods, of which the most common are:

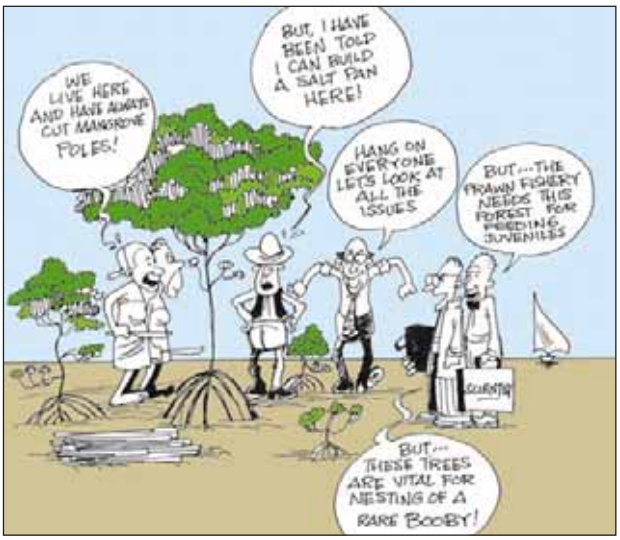
- Negotiation
- Arbitration
- Mediation
- Community conferencing

Details of these are given in the sources of further information provided overleaf. Managers may need to act as the facilitator or decision-maker, if the conflict relates to other stakeholders in the MCPA. In some cases, the MCPA itself may be part of the conflict, and the manager or other MCPA personnel may have to negotiate with another party. Institutions can be important in resolving conflict, and it is important to understand their role (e.g. religious leaders, local administration, local customary law). To some extent, negotiation is like bargaining in a shop or market to reach an agreed price for a purchase. To be successful, this requires certain skills and practice, and a manager should seek training in negotiating skills before embarking on conflict resolution. It is useful for managers to understand management methods that local communities are familiar and comfortable with, and that they can understand and abide by.

RESOLVING CONFLICTS

There are a number of established methods that have been developed for dealing with conflicts on different scales, which are now viewed as common processes that are adopted as a matter of course. Examples include zoning (see sheet C2), Environmental Impact Assessments (see sheet A6), and the development of alternative livelihoods and compensation schemes (see sheets B5 and B6). In terms of day-to-day conflict resolution connected with MCPA management, some of the main steps involved are given below (these may act as precursors to pursuing the more issue specific conflict resolution techniques mentioned above):

1. Begin by communicating the need to discuss the issue clearly through formal and/or informal consultations (as appropriate);
2. Check that all parties involved are ready to participate and willing to cooperate;
3. Ensure that the proposed meeting time and place is agreeable to all parties;
4. At the beginning of the meeting, ask each party to explain clearly what they want and why;
5. Identify areas of agreement;
6. Identify additional information required for all parties to understand the claims of others (if necessary, stop the process in order to obtain the information);
7. Identify the areas of disagreement;
8. Agree on a common overall goal for the negotiation – e.g. the MCPA providing benefits for the stakeholders;
9. Help the parties compile a list of possible options to meet the goal; compare on an open platform goals that the local community have along with the goals of the MCPA - is there scope for common ground? Can there be means to bring that about?;



10. List criteria against which each option should be measured – e.g. urgency, feasibility, economic returns;
11. Evaluate each option against these criteria;
12. Develop an agreement on one or more of the options that is satisfactory for all parties;
13. Decide on the processes, responsibilities and timeframes for implementation of the agreement;
14. Write up the decisions made and ask the parties to sign the agreement.

KEY POINTS FOR THE MCPA

- **Attempting to find something that can be agreed on, however small, can establish a tone of cooperation and problem-solving to tackle other issues.**
- **Admit mistakes, when appropriate, and be prepared to accept different opinions. A manager who admits a particular policy has not worked as intended can gain the support of the affected stakeholder groups and can help to gain trust and encourage positive future interaction.**
- **Avoid personal attacks and assigning blame. For example, a manager should not criticise the views of a fisher opposed to a new area closure, but should explain why the closure is needed, and ask the fisher to provide ideas on how to minimise negative impacts.**
- **Generating several potential answers to a problem helps to avoid or break deadlocks. If scuba diver impact in a sensitive coral area is causing conflict, rather than banning divers altogether, it may be possible to introduce several options such as having temporary closures, alternating days for different dive boats, and increasing diver education and monitoring of divers.**
- **Make sure there is an implementation plan once the conflict resolution process is complete.**
- **Trust in the facilitator is very important, and the facilitator should be perceived as neutral by all involved.**
- **Those who enter into a negotiating process should understand and agree on the decision making process. Ensure that those involved are truly representative of the stakeholder group or community involved in the issue.**

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MPA Training and Technical Assistance Coordinator, 2234 South Hobson Avenue, Charleston, SC 29405-2413, USA. Tel: +1 843 740 1194. Email: heidi.recksiek@noaa.gov – this organisation offers assistance and advice.

CASE STUDY

Conflict Resolution in Mahatma Gandhi Marine National Park, Andaman Islands

Mahatma Gandhi Marine National Park is situated 25 km from Port Blair, the capital of the Andaman and Nicobar Islands. The park covers 281.5 km² made up of 15 uninhabited, thickly forested islands with mangrove creeks. Two islands, Jolly Buoy and Redskin Islands, are open to tourism. Tour operators provide access to the coral reefs, offering glass bottom boat trips, scuba diving and snorkelling activities.

Before the formation of the park in 1983, a few local fishermen and a well known sailor, Captain Beale, catered to tourists who visited the park. This attention by tourists was instrumental in the declaration of the park. Soon, local fishermen were not allowed to use their boats in the park, as only bigger boats operated by businesses based in Port Blair were permitted to service tourists. This resulted in the removal of important sources of income for local fishermen, creating resentment in the local community. There were instances of local villagers being caught fishing in the waters, and poaching sea-shells, sea cucumbers and, later, lobsters, crab and fish. Though the management plan of the park sought participation from adjoining villages, no proper steps were taken to bring them actively into the management framework of the park. Further, bigger boat operators discouraged the entry of local fishers into the park and monopolised the tourist market using their influence in decision-making.

The need for a fish landing centre near the boundary of the park was the first major example of where local villagers and management authorities sat down together and solved a problem related to conflicting MCPA stakeholder interests. A fish landing centre and a parking lot for the tourists were eventually created, catering to the needs of management authorities, the tour boat operators as well as local fishermen.

More recently, immediate decreases in fish catches due to the Asian tsunami in 2004 forced some fishers to seek other sources of income for more than a year. The fishers began to take tourists outside the perimeter of the park to a nearby cove with a coral reef. Two large tourist boat operators, recognising the potential of this new area, started to bring their boats to this cove. Attempts were made to prevent local boats from working in this area by persuading the police to stop the local boats on the grounds that they did not have adequate safety equipment and were only allowed to use their boats to fish in inland waters. A meeting was convened by the Forest Department in March 2008 to discuss the situation with relevant government departments and local stakeholders' representatives. As a result of the meeting, new ventures were disallowed until the waters of the site were declared under the Inland Vessels Act, legally allowing local vessels to continue to operate, but disallowing new, large operators to enter the area.

The park management realises the potential of involving local people and allowing them to benefit from the park as a means to change the way the local fishers use and value the park. This process of dialogue and negotiation, moving towards better participation of local communities in the use of, and decision making processes governing the park, has brought about positive change.

Gender and MCPAs B3

In South Asia the role of women in coastal and marine management tends to be overlooked, although women may play key roles as stakeholders, resource users and managers. This sheet outlines how women and men can play different but equally important roles, and provides guidance on how to stimulate participation from both.

The term 'gender' refers to the socially-determined roles, rights and responsibilities of men and women and the relationship between them. These are very variable across countries, religions and cultures and may change with time. In most countries, women are little involved or even overlooked in the planning, development or management of marine and coastal resources. This is despite the fact that such activities could easily involve women, and indeed would clearly benefit from their contributions. Fortunately, many South Asian countries recognise gender and the participation of women in the development processes as central for sustainable development, and are signatory to international agreements on gender equality.

Due to their different roles, MCPAs affect women and men differently whether or not they are consulted or involved, and both men and women inevitably have an impact on MCPA implementation and management. Recognition of gender differences and their integration into MCPA planning increases the chance of both women and men participating in and benefiting from an MCPA, which in turn contributes to its success. Such planning can also reduce conflicts, as in some cases management interventions can lead to social shifts hinging on gender issues. For example, alternative livelihood schemes in communities where men are the primary income earners can lead to conflicts. Careful negotiation and sensitisation may therefore be necessary (see sheet B2).

MCPA establishment and management needs to be responsive to gender issues in terms of (a) ensuring women's participation at the stakeholder level, and (b) the management personnel who may or may not include women.

WOMEN AS MCPA STAKEHOLDERS

Fishing is heavily dependent on tides, weather, seasonal variations in fish stocks and other variables. Given that in most societies women have primary responsibility for child-rearing and running the household, they generally do not play a major role in direct fishing activities. Processing, trade, mariculture and gathering marine products on foot can more easily be combined with women's roles in the household, and so these are preferred activities for women, as summarised below:

- Fishing – although women rarely go out in boats in South Asia, they may gather shellfish and invertebrates in intertidal areas, on foot, using a variety of gears and methods;
- Shell collection and preparation of ornamental shells for sale;
- Processing of fish products, and associated work such as collecting freshwater and fuel wood, is largely carried out by women. Women play a major role in traditional fish processing such as salting and drying in Bangladesh, India, Pakistan and Sri Lanka, and in making 'Maldive fish' in Maldives. Even in industrial fisheries, women carry out much of the freezing, canning and processing work;
- Trade – women are extensively involved in the buying and selling of fish products, through local markets, restaurants or other outlets;
- Coral mining – in some areas, such as the near shore areas in Rekawa, Sri Lanka, it is mainly women who are involved in coral mining;
- Mariculture – although large-scale, intensive aquaculture (e.g. shrimp farming) tends to be dominated by men, women often play supporting roles and may be actively involved in other small scale and less technological forms of mariculture such as seaweed farming.

Women are also involved in other activities that may be affected by MCPA management activities, such as gathering of mangrove products and making handicrafts. They may also play a crucial role in aspects of community involvement in MCPA management and are often very effective in planning and consultation.

MCPA STAFF

Protected area staff in South Asia are generally males, and this bias may be particularly strong in MCPAs, since in many cultures women are not encouraged to learn to swim and do not have experience of boats. However, women are increasingly playing important roles in MCPA management and in East Africa, for example, female park wardens are now a feature in traditionally male dominated countries such as Kenya. In some South Asian countries, such as the Maldives, the involvement of women in marine and coastal management and research is significant, and the number of women gaining education and employment in this field is slowly increasing. It is generally recognised that women can bring particular skills to a management team, for example, in helping to involve communities, children and youth and in relating to women's perspectives and knowledge. It should equally be recognised that trained and educated female staff can fulfill the same roles as male staff, that they may desire to have similar work opportunities as male staff, and that women should not be confined only to these gender-specific roles. Given technological advances, the issue of physical strength is no longer a great barrier to the involvement of women in career areas that have been traditionally seen as male dominated, and it should be understood that many women may actively want to take up roles that are currently male dominated and involve very physical activities. Gender sensitive male staff can help by fostering more equitable involvement of women. Recruitment criteria for long term staff, researchers and consultants should include gender sensitivity. Therefore it is important to work towards including female staff as part of South Asian MCPAs in the future.

V. Hoon

Women in the Lakshadweep Islands, India involved in local environmental education activities

KEY POINTS FOR THE MCPA

- Plan and budget for gender sensitivity training for staff. Develop a gender policy and agree simple strategies, e.g. where culturally acceptable, address men and women in the same way and accept that men can serve tea, be receptionists and file letters, while women can be wardens and boat drivers!
- Learn about the gender structure of local communities and find out why women often cannot participate as much as men; address this by asking both women and men for solutions; proceed gradually and gain the support of men as well.
- Use the knowledge of women about biodiversity, as they interact differently with the marine environment than men (e.g. their role in post-harvest activities such as gutting fish, may give them greater knowledge about fish reproductive seasons).
- Ensure equitable participation in all activities, including training, of both stakeholders and staff (recognising that participation should never be mandatory). This may mean budgeting for childcare and scheduling meetings to suit women (e.g. not at traditional male meeting places); using particular methods such as single sex focus groups and separate meetings with men and women (see sheet B1); and engaging gender-sensitive facilitators.
- Monitor how women and men participate in, and benefit from MCPA management. Keep gender disaggregated data on all employment, training, enterprise group loans, and meetings, in order to determine trends in proportions of budgets spent on and participation of both sexes.
- Create 'role-models' and encourage leadership and responsibility in promoting gender equity.
- Recognise that for some activities (e.g. school visits involving snorkelling and swimming) males and females may need to be in separate groups.
- Ensure that female visitors are given equal opportunities as male visitors to the MCPA. Do not assume that a female visitor or student will not want to engage in physical or water based activities. Ensure that the choice is available to both females and males.

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CASE STUDY

The Agatti Conservation Reserve: A Gender Sensitive Approach - Promoting Conservation Through Women

The Lakshdweep Islands are an atoll chain off the coast of India with a predominantly Muslim community. Fishing is the main occupation of the community with increased revenue being generated from a growing tourism industry. Currently, steps are underway to establish India's first community co-managed MCPA on Agatti Island. The Agatti local government has submitted a letter of support for establishing the Agatti Conservation Reserve to the Administrator of Lakshadweep. This marks a significant official commitment of the administration towards establishing a new community co-managed MCPA.

The official commitment towards the MCPA comes as a result of extensive research, conservation and awareness raising within the local community. Community consultations were held involving 55% of the adult community members in the Agatti Conservation Reserve planning process. More than 300 of the participants were women, and they played a leading role in sharing ideas and promoting resource management.

Women play an important role within the community and therefore contribute greatly towards influencing attitudes towards resource management in Agatti's matrilineal Muslim society. Many are involved in subsistence fisheries, mainly collecting octopus and shellfish from the reef lagoons, and their specialist knowledge of cowrie, octopus and other species is vital for managing the proposed reserve.

Organised networks of self help groups run by women leveraged resources and disseminated project ideas among community members and were a major driving force behind the MCPA. In addition, women's groups have successfully been involved in socioeconomic and reef monitoring activities that provide a valuable insight on the marine resources and management needs of the Lakshadweep Islands.

Source:

Project Giant Clam of the Bombay Natural History Society and LEAD International - http://www.lead.org

Local and traditional knowledge B4

Local and traditional knowledge is the knowledge held by individuals that comes from their own observations, experiences, beliefs or perceptions rather than from scientific research. This sheet emphasises the importance of taking this into account in the development and management of an MCPA.

Fishing communities have their own knowledge about fish stocks and other marine and coastal resources, including information on the location of resources, migration patterns, movements and seasonal abundance of species of economic importance, and details on their reproductive and feeding behaviour. Local people often also have a good understanding of how resources and the environment have changed over time and possible reasons why.

Other stakeholders in an MCPA also have relevant knowledge. Women and men that are not directly involved in marine and coastal resource use activities may have knowledge of trends in local community structure and household characteristics. Government agencies and local businesses are likely to have access to useful information on socioeconomic trends (e.g. the development of tourism in the area or changes in demography and local government). Divers and dive operators may be able to provide information on the status of reefs in terms of coral health and fish populations.

Indigenous and local communities often have their own names and classifications (or 'taxonomy') for resources, places (particularly significant sites such as fishing grounds, and possibly fish spawning aggregation sites), and marine-related activities. The ways in which these items are classified may not reflect the scientific taxonomy familiar to biologists; for example, criteria such as palatability and seasonal availability may be used to categorise resources.

Local or traditional knowledge is generally passed by word of mouth through generations and is not often recorded in writing. For example, knowledgeable elders in coastal communities of the Indus Delta engage in periodic gatherings with younger community members to share their experiences in connection with local fishing practices, grounds and seasons. Gathering information of this nature therefore requires techniques such as interviews, focus groups and other participatory methods (see sheet B1).

LOCAL KNOWLEDGE FOR MANAGEMENT

In some places local people have traditional systems of rights over marine areas and resources, and these can be a useful basis for developing community involvement in MCPA establishment and management. Many of the best studied and applied examples come from the Pacific region, where customary tenure is providing a basis for more modern marine resource management. Traditional management often includes the main forms of regulation that are familiar now – gear restrictions, limited access, time limits, size restrictions and sacred or protected areas – although these may be used more for social, cultural or political reasons than for increasing fish stocks or protecting biodiversity. Nevertheless, they may have application for these latter objectives. Religious and cultural beliefs and customs may also be highly relevant in MCPA management.

Such customs are not always common in South Asia and it seems likely that traditional tenure was not as well developed there as in the Pacific. Nevertheless, it is useful for MCPA managers to understand the concept as it may be relevant in some situations, especially if traditional management systems exist and are a cause of conflict between local communities and the MCPA authority and there are issues concerning the equitable sharing of benefits from the MCPA.

Several examples of traditional management and co-management do exist in South Asia. In Maldives, traditional systems provided fishing rights to specific islands and reefs. The government of Maldives has recognised the importance of such systems and has now incorporated traditional rights into fisheries law and increased awareness among communities on traditional management systems. In Sri Lanka, beach seine fisheries and some small scale artisanal fisheries have traditional management systems that limit entry and fishing effort. The beach seine fishery is now regulated through fisheries law that reflects and maintains traditional systems and values. Some fishing communities in Pakistan have introduced gear and size restrictions in order to promote sustainable management of fisheries (see case study). A community co-managed protected area is being pioneered in Lakshadweep with the support of local fisherfolk. In addition to marine fisheries, traditional community knowledge and management is widely applied in inland and estuarine fisheries throughout South Asia. Some of the best studied examples in community based fisheries management are of the ox-bow lakes in Bangladesh where communities are given ownership and responsibility to manage fisheries.

G. Sriskanthan

Fishermen in Tamil Nadu, India discuss the changes that have occurred over the last 50 years in the fishing resource base

KEY POINTS FOR THE MCPA

- Find out whether local people in or adjacent to the MCPA have relevant traditional beliefs and knowledge or cultural practices. Asking local fishers about what they know helps to form a relationship with them and to build trust.
- Where there is a traditional conservation ethic, get to understand this and use it as a foundation for local conservation education and awareness-raising.
- Use local people's knowledge to fill gaps in scientific information, e.g. fishers often know the location of fish spawning areas, and of populations on a finer scale than academic or government information can provide.
- Learn local names of places, fish and other natural resources, and use local terminology when talking to stakeholders if appropriate; this will help to facilitate interactions with stakeholders (e.g. fishers may not respect MCPA personnel if they do not fully understand the area and its resources).
- Use local knowledge and classifications in monitoring programmes to increase participation of communities and make use of as much information as possible.

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CASE STUDY

Community Led Fisheries Management in Ganz, Pakistan

The traditional fishing waters of the Ganz community spans a coastal area of approximately 20 km in Gwadar District on the Balochistan coast of Pakistan, from Garian in the west to Gut near Pishukan in the east. The people of Ganz have been fishing with traditional methods for the past century, while in neighbouring villages fishers have recently begun to adopt destructive and illegal practices to increase catch, such as using smaller mesh nets. This has led to a decrease in fish stocks and conflicts over access and rights to the fishery.

The fishermen of Ganz recognise the potential impact that the use of small mesh nylon nets and the depletion of local fish stocks could have to their livelihoods, and the livelihoods of future generations. As such, the community has decided to continue using nets of larger mesh size, to fish using hooks and lines, and has placed a prohibition on catching juvenile fish. Catching juvenile fish is not seen as economically viable due to their low market value, and the long term impacts on the viability of fish stocks. By waiting for the fish to grow larger these fishermen can increase their incomes and also ensure the replenishment of fish stocks. Further, they prohibited fishers from other areas from fishing in their territorial waters.

The fishing regulations were governed by village elders, and surveillance teams were established to prevent illegal fishing by fishers from outside. Conflicts between the fishermen of Ganz and those from the neighbouring village of Jiwani were resolved through reconciliation meetings. Both communities decided to define their territorial waters and not to encroach into each other's fishing grounds.

As a result of these management measures the Ganz community has noted many positive benefits that include increased size of fish and numbers in catches, stock recovery, increased prices for their fish, reduction in by-catch, and the protection of traditional fishing rights and livelihoods of the Ganz people. Although it does not yet have a legal framework, this community initiated management approach has proven to be successful in managing the local fisheries and improving the livelihoods of traditional fishermen.

Source:

WWF Pakistan – www.wwfpak.org/pdf/tp_cs_ganz_fishing.pdf

Poverty and coastal and marine ecosystems

B5

Management interests of MCPAs are generally focused on conservation related goals. It is often forgotten that MCPA areas can provide a vast number of benefits that contribute to the livelihoods of the coastal poor. Although small in purely economic terms, this may be of vital importance from the point of view of supporting local livelihoods and food security, reducing vulnerability, and conflict resolution.

Unless poor people are engaged in the development and management of MCPAs, they can represent a significant threat to the long-term success of an MCPA. When people's time horizons are reduced, and their livelihood strategies are focused on immediate needs, they are unlikely to support MCPA restrictions solely on the basis of the potential long-term benefits that an MCPA may bring. Where MCPAs are being planned and implemented in connection with poor communities, this process must be carried out in the broader context of coastal poverty and livelihood development.

POVERTY IN COASTAL AREAS

Poverty in the coast is often interstitial – i.e. there is much wealth and development in many coastal areas in South Asia but the poor tend to fall into 'gaps' where they are not easily seen or heard, and from which it is often difficult for them to escape. As a result of broader social and economic changes, the traditional roles occupied by the poor in society may no longer be viable or needed and they may become displaced as coastal development creates a new social and economic order around them. This can create a form of development exclusion paradox: the more "development" that takes place, the greater the exclusion of some groups from that development and the worse-off they become. This situation is often disguised by the aggregate increase in wealth in the coast. In the same way, it is often the poor who are excluded from programmes focused on coastal resource management and conservation, as the poor often depend upon coastal and marine resources in complex ways that are difficult to see or understand.

COMPLEX RELATIONSHIPS WITH ECOSYSTEMS

For many communities living in the vicinity of productive ecosystems (e.g. coral reefs or mangrove forests), these ecosystems represent physically and economically accessible resources that are diverse and highly lucrative. They provide a complex range of benefits that can affect the livelihoods of different groups of people in many different ways.

For coastal communities in South Asia, coral reefs and mangrove ecosystems provide seasonally stable sources of food, building materials, a medium of exchange, medicines, and a source of income and status. It is the reef that often gives rise to islands that provide habitats for people and lenses of freshwater for drinking and agriculture. Reefs and mangrove belts also protect coastal villages from storms and wave action. Reefs provide shelter to lagoons and other productive areas, such as sea grasses and mangroves, which in turn provide a reserve of food in all weather conditions. The physical structure of coastal and marine ecosystems can influence the way that many activities are carried out (e.g. communally or otherwise), and the traditional linkages between natural resources and cultural belief systems mean that ecosystems can have a strong cultural importance to certain communities.

OPPORTUNITIES FOR POOR WOMEN

Unlike many fisheries, where women are excluded from production, reefs and mangroves offer opportunities for poor women to collect valuable natural resources. Women often fish from the reef by foot, an activity that has significant benefits in empowering women in the household, and different reef-based strategies between men and women spread household risk. Similarly, the collection of mangrove ecosystem resources (such as food resources and fuelwood) are activities that women in many poor communities in South Asia are routinely engaged in.

STAKEHOLDER DIVERSITY AND NATURAL RESOURCE DEPENDENCE

The diversity of benefits from coastal and marine ecosystems support multiple opportunities for direct exploitation by people with many different skills and provide access to a wide range of different markets, including high value export outlets.

The level of dependence of these different stakeholders on these resources vary, from those whose association is full time, to part-time users and those who only occasionally depend on them. Some may depend on these resources only on a seasonal basis, but that dependence may be absolute, at such times, they can become a critical keystone resource without which their survival would be threatened. Others may depend on coastal and marine ecosystems only occasionally, when they act as a safety net that enables them to overcome periods of hardship or crisis. In this way, those not generally considered as coastal and marine resource users, such as farm labourers, may also be dependent on these resources at certain times. They may make use of such resources for food or income during slack periods in the seasonal cycle of agricultural activities

G. Sriskanthan

Fisher families like these on the Gulf of Mannar can face serious difficulties in maintaining their livelihoods when well-meaning efforts to protect and conserve coral reefs result in reduced access to the fisheries resources they depend on

when labour demand is limited or when there are droughts or crops are affected by pests or disease.

In some situations, coastal and marine ecosystems play an important role in preventing poverty in adjacent communities, but the growing threats to these ecosystems and to access for the poor is progressively making the livelihoods of coastal communities in South Asia more vulnerable and increasingly uncertain.

LEARNING ABOUT LIVELIHOODS AND ECOSYSTEMS

A critical early step in developing a successful MCPA will be acknowledging the complexity of relationships between people and coastal and marine ecosystems, and working to gain an understanding of this complexity. Only by understanding people's livelihoods and the differences between the livelihoods of different groups can we see how people are likely to respond to an MCPA. This understanding must go beyond an aggregated view of a community so that it reflects the diversity of livelihoods within a community. It must also include considerations of people's relationships with the resource – relationships that may well extent beyond simple economic ties.

There is no escaping the fact that it is difficult to learn about, communicate with and work with the very poor. Indeed, part of the reason that they are very poor may be that they are not visible and are difficult to communicate and work with. This means that it will take time for the MCPA managers to engage with very poor groups, they may take longer to engage in MCPA management processes, and the field-staff will have to use the best of the facilitation skills to help very poor people participate.

KEY GUIDANCE FOR MCPA

- **Acknowledge the complex and diverse nature of poverty, which often means that the poor are hidden or excluded from interventions and may co-exist in coastal areas of apparent wealth.**
- **Use specific targeted methods to identify and engage with poor stakeholders (see sheets B1 and B6). Seek the assistance of socioeconomists/poverty experts with specialised skills if MCPA staff do not have experience and training in dealing with poor communities.**
- **Acknowledge the many and different types of dependence on natural resources in and around MCPAs among communities, and ensure this is reflected in MCPA activities**
- **Adopt more holistic approaches to improve our understanding and targeting of poor and vulnerable stakeholders. These may include the Sustainable Livelihoods Approach.**
- **Ensure participation of the reef stakeholders in the planning and implementation of new MPAs.**

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www.livelihoods.org – provides materials and resources on sustainable livelihoods.

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Coastal Oceans Research and Development in the India Ocean (CORDIO) – http://www.cordio.org/

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CASE STUDY

Reef Gleaning in the Lakshadweep Islands, India

Exploitation of the reef flat on foot and by hand, or reef gleaning, is commonly the domain of women and children. On a daily basis, reef gleaning in many communities provides a regular supply of protein and may significantly enhance the nutritional status of households (Gina-Whewell, 1992). In certain seasons when weather limits access to more exposed parts of the reef, it may also be the only source of food or income.

On the Lakshadweep Islands reef gleaning is an activity carried out mainly by women as well as by children. Not only does it provide a supplementary source of income that women can control, it is also the source of a wealth of knowledge about a reef resource, which women accumulate from a young age. Although the financial dependence on reef gleaning has diminished, its importance as a recreation, a break from household duties and a chance to chat together away from the men, is still of great value. For the elderly as well as for people lacking formal education (who cannot access jobs, e.g. in the government sector) and live by subsistence means, reef gleaning still forms an important share of household income.

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MCPAs and livelihood development

B6

In South Asia the services provided by coastal and marine ecosystems benefit a wide range of people, many of them very poor, in different, complex and changing ways. The long term effectiveness of an MCPA can be undermined where livelihoods of the poor are compromised in the short term. People need to be equipped with the confidence and capacity to respond to the opportunities and threats that an MCPA may bring to their livelihoods. This sheet provides guidance on how to approach the challenge of sustainable livelihood enhancement and diversification in natural resource dependant communities.

The ecosystem services provided by coastal and marine ecosystems are diverse and include: supporting services to wider ecosystems (e.g. fish breeding grounds); provisioning services (e.g. nutrition and building materials); regulating services (e.g. coastal protection); and cultural services (e.g. recreation, spiritual and education). In South Asia these services benefit a wide range of people in different, complex and changing ways. Many of these people are poor and rely on the reefs for part if not all of their livelihoods (see sheet B5).

CONSERVATION AND POVERTY

When ecosystems are degraded, the services that they produce often decline. For poor people who depend on those services, their livelihood outcomes are likely to suffer as a consequence (Fig. 1).

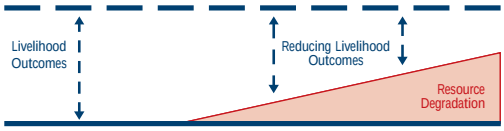

Fig 1: Resource degradation and livelihood

Where environmental protection measures, such as MCPAs, have been introduced in an attempt to arrest the degradation of ecosystems, in the short term at least, they can further reduce the services provided by these ecosystems to poor people (Fig. 2). Communities have been expected to adapt to the reduction in opportunities. Even where benefits from marine protection are realised in the long term (perhaps through tourism, or increased fisheries productivity), the poorer members of resource-dependent communities are often the least able to take advantage of those opportunities. This leaves the poor facing the choice of either accepting a permanent decline in their livelihoods, migration in search of alternatives, or the continued but now illegal exploitation of "protected" resources.

SUPPORTING LIVELIHOOD ENHANCEMENT AND DIVERSIFICATION

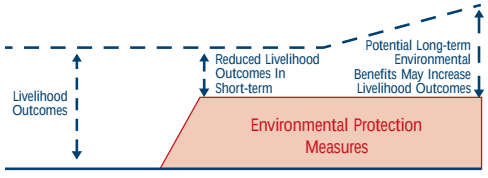

Fig 2: Environmental protection and livelihood outcomes

The process of sustainably enhancing and diversifying livelihoods has been recognised by many conservationists as a mechanism to promote livelihood development and encourage people to move away from the harmful exploitation of natural resources. However, it is not a simple task and recent experiences have shown that where such initiatives fail they have the potential to undermine the very conservation measures that they are intended to support. Processes designed to support livelihood enhancement and diversification should: respond to the complexity of people's livelihoods; build on their strengths; and give them the capacity and confidence to overcome the challenges set by resource degradation and new conservation measures.

The key phases in the process of supporting livelihood enhancement and diversification should include:

1. Understanding the complexity of people's livelihoods and their relationship with natural resources, the wider economy and society (see sheet B5). Collaborative learning with people about the diversity of resources, skills, capacities and interests that inevitably make up any community and building a consensus for change;
2. Developing realistic visions and plans for equitable and sustainable livelihood change that are rooted in people's strengths, capabilities, reflect market realities and maintain their desired cultural/social connection with coastal and marine areas;
3. Building people's capabilities and adaptive capacity, together with networks of government, civil society and private sector services to support sustainable and equitable livelihood development.

Supporting livelihood development is a challenge that requires a broad range of cross sectoral skills and capabilities. MCPA managers cannot possibly expect to have the range of skills and networks that are required to deal with the challenges of livelihood development. Managers need to understand the challenges and form the partnerships with a diversity of agencies that have the required skills and capacity.

The support needs of people will differ, reflecting their aspirations, capacity and stages of development. The kinds and levels of support will differ. It will be necessary to built relationships across different agencies to provide the support that is required.

KEY GUIDANCE FOR MCPA

- **Where possible, implement the measures to build the capacity and confidence of people to positively respond to the changes brought by MCPAs before MCPAs are implemented.**
- **Form partnerships and enlist the support of local agencies that have the skills to support livelihood development activities.**
- **Take time to form a relationship with the community that is built on respect and a consensus that change is needed.**
- **Recognise that MCPAs will affect different groups of people in different ways, and that different types of stakeholders may have differing relationships with, and levels of dependency on MCPAs. Do not address the community as a homogenous unit.**
- **It will be particularly difficult to work with very poor and marginalised people. It is therefore important to be innovative and flexible.**
- **Use a systematic approach to supporting livelihood changes that responds to the complexity of people's livelihoods and builds on their strengths.**

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www.livelihoods.org – provides a broad range of materials on livelihoods.

CASE STUDY

Coral Reefs and Livelihood Initiative – Supporting the Development of an Improved Approach to Sustainable Livelihoods Enhancement and Diversification (SLED)

The SLED process was initially developed by IMM Ltd. who built on the lessons of past livelihoods research projects to develop an improved process for supporting SLED. The process provides a framework of action for development and conservation practitioners. It is designed to:

- Shape peoples attitudes, and provide the skills and knowledge that will allow them to approach SLED;
- Develop people's ability to recognise and respond to opportunities, and create new opportunities for SLED;
- Generate wider support from 'enabling' institutions for SLED.

Under the Coral Reefs and Livelihoods Initiative this approach has been field tested and further developed in very different circumstances and institutional settings, in six sites across South Asia and Indonesia.

The Centre for Action Research on Environment Science and Society (CARESS) has been working to engage the local community to establish a conservation, enterprise and livelihood development project in the Lakshadweep Islands in India. Both the local community and CARESS have found the tools and approaches very useful in the process of joint learning. The SLED visioning process provided clarity for people in establishing their aspirations for future livelihood development. The emphasis on people's strengths and potential has helped the SLED participants to realise that they were not helpless, but were capable of taking charge of their own lives. One of the changes noted is that the groups have become more assertive and are confident about approaching and even demanding services from local service providers.

Mrs. Nafeesath ME was a silent partner in a family bakery business. After taking part in a SLED visioning session, her individual vision was to have personal financial independence. CARESS assisted her to walk though the various paths to achieve her dream by listing her strengths. She felt she could manage a sweet and snack making unit because of her earlier experience with the bakery. She had noted that many families in Minicoy were purchasing these items from Kerala and bringing them home. She thought that there would be great demand for fresh products made in Minicoy.

During the SLED discussions, she learnt about different service providers she had access to and the possibility of taking a loan from the local bank. Her family was supportive and helped her prepare a business plan for the bank. She took a loan for IRs 200,000 and started the business. Her intuition proved right. The unit started in April 2007 and within no time the products (ladoo, burfeee, chips, mixture) became popular all over the island. The snacks and sweets are sold through established shops in the island. They also target events such as marriages and school functions for selling their products in bulk. She currently employs three people and has a turnover of around IRs 300,000, making a profit of IRs 30,000 month. They have paid off 40% of their loan in one year of establishment.

Mapping and surveying C1

Identifying the locations of the habitats, species and resources of an MCPA, and the places and activities that influence it, is an essential first step in providing the basic information needed for management. A map is thus essential. This sheet gives a general overview of methods and technologies available for surveying the MCPA and preparing a map.

A map of the MCPA has a wide range of uses. It assists with planning, research and monitoring; it helps to make boundaries and zonation schemes clear to MCPA users; it improves the quality of leaflets, posters, souvenirs, and other materials for visitors; and it enhances reports. Oil spill contingency planning (see sheet K3) requires sensitivity mapping to highlight areas vulnerable to oil spills.

Maps designed for use at sea are called 'charts'. They show water depth (bathymetry), currents and details related to navigation (e.g. positions of channels, buoys, islands, wrecks or other hazards). These, as well as the routes for surveillance patrols, can be marked on maps produced specifically for the MCPA. Tools, such as remote sensing, geographical information systems (GIS), global positioning systems (GPS) and digital or laser printing have greatly simplified map production and increased speed of production and flexibility. However, the accuracy of these more modern tools is only as good as the quality of data collected. Often the high costs associated with purchasing satellite or aerial images dissuade MCPA managers from producing good quality maps. Even in the absence of hi-tech resources, it should be remembered that even a simple, hand-drawn map can be useful for an MCPA.

SURVEYS AND ASSESSMENTS

The very first step of any surveying or mapping effort should be to collate all existing data available, including all current and past maps, charts etc. Before a map is prepared, surveys must be undertaken to determine the distribution of different habitats and species, human settlements, boundaries and other important features. Locations are usually measured with a GPS, and ground surveys should be undertaken on foot, by boat or by snorkelling and/or diving. Such surveys and assessments will also generally form the baseline for the monitoring programme (see sheets G3 and G4). They should include detailed sampling as well as more rapid, time-efficient methods such as spot sampling where brief notes are taken. The data can then be matched against information from other sources (e.g. aerial photographs or satellite images), enabling a picture of the entire area to be constructed. Aerial photographs are useful complements to the ground surveys. If taken during spring low water, they can show the coverage of intertidal areas, type of substrate, presence of macroalgae or seagrass, and shallow seabed features such as coral reefs. Stereo photographs are aerial photographs of the same area captured from different positions but with same focal length and altitude, so that a three dimensional image of the area can be obtained using a basic instrument called stereoscope. When examined with an appropriate viewer, provide a three dimensional image that helps interpret topography. Most government cartographic agencies have collections of aerial photographs, copies of which can usually be purchased for a small fee. In some countries in South Asia maps of certain areas may be classified or restricted, and special permission may be needed in order to gain access to them.

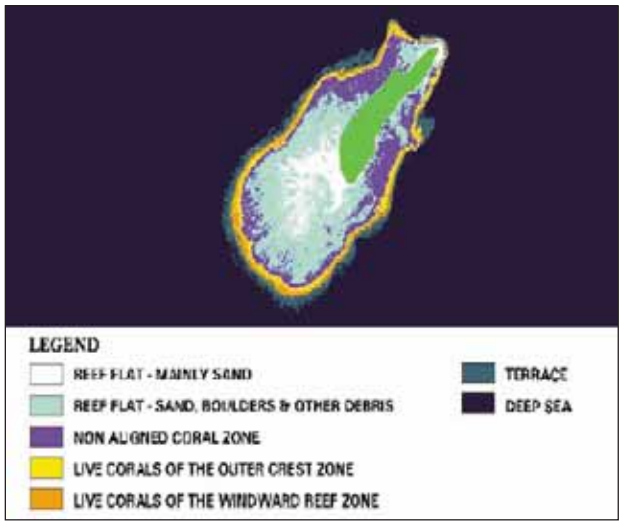
Satellite or remote sensing images may be very useful and relatively cheap. Some SPOT and LANDSAT satellite images can be obtained free as well as from the relevant supply companies for a fee, but their use requires equipment and professional training. Thus, if planning to use them for MCPA surveys and mapping, it is best to work with a research department or qualified consultants.

Locally generated maps incorporating the traditional and historical knowledge of villagers and fishermen can also be developed to improve detail on a map, e.g. determining water currents, seasonal changes in water turbidity or whether certain areas dry out at low tides. In this manner, a good technical map with local relevance for communities can be prepared. Note that such information will reflect the local peoples' perspective and may include their own terminology. It can be stored in the GIS database and incorporated into the production of maps.

PREPARING MAPS AND CHARTS

The data gathered in the survey are compiled to produce a map. A preliminary map can also be prepared by compiling data from other existing maps (i.e. a 'derived' map) and this is often a useful first step. In the absence of computer-aided software (e.g. GIS – see below), a map can be prepared by a cartographer, who uses the surveyor's plot to draw the first map or 'base map', and then adds other features.

Maps can be printed on paper or used in digital form. Digital maps, when viewed on a computer screen appear sharp although the resolution of most screens is only 72 dpi (dots per inch). Prints can be adequate on higher standard printers and good quality paper, but are likely to be expensive, and colours often fade with light. Standard printing processes generally have much longer-lasting colours and are produced at greater resolutions of 2,400 dpi.



IKONOS MSS

Habitat map developed from IKONOS MSS for Jolly Buoy Island, Andaman Islands, India

The following characteristics affect the use of maps:

Scale – The size of the MCPA, the scale required and the size of the printed map (and thus the paper to be used) must be chosen on the basis of the size of the MCPA, the needs and expected uses. Scale refers to the degree of reduction of the graphic representation compared to the true size of the feature. Scale bars are used to indicate the length of miles or kilometres as represented on the map, or may be given as a ratio. A scale of 1:50,000 means that

a measurement on the map represents a distance 50,000 times greater on the land or sea; thus 1 cm on the map represents 500m in reality. Maps of 1:50,000 (used to show buildings, roads, etc) are considered large-scale compared with those of 1:1,000,000, which are considered small-scale and are used for whole countries or oceans. When preparing maps, it is generally better to use bar scale rather than ratio scale so that map reduction or enlargement will simultaneously change the scale bar.

Resolution and accuracy – This refers to how accurately a feature can be depicted on a map: the larger the scale, the higher the resolution. Using a scale of 1:50,000, a 30m long building would be just over 0.5mm on the map. The choice of line widths used can introduce errors; for example, on a map with a scale of 1:50,000, a road represented by a line 0.5mm thick will mean that it is 25m wide in reality. Similarly, a 1mm error in the location of the line on the map will mean a 50m deviation from reality. Factors affecting accuracy can also have cumulative effects.

Coordinates – These are usually marked as intervals along the margins or by placing the coordinates in the grid. They can be in the form of latitude and longitude (as used on charts) or UTM coordinates in metres (frequently used by government cartographers). Most GPS and GIS can convert between these two, and other settings.

GEOGRAPHICAL INFORMATION SYSTEMS

GIS is a programme that incorporates a database for positional (geo-referenced) data, allowing manipulation and analysis. A major benefit is that it allows different data layers to be overlaid, e.g. data on coral reef status can be overlaid onto data on fishing activity, permitting analysis of any spatial relationships between the two parameters. GIS is thus a powerful tool to assemble, analyse, store, utilise, retrieve, manipulate and disseminate scientific/technical data and thus aid in decision making. GIS is particularly useful in map production as prints or digital images can be produced as required, containing the selection of data layers needed for a particular use.

Setting up and developing a GIS usually requires considerable experience and MCPAs are advised to collaborate with relevant institutions. MCPA staff will be able to operate the system, once trained, provided there is expert supervision and appropriate maintenance.

KEY POINTS FOR THE MCPA

- **Ensure that the necessary maps for the MCPA are produced and available in printed or digital form as appropriate.**
- **Make sure that important features/datasets (e.g. MCPA office; depth/elevation; habitats; places of interest – tourism, fishing, anchorage/mooring sites; cyclone shelters etc.) are noted.**
- **Use a team approach for preparing maps, involving local stakeholders and technical institutions; involve relevant MCPA personnel in the collection of ground and sea survey data and aerial photography, and in finalising the maps (e.g. editing, choosing colours and other details).**

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www.esri.com - a commercial website providing information and advice on GIS products, training and support in relation to natural resources.

http://eol.jsc.nasa.gov/reefs/ - A NASA-sponsored partnership between remote sensing scientists, international agencies and NGOs to develop baseline global reef maps and use remote sensing data for applied science problems and improved management of coral reefs.

CASE STUDY

Surveying and Mapping of Coral Reefs in Mahatma Ghandi Marine National Park, Wandoor, Andaman and Nicobar Islands, India

The Mahatma Gandhi Marine National Park, established in 1983, is among the earliest marine protected areas of India and encompasses some outstanding coral reefs of high natural diversity. A number of studies have been carried out to assess and map the coral reefs in Andaman and Nicobar Islands (Nayak *et al.* 1994, Turner *et al.* 2001). The Department of Environment and Forests, Andaman and Nicobar Administration now has a fully fledged remote sensing and GIS laboratory and has initiated mapping studies based on satellite data.

As coral reefs are usually found in clear waters they are amenable to remote sensing techniques, which can provide information on reef geomorphology and basic ecology. The types and categories of the coral reefs and associated features at three selected islands within the Mahatma Gandhi Marine National Park were mapped on 1:50,000 scale, using multi-spectral satellite data sets of varying resolution, and a comparative analysis drawn between the techniques used (IRS, LISS 11, LANDSAT TM and SPOT MLA) to identify the potential of different multi-spectral datasets in discerning the units in a diverse reef habitat.

The study area comprises fringing reefs and patchy coral reefs known to occur down to a depth of 35m. All digital datasets were corrected and geo-referenced with respect to the key IKONOS dataset and ground truth information.

Initial findings indicated clear distinction between prominent classes (e.g. coral reef flat, coral zone) and the identification of six classes of reef habitat with an overall classification accuracy obtained for IKONOS MSS (Landsat Multi-spectral Scanner) of 86% – the highest among all datasets considered. IKONOS MSS recorded a total of 21.92 hectares of live coral cover located at windward reef front and outer reef crest zones. The study highlighted the fact that that while more reference points should be taken in the transition edges between two habitat classes to improve accuracy, high resolution satellites like IKONOS MSS can contribute to a considerable extent in capturing differences within a geomorphological unit of coral reef.

Sources:

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MCPA design and zonation C2

Careful attention to design is often overridden by social, political and economic issues when establishing an MCPA. As a result, some MCPAs are poorly located, or are inappropriate in size or shape for achieving their objectives. This sheet describes key design components and suggests how managers may be able to progressively improve the design, even once the MCPA is established.

Design aspects include size and shape, location, position of boundaries, zoning, ecological representation, and links or connectivity with other MCPAs. There are also practical considerations in terms of ease of management and access (e.g. whether the MCPA is adjacent to sources of threats such as coastal development, tourism pressure, monsoons or frequent disturbances such as cyclones and storm surges, e.g. St Martin's Island in Bangladesh).

BOUNDARY LOCATION

The location of MCPA boundaries should be based on a number of factors. Ecological factors including breeding, recruitment and nursery grounds, fish aggregation sites, resilient habitats (e.g. reefs that survive bleaching), current patterns, and stability of populations of key species and communities are an important consideration. Other factors, such as the ease of enforcing and demarcating the area can be equally important considerations. If the original designation was driven by socioeconomic-political factors (e.g. interests of the stakeholders, immediate availability of an area), key ecological sites may lie outside the boundaries of the MCPA but it may be feasible to change this with relatively minor alterations. It is essential to include within the boundaries ecosystems that can withstand damaging impacts and areas of high biodiversity that have been degraded, to enable them to recover. For example, coral reefs known to be particularly resistant or resilient to bleaching (see sheet H7) should be included wherever possible, and given high protection under any zoning scheme. New threats may also necessitate changes, e.g. excess siltation and sedimentation in the Hikkaduwa National Park in Sri Lanka following the nearby construction of a fishery harbour has led to changes in the proposed management plans.

Stakeholders must be closely involved in establishing or changing boundaries. For example, consultations should be held with fishers, village leaders and all user groups within the proposed area, to identify guiding features on which the boundaries could be based (see sheets B1 – B3). Accordingly a map should be prepared with key boundary points identified by GPS and verified by government officers, MCPA management personnel, fishers and scientists.

Clearly marking and maintaining the boundaries of an MCPA is often difficult particularly in deep waters and/or strong currents, but if this is not done, confusion and conflict may arise. In addition, boundary markers require regular inspection, maintenance and vigilant surveillance against theft. Limited surveillance at the Hikkaduwa National Park in Sri Lanka led to the loss of mooring buoys on the seaward boundary of the park. Good concise descriptions are also needed that can be translated into legally defensible boundaries in the field and make it easier for technicians, GIS specialists and cartographers to map them (see sheet C1).

SIZE

For ecological reasons, MCPAs should be as large as possible because of the open nature of marine ecosystems. Large MCPAs have better buffering capacity, can be zoned to accommodate a variety of uses and levels of protection, will protect a higher diversity of habitats, and are more likely to retain viable populations and maintain ecological processes. However, small MCPAs such as the Hikkaduwa National Park in Sri Lanka (45ha), are often more acceptable to local communities and therefore easier to implement. Small MCPAs are effective conservation tools for many marine resources, depending on their location, connectivity to other MCPAs, and how well adjacent areas are managed.

ZONING

Zoning is a key management tool for multiple-use MCPAs. It allows areas to be set aside for particular activities such as protection of key habitats or nursery areas and breeding sites, research, education, anchoring, fishing and tourism. Zoning plans should be based on accurate available data, and a survey process (either to gather primary data or to review secondary data if available) to understand ecological and socioeconomic factors, should be conducted before developing a zoning plan. Zoning helps to reduce or eliminate conflict between different users of the MCPA, improve the quality of activities such as tourism, and facilitate compliance (see sheet G2). A zoning scheme generally includes areas under strict protection (see sheet I1) and areas with increasingly fewer restrictions. There may also be sub-zones, which might be modified on a seasonal or temporal basis, e.g. for boat access or because of breeding cycles of organisms.

The scheme should aim to provide a balance between conservation and use, and should be as simple as possible. If it is too complex, it will be difficult to enforce as stakeholders may have difficulty distinguishing the different zones. The zoning plan must be included in the management plan (see sheet C3) or a separate document and in some cases the zone types are laid out in the MCPA legislation (see sheet A4). This is important, because if a zoning plan is not officially recognised it can delay management decisions. The plan should identify the boundaries of the different zones and explain how each area can be used. As with the outer boundaries of the MCPA, it is essential that zones are clearly marked once agreed and approved.

CONNECTIVITY

Connections with other MCPAs and other ecologically important areas should be considered. An MCPA ideally needs to be part of a network of protected areas that takes account of the movements of species, dispersal of larvae, and exchange of nutrients and other matter between ecosystems. In South Asia, information on such parameters is largely lacking, but where it is known or can be obtained, it should be used. For example, information on current patterns is increasingly available, and methodologies are being developed to track the movements of animals (e.g. satellite tagging for fish and turtles, and acoustic tracking of fish). As MCPAs are effectively one of many tools available to integrated coastal managers, MCPA design should also take into account connectivity and be incorporated into any existing framework of integrated coastal management.

http://www.cea.lk/muthubuffer.htm

Zonation plan for Muthurajwela Marsh and Negombo Lagoon, Sri Lanka

KEY POINTS FOR THE MCPA

- Zoning requires knowledge gained through a participatory process that is well integrated with tools such as participatory mapping and GIS.
- Consider carrying out an assessment of the design of the MCPA, to understand any shortcomings and to make recommendations for improvements; and any necessary changes that are feasible.
- For boundaries, avoid ambiguous language such as 'approximate low water', and use the most detailed charts or maps available to ensure the greatest level of accuracy.
- When defining boundaries, reference fixed features that will not move over time, e.g. rocky headlands rather than sandy headlands or buildings, to provide easy visual reference.
- Even simple ground level action at an MCPA must be discussed with stakeholders as their agreement and support will improve compliance.
- The declaration of an MCPA can involve a significant investment of time and regular and constructive pressure and consultation is needed to keep the process in motion.

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CASE STUDY

Zonation Scheme in Hikkaduwa National Park, Sri Lanka

The Hikkaduwa National Park (HNP) encompasses an area (45 ha), including rocky islets and fringing coral reefs running parallel to the coastline. Hikkaduwa is a major tourist resort within Sri Lanka, and heavily populated. As such, the HNP zoning scheme has to take into account the high recreational and scientific value of the area, the adjacent fishing harbour and fishing activities, and the diversity of habitat and species. The zoning is prescribed as follows under the MCPA legislation, and is the product of a long term consultation with stakeholders.

Glass Bottom Boat Zone – Glass bottom boats are allowed only around the rocky islet area, but not in the areas where shallow coral patches are present. Shallow sandy areas are reserved for bathing activities. Provisions such as floating buoys are made available for boat anchoring. Fish feeding once very common during glass bottom boat trips is now prohibited.

Snorkelling Zone – Snorkelling is prohibited in very shallow waters, and adequate buoyancy vests or floatation devices should be provided to prevent participants standing on the delicate reef habitat. In addition, snorkelling during low tide should be minimised, and designated paths and places to get in to the water established to facilitate safe passage to deeper water.

Bathing Zones – Sandy, shallow water areas are designated as bathing zones. Two bathing zones have been established in HNP.

Research Zone – Specifically designated for scientific research purposes, this area is closed to other users to prevent disturbance. There is a further division within the research zone itself according to the topography, substrate and the species composition. E.g. Zones I, II and III etc.

Strict conservation Zone – Established to protect sensitive habitat areas, such as fragile plate coral habitat, sea grass habitats, and coral rehabilitation/restoration areas. Strict controls on access to all user groups, including for research purposes.

Despite having outlined the different use zones for the HNP, this zonation system has not yet been effectively implemented or enforced and remains in the consultation phase. The Department of Wildlife and Conservation is responsible for the overall management of the protected area.

Source: www.dwlc.lk

Management plans C3

Each MCPA should have a Management Plan that is designed to ensure that the objectives are effectively achieved. The way in which the Plan is prepared, its content, and its presentation all affect the extent to which it is useful, and this sheet provides general guidance on these key issues.

The Management Plan is the main tool to guide the development and management of a protected area and all MCPAs should have one. A Management Plan helps to:

- Improve use of human and financial resources, by setting priorities;
- Provide continuity in case of staff changes;
- Increase accountability both at the level of the MCPA itself and the management agency;
- Improve communication with stakeholders, the public and potential donors;
- Ensure that management decisions are based on a clear understanding of the MCPAs objectives.

Management Plans have tended to be 'issue-driven', or focused on issues that were important when they were prepared. A more useful approach is for a Plan to answer the question 'what is needed for the objectives of the MCPA to be met?' Objective-oriented management is proactive rather than reactive, emphasises outcomes and makes progress easier to measure.

Most protected area agencies are required by law or policy directive to produce and implement Management Plans, and the format, content and process may be defined in the legislation. Management agencies should aim to promote a common approach and format for the Plans for all MCPAs under their mandate, in order to harmonise objectives, facilitate comparison between sites, and streamline planning and reviewing procedures. However, each MCPA is unique and its Management Plan must be designed specifically to address its own needs. Where an MCPA has a national, international or other specific designation (e.g. World Heritage Site), the Plan should address this and may require a certain format.

Some Management Plans have the status of legal documents, in which case failure to manage an MCPA in accordance with it may constitute an offence. Although this may seem stringent, legally binding Plans are advantageous as they have greater force and help to back up management decisions and actions. Once the Plan and any supporting documents are produced, they should be used to guide implementation of the MCPA, and monitoring programmes should be designed to assess their effectiveness (see sheet G10). Plans are often not used or are difficult to implement, particularly if they have been prepared without the participation of all those involved in implementation, and if they have been poorly structured and written. Management Plans should be revised and adjusted at intervals to reflect new issues, lessons learnt, or changes in management objectives, adapting the contents according to new information gained from monitoring (see section G). The review process for this is usually laid out in the legislation or in the Plan itself.

MANAGEMENT PLAN PREPARATION

The Plan can be prepared before or after the MCPA is set up, and will usually take at least a year to ensure adequate consultation. MCPA agencies often lack the financial resources for the work involved but donors may be willing to fund such activities.

Management Plan preparation generally involves the following steps:

- Pre-planning – establish the planning team, define the process to be used, find funding, and train the planning team and key stakeholders if required;
- Review existing information (e.g. physical, biological, social, economic, policies, legislation) and describe the 'context' of the MCPA;
- Identify stakeholders and establish a transparent consultation process, which may involve meetings or workshops, with individual interest groups and for all stakeholders together;
- Analyse constraints, opportunities, threats, issues, problems, and needs, and identify solutions;
- Formulate vision, objectives and, where appropriate, targets;
- Design management actions and interventions, including boundaries and zonation schemes (see sheet C2) and acceptable mechanisms for enforcement and compliance (see sheet G2);
- Determine financing mechanisms, bearing in mind the need for benefit and revenue sharing with stakeholders;
- Establish monitoring and evaluation protocols (see sheet G1), including a process for periodic review and revision;
- Prepare the draft Plan, and submit it for public consultation and review;
- Incorporate comments and publish a final Plan (preferably both as a hard copy and electronically);
- Submit the Plan for approval by the appropriate governing agencies (the mechanism for this varies between countries) and await endorsement before disseminating to all stakeholders.

Where an MCPA does not have sufficient capacity or expertise to prepare a Plan, it may be useful to hire a consultant (see sheet D2). Such a person must work closely with MCPA personnel and stakeholders, so that when he/she leaves all involved feel ownership of the Plan and are willing to implement it.

CONTENT

The Plan may be a single document covering all aspects of management or a general 'umbrella' document. In the latter case, specific plans are developed separately, such as a day-to-day operational plan, annual work plans, detailed zoning plan, business and financial plan, and visitor plan. These may have different target audiences and may need to be prepared in different ways. The level of detail to be included in the Plan will be decided by the site manager and the relevant management agency. The Plan should present both the strategic and operational elements of the MCPA and clearly link them, be flexible enough to cater for unforeseen events and interpret national policies in relation to the MCPA, taking into account obligations under international conventions. It should identify the assumptions (e.g. adequate funding and political stability) that have to be made for successful implementation; these may be beyond the manager's control but may have consequences that require contingencies. Many Plans give too much description; detailed biological and socioeconomic information can be placed in annexes or a separate volume. Good presentation, with maps

and other visual aids, will help to ensure the Plan is used. The text should be clear, concise and accurate. It may be necessary to translate it, or key sections, into local languages, and to prepare a summary for broader dissemination.

KEY POINTS FOR THE MCPA

- **Thorough social and ecological context research should be a prerequisite to the design of the MCPA Plan, and knowledge management and information flows must be relevant and shared with all stakeholder groups to maintain interest and manage expectations.**
- **Ensure that all staff are familiar with, and use the Management Plan, and understand its status (as a legal document or general guidance).**
- **Review and revise the Plan at the appropriate intervals, involving all stakeholders, and ensuring an objective-oriented approach.**
- **Ensure that the budget allows for preparing and/or revising the Management Plan, or that special funding is sought. Funds should also be allocated to support the monitoring and evaluation of Plan implementation.**
- **Obtain copies of management plans for other MCPAs, both within your country and from other countries for comparison.**

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CASE STUDY

Management Plan for Hikkaduwa National Park and Environs, Sri Lanka

In an effort to combat environmental and social problems in coastal areas, Hikkaduwa National Park was selected in 1992 as one of two Special Area Management (SAM) sites under the Coast Conservation Department and the Coastal Resources Management Project of the University of Rhode Island. The participatory planning approach coordinated by the Hikkaduwa SAM Coordinating Committee promoted collaboration between local organisations and relevant government agencies, for the involvement of all stakeholders in the process of planning and implementation. One of the outputs of this process is a management plan that provides a brief environmental, social and political description of Hikkaduwa, and presents policies, strategies and actions that have been identified during public meetings as mechanisms to resolve the major challenges affecting the area. The plan also serves as a model to assist managers working in other similar situations along the coast of Sri Lanka.

The goal of the plan was to ensure the sustainable management of the coastal resources in the area. The SAM process included data collection, the development of an environmental profile; education within the local community; the development of a collaborative management plan; and the incorporation of critical economic considerations. The central involvement of the local community in the planning process helped to develop stewardship, and build understanding of financial and social benefits that could be achieved from sustainable development.

Some example objectives in the Hikkaduwa National Park Management Plan include:

1. Protect and improve the quality of the coral reef ecosystem and biodiversity in the sanctuary;
2. Develop a well trained and motivated sanctuary staff and provide them with the tools necessary for law enforcement;
3 Build community and public awareness about the importance and potential benefits of Hikkaduwa National Park;
4. Elevate the status of the sanctuary and establish a source of revenue that can be targeted for sanctuary management activities;
5. Reduce damage to the sanctuary from fishing and glass bottom boats.

Logical framework approach C4

Good planning is a key element of successful MCPA management. This sheet gives specific guidance on preparing a Logical Framework Matrix, or logframe, as this planning tool is frequently required by donors and others involved in MCPA establishment and management.

With the recognition that good planning is the basis of good implementation and effective management, various methodologies have been developed to assist with, and improve this process. Donors often require plans to be developed in a particular way and presented in a set format. A specific terminology has also developed that may vary (particularly from donor to donor), but in general the principles underpinning the approaches are the same. An effective MCPA manager will need to be familiar with some of these terms and approaches, especially if he/she has to seek funds from donors.

PRINCIPAL METHODS

Logical Framework Approach (LFA) – originally developed in the 1970s, this planning process is required by many donors, including the Global Environment Facility (GEF).

Objective Oriented Project Planning (OOPP; originally called ZOPP – the German acronym) – very similar to the LFA.

Results Based Management (RBM) or Results Oriented Assistance (ROA) – now being used by donors such as USAID and Canadian CIDA; it places as much emphasis on management, monitoring and evaluation of a project as it does on design.

The key points of these methods are that they:

- Require the participation of all key stakeholders and those who will be involved in implementing the plan;
- Are objective and/or results oriented, i.e. they focus on what it is to be achieved as well as on the immediate things that need to be done.

All the methods involve objective-oriented planning, which comprises a series of steps:

- Analysing the existing situation;
- Describing the desired situation, which requires identifying the solutions – often called project objectives;
- Choosing the strategy for meeting the objectives;
- Identifying the actions to be taken and the desired results;
- Analysing the risks or potential hindrances to success and the assumptions.

The plan, for a particular project or initiative, developed using the above process is often summarised in a table that is referred to as a logical framework matrix, or logframe. The three main elements of the matrix are the impact of the project, the project itself, and the external environment.

THE LOGFRAME

The logframe summarises the project and its context in a logical manner, so that the connection between the activities (sometimes known as inputs) and the expected results (sometimes called outputs) can be seen. The framework has both a vertical and a horizontal logic. The vertical logic shows what the project intends to do, the relationships between what will be done and what will be achieved (the 'means to the end'), and specifies the main risks and assumptions. The horizontal logic defines how progress and performance will be monitored, and the sources of information for doing this.

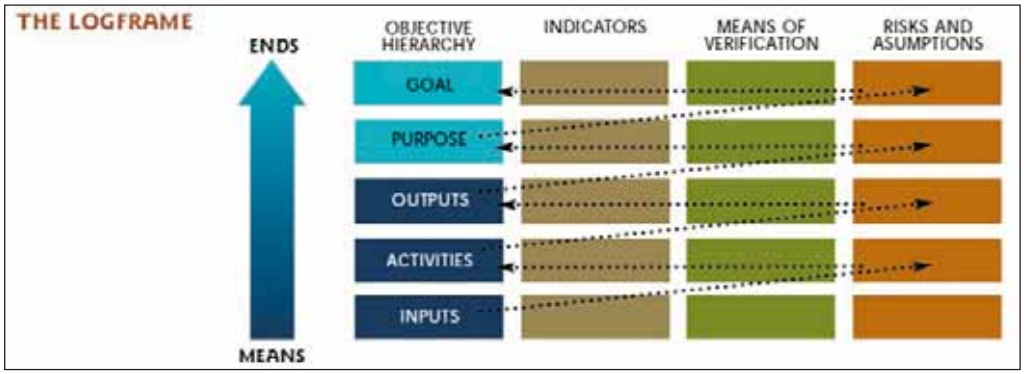
OBJECTIVE HIERARCHY – This describes the project in a logical sequence which is broken down into the following components:

Goal or Long Term Objective: The expected long term 'impact' of the project. The goal describes a desired situation for the environment and/or people that the project will help to achieve (e.g. integrity of an ecosystem or survival of a threatened species). Note that the project will not itself be able to achieve this goal; it will only contribute towards it. The timeframe of the goal is usually more than five years.

Purpose or Short Term Objective: The situations, conditions or behaviour that needs to be changed in order to contribute to the goal. This statement is what will be achieved by the project (e.g. the protection of an area or resource). The purpose usually has a timeframe of 3-5 years.

Outputs (sometimes referred to as results): The tangible products or services to be delivered, and for which those implementing the project can be held directly accountable for producing (e.g. legislation enacted, management plan produced). Outputs may have a time frame of around a year.

Activities: Specific actions that must be undertaken to achieve particular outputs (e.g. baseline surveys, training courses, staff recruitment and infrastructure development).



Inputs: The resources that are required to carry out activities, i.e. financial, human and physical resources.

INDICATORS – These are used to measure the extent to which the different components of the objective hierarchy are being achieved. Indicators need careful selection (see sheet G1).

MEANS OF VERIFICATIONS – These include the sources of information that will show whether the indicators have been achieved. This column, with the indicators column, provides the basis for developing the monitoring and evaluation programme for the project.

RISKS AND ASSUMPTIONS – These may affect whether the objectives are achieved. A risk is an external factor that may negatively influence the realisation of objective(s) while an assumption is the underlying hypothesis on which the cause-effect relationship is based. Identifying risks and assumptions helps to determine what is under the direct control of MCPA management, what requires collaboration with others, and what is beyond the influence of the MCPA and its stakeholders. An example of a risk that can be managed is 'cooperation of local communities'. Such a risk may mean that additional project activities are required such as an environmental education or income generation component. Examples of unmanageable risks are the effects of global warming, international commodity prices and government policy. By working through the identification of risks and assumptions in advance of project activities, managers may ensure that all actions are well planned, are based on a consideration of the full scope of eventualities, and are supported by contingency planning around potential pitfalls.

Logframes are generally used for projects of limited duration with a set budget. An MCPA is a permanent institution and, although potentially feasible, it is not usual for an MCPA management plan to be drafted in the form of a logframe. The goal and purpose or objective of a logframe is therefore unlikely to be identical to the goal and objectives of the MCPA itself. However, the principles used are useful to consider in any form of planning.

KEY POINTS FOR THE MCPA

- **The principals underpinning the logframe can be applied to planning for any action and used to guide consistent thinking around any action.**
- **Ensure that the goals of any planned actions are realistic, clearly articulated and understood by stakeholders.**
- **Ensure that the action is relevant and responsive to the MCPA and ecosystem management issues.**
- **Ensure that there is sufficient capacity (human, financial and equipment) to perform and maintain the proposed action, and that the responsibilities of each partner are clear.**
- **Set manageable deadlines for the completion of actions to ensure the objectives can be attained.**
- **Sustainable financing mechanisms should be explored and, if possible, tested.**
- **Ensure that appropriate monitoring information is collected to support reporting against effective indicators of progress and the objective evaluation of the action.**

Sources of further information

Kareko, J. & Siegel, P. 2003. Planning for Marine Protected Areas. Module 2. p. 39-84. In: Francis, J. et al. (eds.) Training for the Sustainable Management of Marine Protected Areas: A Training Manual for MPA Managers. CZMC/UDSM, WIOMSA, World Bank. SEACAM, 1999. From a Good Idea to a Successful Project: a manual for development and management of local level projects.

UNDP/GEF, 2002. Project Preparation Manual. Introduction to the LFA. M&E Reference Unit. Available from www.pops.int/documents/guidance/NIPsFinal/logframe.pdf

UNEP. 2000. Project Formulation, Approval, Monitoring and Evaluation Manual. Programme Coordination and Management Unit, UNEP, Nairobi, Kenya. Available from http://www.unep.org/pcmu/project_manual/chapters.asp

Örtengren, K. 2004. A summary of the theory behind the LFA method. Swedish International Development Cooperation Agency (SIDA). www.sida.se/publications

Donor guidelines are available as follows:

AusAID, 2000. AusGUIDELines. The Logical Framework Approach – www.ausaid.gov.au/ausguide/pdf/ausguideline3.3.pdf

CIDA, 2000. PRB-RBM Handbook on Developing Results Chains. Results Based Management Division – www.acdi-cida.gc.ca

European Community – general information on their project approach – http://europa.eu.int/comm/europeaid/

Finland. Dept. for International Development Cooperation. Ministry of Foreign Affairs. Guidelines for Programme Design, Monitoring & Evaluation – www.global.finland.fi/english/publications/guidelines

NORAD, 1999. The Logical Framework Approach. Handbook for objective-oriented planning - www.norad.no

www.teamusa.com – provides Windows-based Project Cycle Management software for assistance in developing logframes.

Sourcebook is an electronic resource to assist in the design, award, and administration of results-oriented grants and cooperative agreements to implement foreign assistance activities – http://www.usaid.gov/pubs/sourcebook/usgov/

http://gefll.reefbase.org incorporates a comprehensive database containing lessons learned, best practices, manager's toolkits, metadata, together with relevant publications and references.

Progress and donor reports C5

Most MCPAs have requirements for regular progress reporting. There may also be requirements for a range of other reports. Report writing is an essential skill to develop, either for the MCPA manager or other staff delegated to this task. This sheet provides guidance on how to prepare reports and a suggested outline for annual or project reporting.

Planning, monitoring and reporting are all interlinked. Progress reports are essential for measuring achievements, focusing activities and improving subsequent work plans, encouraging new funding, and providing a historical record for future reference, particularly if impacts of the work are to be assessed. MCPAs generally have a series of different reports that have to be produced on a regular basis for various reasons, including progress reports to the management agency and donors. In addition, many MCPAs have to meet donor reporting guidelines for some of their activities and these may show a variance in specifications. While some have clear guidelines, others are vague and others state that an institution's own guidelines can be used as long as they are "good".

Compilation of progress reports should involve key individuals involved in the work undertaken. Use can be made of photos, maps and graphics where appropriate, as this can greatly enhance the usefulness of the report. However, figures should be used to clarify points made, not to duplicate information. Do not spend so much time on figures that the content of the text suffers. What you say is ultimately more important than how you say it, but presentation is important if the report is to be read and taken seriously.

A good report is not necessarily a long report, despite the many sections that should be included. Care should be taken to avoid duplication, and text should be relevant to the section and concise and clear, so that it is immediately understood by the person reading it. Pay attention to the logical structure of the report, ensuring that the right information is presented clearly in the right sections. Many donors as well as other report 'users' will have many documents to read; thus a report that clearly conveys the message and is to-the-point, is a good report.

REPORT STRUCTURE

Despite the variety of formats that may be required, most reports generally require the same topics and content to be covered. The following reporting structure may therefore be a useful guide but should be adapted to suit the specific situation. In particular, if there is a logframe (see sheet C4), the report should reflect the structure of this, and report on each of the levels (e.g. goal, purpose, outputs/results).

It is likely that many reports will have to be produced by the MCPA management continuously, as an MCPA may have many concurrent projects and donors. It is good practice to use the information that has been developed from one report in another. Where possible general content (e.g. background text, site descriptions, organisational information) and formats produced for one report should be used in another; this will save time and increase reporting efficiency.

Title and cover – The cover page should clearly show the title and date of the report, and often it should give details such as the type of report (e.g. annual/semi-annual/quarterly), period it covers, and number and name of project (if the report is a project report), the name and contact details of the author and the intended recipient of the report (e.g. the donor).

Executive summary – This should capture the essence of the report and should include an overview of its contents and summary of its conclusions or findings. It should be the last section to be written, although it is placed at the beginning, and it should be kept short. It should not contain anything that is not referred to, and supported in the main report.

Background and/or introduction – Some donors require a summary giving highlights of the activity being reported on, including location, the justification and rationale for it, start and end dates, and planned period. The introduction should set the tone of the report, and summarise the goals and objectives. It should include any changes that might have taken place in the logframe or reporting schedules since the previous report was written.

Update on activities – This section should provide an overview of the status of activity implementation during the reporting period, highlighting the extent to which planned activities were implemented. The report should refer to the indicators and their means of verification at the activity level in the LFA, and any deviations from what was planned should be explained. It is advisable to make a brief narrative statement highlighting any notable achievements and/or deviations, and to present a detailed account of progress in an LFA-type table indicating status of implementation.

Results – This section should provide an analysis of the extent to which implementation of activities has contributed to the achievement of results (sub- and key results), planned results achieved and whether the activities were appropriate. The report should refer to the indicators and their means of verification at the appropriate level in the LFA, and provide supporting material as evidence of achievement, such as special reports, workshop reports and others. Provide a list of publications and other outputs or activities where appropriate. This analysis will be particularly useful in half-yearly and annual reports. The report should refer to the

indicators and their means of verification at the appropriate level in the LFA, and provide supporting material as evidence of achievement, such as special reports, workshop reports, and others. Provide a list of publications and other outputs.

Contribution to purpose and longer term goal – This section should provide an analysis of the extent to which the activities and results achieved have contributed to achieving the project purpose and its long term goal. In addition to further reflection on the effectiveness and relevance questions, an analysis of impact and sustainability should be attempted, thus: To what extent have the longer term goals been achieved? What should be done differently to ensure progress towards longer term goals? Have there been any unanticipated positive or negative consequences? Why did they arise? If negative, what should be done about it? Will there be continued positive impacts as a result of the activity once it has finished and, if not, why? What should be done differently to ensure sustainability? This information will not normally be included in quarterly or half-yearly reports, unless something very significant happens during the reporting period.

Deviation from the objectives/key results/goals – State whether the activity is still on track. Has the logframe been revised extensively as a result of a review and its recommendations, or for any other reason (i.e. a better understanding of on-the-ground realities)?

Obstacles encountered and solutions identified – Obstacles and problems may have origins within the MCPA or project (e.g. staff changes or illness, breakdown of equipment), or outside (e.g. bad weather, changes in government policy). An analysis of problems will help the donor, the project staff and the MCPA staff understand the constraints under which the activities are being carried out. It is especially important to describe the solutions that have been found, or the actions that have or will be taken to overcome the obstacles, and any lessons learnt. Many people feel they must only report on successes and achievements. However, there are probably no projects that do not encounter problems at some time. These should be identified and an explanation given of the impact they have had on the progress of the project.

Plans for the next reporting period – This is not always required, but it can be very useful for donors and others using the report if there is a short summary of the main activities to be carried out in the next reporting period. This will show that "lessons learnt" and activities postponed in this period are being acted upon. Reports should be focused, but nevertheless reflective.

Financial report – This section should include the detailed financial report (usually as a spreadsheet) as well as a short text summary that shows how the resources have been used and what problems might have been encountered, highlighting significant deviations from the approved budget. Any requests for approval for changes to the budget, such as for budget reallocations, should be included in this section. Most donors have quite specific instructions on financial reports.

FINALISING A REPORT

This involves the following steps:

Checking the spelling – Use the computer spell checker (select appropriate language version);

Editing – Check logic, content with respect to headings, references, and consistency;

Proof-reading – This should be done by someone other than the author;

Acronyms and abbreviations – Provide a glossary;

Numbering – Check that annexes, figures, tables etc are correctly numbered.

It is important to make sufficient copies of the report for all partners as well as the donor, and to keep reports on file and use the previous one as a 'template' for the next one. This will allow the donor and other readers to compare achievements between years. However, do not 'cut and paste' the same information from report to report. Apart from general information in the background or introduction sections, the information to be provided will differ in each report. Try to use emailed electronic copies as far as possible, as printing and postage waste resources.

KEY GUIDANCE FOR MCPA MANAGERS

- **Reporting should be made against effective indicators of progress to allow for objective evaluations.**
- **Frequent assessments allow for flexibility and rigorous monitoring of progress but should not detract from implementation of activities/actions.**
- **Ensure that MCPA staff who are responsible for report writing have appropriate training.**
- **Make sure that all staff involved in the submission of reports are aware of schedules and deadlines.**
- **Before reports are submitted, look at them critically, as if you were the recipient.**
- **Ensure that reports are filed in both hard copy and electronic form and are accessible for future reference; associated correspondence should also be filed.**
- **Ensure that the reports are disseminated effectively to individuals/organisations who need or could benefit from them.**

Sources of further information

Parr, S. & Fielding, P.J. 2003. Communication and Public Relations. Module 5. p.149-186. In: Francis, J. et al. (eds.). Training for the Sustainable Management of Marine Protected Areas: A Training Manual for MPA Managers. CZMC/WIOMSA, World Bank.

Swamy, K. 1997. Report writing. In: Samoilys, M. (ed.) Manual for Assessing Fish Stocks on Pacific Coral Reefs. Queensland Department of Primary Industries, Brisbane. 78pp.

http://gefII.reefbase.org – Incorporates a comprehensive database containing lessons learnt and best practices on project design and management, including manager's toolkits, metadata, together with relevant publications and references.

Personnel D1

MCPAs employ a range of personnel for specific duties. Management of these staff is very important and sufficient time must be allocated for this purpose. This sheet outlines some of the key elements in day-to-day management of MCPA personnel: assessing capacity and skills needs; recruitment; use of temporary staff; motivation, incentives and performance appraisal; training (courses, workshops, on-the-job and study visits); and elements of effective teamwork.

The personnel of an MCPA are one of its key resources and an important task for the manager is to put in place a group of staff who are capable of working together as a team. The operational part of the management plan (or the operational plan if this is a separate document) should identify the activities and tasks that are needed to meet the objectives of the MCPA. These will range from issuing permits and patrolling, to research and monitoring, education and interpretation, community consultation and facilitation, and a range of support duties. Each task will need to be broken down into a set of roles and responsibilities, with individual goals that can be assigned to different staff members. In this way the needs in terms of capacity and skills can be assessed. In reality, some tasks may be carried out by several people; conversely, individual staff members may have several responsibilities.

The number of permanent staff employed by MCPAs in South Asia is highly variable and can range from one or two to more than 20. MCPA staff should be a combination of professional and technical staff with skills in key programme areas (e.g. fisheries, monitoring or community activities) and support staff with more general skills, but there tends to be much overlap in jobs. Important staff positions include field staff or rangers, boat crews, MCPA manager, communications officer, research personnel, community development coordinator and law enforcement officer. Support staff such as cooks, mechanics, cleaners and security guards may also be needed. In general, the larger the area of the MCPA and the greater the number of visitors (e.g. involved in recreational or commercial activities), the higher the staff levels. The workforce can be increased by using seasonal staff or volunteers as well as consultants or contract staff.

In large MCPAs, there may be sufficient funding to appoint a human resources manager who would be responsible for management of personnel. However, this is not possible in most South Asian MCPAs, and this responsibility often falls to the senior manager and/or the overall management agency. A good manager will be in touch with, and approachable by employees and will be aware when there are problems related to performance, job satisfaction or working relationships.

Coastal Conservation Department

Staff of the Coastal Conservation Department, Sri Lanka, carrying out surveys

RECRUITMENT

This involves preparing job descriptions, advertising, selecting candidates for interview, selection of an interview panel, interviewing (including development of interview questions), obtaining references, deciding on the most appropriate candidate, and appointment (preparing a letter of appointment). Recruitment is often best carried out in a phased manner, with a small number of staff being recruited initially to carry out the core tasks involved in setting up the MCPA. Additional posts can be filled later. It is important to be aware of the following when embarking on any recruitment activities:

- Recruitment can be costly, both financially (e.g. costs of travel and accommodation for interviewees and selection panel), and in terms of time;
- There may be legal requirements (e.g. working conditions, provision of holidays, conditions for dismissal) that affect employment of staff and it is important that these are observed;
- Attempts should be made to employ staff on as equal terms as possible, while recognising that employees' rights and benefits may vary according to whether they are permanent or temporary, full-time or part-time, and to their skills and qualifications.

It is also important to ensure that all aspects of recruitment are carried out as fairly, efficiently and transparently as possible, with due consideration of gender and equal opportunities for men and women (see sheet B3). Following appointment, a probationary period (usually 3-6 months) may be appropriate to see if the new employee performs well. The new staff member should be given the necessary training or induction course and helped to settle in.

DAY-TO-DAY STAFF PERFORMANCE

All staff must have clearly assigned roles and responsibilities laid out in their Terms of Reference and individual work plans. These should relate clearly to the job description, and set realistic and time bound targets or measurable standards that must be accepted by both employer and employee. 'Output' rather than 'input' related work standards should be set, e.g. 'MCPA vehicles must not break down as a result of lack of engine oil', rather than 'check the engine oil once a week'; 'the beach by the guest houses must be clean' rather than 'clean the beach every morning'.

Staff often prefer to wear uniforms rather than their own clothes, as it saves on wear and tear, and provides them with the necessary status when dealing with visitors, stakeholders and particularly those who may be causing problems for the MCPA.

PERFORMANCE APPRAISALS

An annual performance appraisal of each staff member is increasingly common in many organisations. It is used to set and review performance objectives, and to determine training and development needs, and it can be a valuable tool for maintaining motivation. Other ways to motivate staff are to hold regular staff meetings to discuss progress and concerns, and to organise social events (preferably outside work hours!).

STAFF TRAINING

Periodically it will be necessary to carry out an assessment of capacity and skills among the staff and organise training where particular skills are lacking. Training can take many forms, from formal courses, exchange visits and study tours, to on-the-job training that might involve participation in workshops and meetings, and increasing responsibility.

STAFF RETENTION AND CONTINUITY

A major problem associated with MCPAs in South Asia is the non-retention of staff within an MCPA for extended periods of time. This is mainly the result of MCPAs being managed by government authorities that are also responsible for managing terrestrial protected areas. Often, institutional rotational arrangements result in a constant transfer of staff between terrestrial and marine protected areas, thereby limiting the impacts of staff training and capacity building in MCPA management. In many cases, MCPA staff who are provided training are transferred to terrestrial protected areas soon afterwards and new staff with minimal skills are allocated to the MPCA. Management authorities need to understand that managing MCPAs requires specific skills and knowledge and efforts to retain trained staff within the MCPA or transfer them among other MCPAs where their skills would be applicable.

KEY POINTS FOR THE MCPA

- Make sure all staff have clear and well understood job descriptions, a line manager, clearly defined annual work plans, and that progress is assessed on a regular basis.
- Hold regular staff meetings, preferably at least one a week.
- Ensure that performance appraisals are carried out on a regular basis, and in a participatory manner.
- Conduct a capacity building needs assessment before launching into training and make attempts to retain trained staff within the MCPA.
- The manager should regularly evaluate how best to deploy staff and make sure that they are willing and able (through training) to be flexible, given that management priorities may change over time.
- Become familiar with the local labour law, statutory minimum pay and conditions of employment, and disciplinary and dismissal procedures.
- If staff are not 'government employees', have a local labour lawyer draw up a standard employment contract.
- Remember the key to good staff management is ensuring staff work together as a team.

Sources of further information

Bird, P. 1998. Performance Appraisals. Hodder and Stoughton Ltd., London, UK.

Corfield, T. 1993. The Wilderness Guardian: A Practical Handbook. African Wildlife Foundation/The David Sheldrick Wildlife Trust. Longman, Kenya. 701pp.

Greenwood, D. 1996. Taking on staff: How to recruit the right people for the right job. Business Basics Series, How to Books, Plymouth, UK.

Humphrey, S. 2003. Administration and Management. Module 6. In: Francis, J. et al. (eds.). Training for the Sustainable Management of Marine Protected Areas: A Training Manual for MPA Managers. CZMC/WIOMSA.

SEACAM 1990. From a good idea to a successful project: A manual for development and management of local level projects. SEACAM, Maputo. 152pp.

Taylor, G. 1996. Managing Recruitment and Selection. Directory of Social Change, London, UK.

http://www.toolkit.cch.com/text/p05-0000.asp – gives practical details on recruitment and staff motivation.

http://www.ee.ed.ac.uk/~gerard/Management/index.html – information on basic management skills.

http://www.jimcollins.com – good articles on management.

http://economist.com/surveys/PrinterFriendly.cfm?Story_ID=770819 – good articles on management.

http://www.wiomsa.org – or secretary@wiomsa.org – for information on the WIOMSA training courses for MPA personnel.

Consultants and experts D2

The large and varied workload involved in managing an MCPA means that particular skills, experience and capacity are often lacking. Consultants and short-term experts are often needed to help fill this gap. This sheet provides guidance on engaging such individuals, preparing their contracts and ensuring that the MCPA cost-effectively benefits from their services.

It is often necessary to contract out important but short term or highly skilled activities, if the MCPA does not have sufficient capacity within its own staff. This can benefit the MCPA in several ways. For example, consultants may provide new ideas and approaches, and a broader view of issues. They are likely to bring their experience from other MCPAs or projects as well as having skills not available among the MCPA staff.

Consultants and other short term experts are relatively expensive compared with full time MCPA staff. In order for the MCPA to get full value from them, it is essential that their role is clear, both to them and to the MCPA staff. If not, there may be conflicting expectations and misunderstandings among MCPA staff, other stakeholders and partner organisations involved. For this reason, a consultant must have clear and concise Terms of Reference (TOR) and an agreed contract with the MCPA agency.

PREPARING TERMS OF REFERENCE

These should be prepared before the consultant is selected, so that the skills and type of person required is known. All those who will be affected by the work of the consultant should have an opportunity to review the TOR. The TOR should be as specific as possible yet flexible enough to allow a consultant the opportunity to exercise his/her experience and expertise.

The TORs should include:

- A description of the general purpose or objective of the consultancy;
- The background to the activity that the consultant is to undertake;
- The specific role of the consultant (e.g. team leader, technical advisor, facilitator) and his/her reporting lines;
- A list of the principal tasks to be undertaken, including field work, analysis and interviews, where known;
- A clear list of outputs expected from the assignment;
- A schedule of completion dates or deadlines, where relevant, and any specific requirements concerning format (whether electronic, paper or bound), quantity or content of reports;
- Any particular working arrangements expected (e.g. collaboration with certain partners or stakeholders) and where the work is to be carried out;
- Arrangements for consultation and collaboration with other MCPA staff (e.g. meetings);
- Administrative support that will (and will not) be available to the consultant, and particular activities or logistics that he/she will be responsible for providing.

SELECTING CONSULTANTS

It is essential that a consultant has the necessary skills, appropriate sensitivity, attitude and cultural understanding, language skills if necessary, and professional competence for the required task, and that she/he is sympathetic to the approach being taken. A selection of CVs should be obtained, and advice sought from a wide range of people and organisations familiar with appropriate individuals. Depending on the situation, a consultancy may need to be advertised or put out to tender.

Thought will need to be given as to whether international or national consultants are to be used, or a combination of both, as this may have different budgetary and contractual implications. If a consultant from overseas is used, it is advisable to team her/him up with a national counterpart, who could be a member of the MCPA staff. This is advantageous to both; the international consultant will benefit from the ready source of local knowledge, and the staff member will learn from the consultant's experience.

If a team of consultants is to be used, attention should be paid to gender and cultural balance, and to working relationships within the team. If using an overseas consultant, an interpreter will need to be available if the consultant does not speak the language.

PREPARATION OF A CONTRACT

Whereas the TOR provides a general description of work to be undertaken, the contract is the legally binding agreement under which consultants and employees agree to work, and the hiring agency (e.g. the MCPA or other management agency) agrees to pay remuneration. Since it is a legally binding document, it is important that all issues that might result in legal action are covered and clearly explained and defined. The management agency may have a standard contract form that is adapted for individual contracts. If not, one should be developed for use by the MCPA, and it is advisable to seek advice from a legal expert. Contracts should specify the following;

- A list of deliverables and expected actions with specific provisions (e.g. 10 copies of the report to be disseminated at no cost);
- Timing of the consultancy and reporting schedule, including timescale for submission of, and comments on draft products/ outputs;
- Fees, payment schedules and arrangements for other expenses incurred by the consultants or employee (such as travel, accommodation, equipment);
- Arrangements for cancellations or delays due to either party (e.g. late delivery of a report by the consultant; late reviewing of draft reports by the hiring agency);
- Any insurance arrangements;
- Any penalty clauses (e.g. for late or non-delivery of the products);
- Intellectual property rights (i.e. subsequent ownership of data and other materials gathered during the work);
- Any *force majeure* – this is a term use to describe a common clause in contracts, which essentially frees both parties from liability or obligation when an extraordinary event or circumstance beyond the control of the parties, (such as wars, strikes, riots, crimes, acts of nature), prevents one or both parties from fulfilling their obligations under the contract.

Make sure any tax responsibilities are also clearly laid out in the contract and any statutory tax deductions (such as withholding taxes) to be made by the paying agency, the MCPA, are clearly defined. The TOR can be incorporated in a contract in a number of ways. It can be appended to the contract as an annex or be an integral part of the contract's main text. Most organisations have their own contract formats and these can vary. The most important thing is to be consistent with the accepted format that the MCPA's managing authority recognises and to avoid duplication (e.g. do not incorporate the TOR in the main body of the text and then duplicate it in an annex). Work schedules and tasks laid out in the TOR should be carefully checked against time lines and reporting requirements in the contract, to ensure that there are no contradictions. The time taken to undertake a task or piece of work can easily be underestimated. This is particularly so in South Asian countries and with tasks related to MCPA management, where unexpected delays may occur due to events such as equipment purchase being delayed, unsuitable weather for fieldwork and a complex bureaucracy. It is therefore important to have a system whereby the final deadline can be extended subject to mutual written agreement.

The contract should be reviewed carefully by both the hiring agency and the consultant or prospective employee to ensure that both are in full agreement with the contents before signing. Normal practice is for two copies of the contract to be signed and for all pages of both the contract and TOR to be initialled by both parties, indicating that they have read, understood and agreed to what is written. The consultant retains the original and the hiring agency retains a copy.

WORKING WITH CONSULTANTS

On starting work, the consultant should be introduced to all those with whom she/he will be working, and given a full briefing, and all the necessary documentation. When the consultant needs to ask questions or obtain further information, MCPA staff should be prepared in advance, and ready and willing to assist. To get full value from a consultant, priority needs to be given to providing the necessary MCPA inputs, in terms of staff time as well as other support, in a timely manner. It is important to remember that a consultant's time costs money.

If things go wrong, as they sometimes do, there are a number of things to consider. Do not accept or pay for work that is unsatisfactory. The products and outputs (deliverables of the contract) should be of appropriate quality and usefulness to the MCPA. Where a report is the 'end product' the following questions should be asked before paying the consultant:

- Has the consultant provided more answers than questions?
- Does the report clearly analyse the issue(s) rather than just describe what is already known?
- Is the report easy to read and clearly laid out?
- Are the conclusions and recommendations clear and unambiguous, and supported by analysis and evidence?
- Has the consultant met her/his overall TOR?
- Has the agreed information and support been provided by the MCPA to the consultant?

If the answer to all the above questions is yes, then both the MCPA and the consultant have done very well!

KEY POINTS FOR THE MCPA

- **Think carefully before hiring consultants and be absolutely sure about what is expected from them; only hire consultants where in-house capacity is lacking and there are no appropriate partners to assist.**
- **Be sure to check the background experience of the consultant and obtain references or examples of previous work.**
- **Obtain samples of TORs and consultancy contracts from other MCPAs as a guide, before developing these documents for the first time, and seek advice from a legal expert.**
- **Check both TORs and contracts very carefully before the contracts are signed, and make absolutely sure that both parties fully understand, and are in agreement with the contents.**
- **Keep in touch with the consultant as the work progresses, so that any problems can be identified at an early stage, thus assisting the consultant and helping to ensure that the MCPA receives a good product in a timely manner.**

Sources of further information

Gosling, L. & Edwards, M. 1995. Toolkits: A Practical Guide to Assessment, Monitoring, Review and Evaluation. Development Manual 5. Save the Children. London, UK. 254pp.

Parr, S. & Fielding, P. J. 2003. Communication and Public Relations. Module 5. pp 149-186. In: Francis, J. et al. (eds.). Training for the Sustainable Management of Marine Protected Areas: A Training Manual for MPA Managers. CZMC/WIOMSA.

CASE STUDY

Sample TOR and Scope of Service for a Reef Status Assessment

The following case study demonstrates the basic attributes for inclusion in a consultant schedule, based on a hypothetical MCPA and service requirement. This is indicative only and MCPA managers should seek legal advice when preparing any formal contracts.

TOR and Scope of Service

Tasks under this contract contribute to the attainment of objectives outlined in the management plan of the Alpha Lagoon MCPA, for the improved understanding, assessment and management capabilities with respect to coral reef resources within the MCPA. Tasks will be carried out in close collaboration with the MCPA management authorities in order to develop the technical capacities of MCPA ground staff. Detailed descriptions of methodologies are included as an annex and form an integral component of this contract.

1. Specific responsibilities

- Monitoring of coral reef status to obtain reliable information on the health of reefs and reef based resources, especially in view of possible impacts of climate change;
- Survey 15 sites within the MCPA, and 10 control sites over a period of 30 days in the field;
- Methods should be based on internationally recognised protocols, e.g. benthic line intercept transect and under water fish visual census (see annex 1), to allow comparison to previous years' data for trend analysis purposes;
- The survey team should be sufficiently large (6 persons) to cover sites in the time available, and should include 2 MCPA staff members. The participation of MCPA staff in the surveys is not covered under this contract.

2. Reporting and outputs

- The results from the surveys should be presented in a "Status of Reefs of Alpha MCPA" report suitable for publishing. The report should be prepared in English;
- A policy brief should be prepared to disseminate results, findings and information on the implications of these to managers and policy makers. This should be prepared in English;
- A draft of the both products should be submitted to the MCPA management authorities, in electronic format, before 15 October. The final products (amended as necessary based on comments provided) should be submitted no later than 30 December. The outputs will give due recognition to all partners of the surveys, and the respective logo placement;
- Ten printed copies of both final products should be provided to the MCPA authorities at no cost;
- The Consultant shall provide brief updates on progress, suitable e.g. for the MCPA website and newsletter, on request;
- A detailed financial statement should be submitted no later than 31 January

3. Cost

- The total cost of these activities is US$ 12,000. This figure does not include insurance which must be provided by the Consultant for the duration. An initial payment of US$ 8,000 shall be made upon signature of contracts, and a final payment of US$ 4,000 made only on satisfactory delivery of all outputs. Invoices to this effect should be submitted to the MCPA management authorities.

4. General provisions

- The Consultant shall be considered as having the legal status of an independent contractor and is not considered as an employee of the MCPA;
- This contract can only be terminated through previous written advice from the interested party at least 30 days before the proposed date of termination;
- In the event of the contract being terminated in this way, the Consultant shall be compensated on a pro rata basis for no more than the actual amount of work performed;
- Publications should be prepared in line with the MCPA profile, and copyright of products shall rest with the MCPA management authorities.

Partnerships and volunteers D3

MCPAs rarely have enough staff to carry out all the activities that are necessary for fully implementing the management plan. Capacity can be increased often at little cost by developing partnerships with local or national institutions with specialist skills or by using volunteers, research groups or student expeditions from overseas. This sheet outlines the advantages and disadvantages of these arrangements, the types of work that are most suitable, and provides information on how to find such assistance.

MCPAs can increase their capacity by taking advantage of individuals and organisations that, for a variety of reasons, have an interest in working in such areas at their own cost. This is particularly useful where MCPAs lack staff with specific skills, such as scuba diving, or knowledge of particular species that need to be surveyed or monitored. External personnel may also be useful for tasks that are labour intensive or take a long time. The types of activities that are suitable to be carried out by non-MCPA staff include:

- Ecological and socioeconomic survey and assessment work of all types (e.g. surveys of coral reefs, marine turtle monitoring (see case study from Sri Lanka), bird counts, collecting data on questionnaires). Often, partner institutions and research expeditions bring in knowledge of methods that the MCPA personnel may be unaware of;
- Research on specific topics (see sheet G11). This can sometimes be carried out by students, research expeditions or visitors from other institutions;
- Certain types of monitoring. Monitoring should be carried out on a regular, long term basis, therefore, short term visitors are generally not the ideal people to assist with this. However, groups or individuals that return to the MCPA regularly or that are based locally can play important roles;
- Fundraising. Local residents and NGOs are often willing to help with this activity;
- Helping to organise special events and assisting with awareness-raising and educational activities;
- Beach and reef clean-ups (see sheet K4) and other general maintenance work around the MCPA requiring physical labour.

If non-professionals are involved, it is most important that the activities are tailored to their skills or that some form of training is given to ensure that the work done is of an adequate standard. If this involves data collection, it is important that the MCPA manager fully understands the quality and reliability of this and to what extent it is comparable with other data collection activities.

PARTNERSHIPS WITH INSTITUTIONS

These might be local, national or overseas organisations that can provide specific assistance to an MCPA, perhaps in terms of funding, technical expertise or training activities. For example, the Global Coral Reef Monitoring Network (GCRMN) and Coastal Oceans Research and Development in the Indian Ocean (CORDIO) assist with monitoring activities in several MCPAs in the South Asian region, which saves these sites money (see sheet G11). Reef Check is one international programme that has worked successfully alongside MCPAs in other regions to engage the local tourism industry in broad scale reef monitoring activities.

VOLUNTEERS

Almost 40% of the population in the UK undertake volunteer work of some kind, and a similar situation occurs in many other western countries. 'Volunteering', or working for no money, is less common in South Asian countries, but nevertheless is growing, particularly among younger people. There are several categories of individuals who may volunteer to work in an MCPA. These include:

- Members of the local community, who may be benefiting from the MCPA and are willing to put back something in return. These include fishers who assist with patrolling, village members who participate in management committees, local residents who help with monitoring, school children and teachers participating in beach clean-ups, and dive operators;
- National or overseas students and/or interns, who come primarily for work experience and on-the-job training, or where their research interests coincide with those of the MCPA;
- Overseas volunteers provided either through one of the bilateral-aid national volunteer programmes or through international programmes;
- Overseas volunteers available through programmes run by NGOs or commercially organised operations; these often work in certain locations for a certain period of time and provide volunteers in teams. Most of these are based in the UK and USA;
- Tourists or visitors to the country who want to do something useful during their holiday.

Individuals participating in organised volunteer programmes will usually be paying a substantial sum of money to cover their travel and costs. Thus, they are not only providing their time for free, but they are also paying for the experience. It is important that the MCPA personnel they work with understand this – there is often an assumption that such volunteers are getting something for free. Furthermore, the volunteers will be expecting some personal benefits, usually in the form of gaining experience or on-the-job training. Many volunteers of this type are highly motivated and can make a major contribution over a short period. On the other hand, they may require support, which takes time (particularly if they are from overseas) and there can be problems if volunteers choose to ignore, or have not been fully briefed on, cultural issues and dress codes, and as a result behave inappropriately in local villages.

J. Tamelander

Local and international volunteers in the south of Sri Lanka assist in removing debris from reefs and beaches after the Asian tsunami, 2004

KEY POINTS FOR THE MCPA

- When carrying out a capacity needs assessment, consider whether other organisations or volunteers could carry out any of the tasks.
- Discuss with the management agency the potential for taking on one or more volunteers, and find out about insurance requirements and security risks (some MCPAs may not be able to host overseas groups of volunteers on these grounds).
- Be aware that some volunteer programmes may have a profit motive as much as a genuine desire to assist the MCPA and their interests may not be directly complementary to the MCPA objectives. It is important for MCPA management to clearly communicate their expectations and aims to intermediary organisations managing volunteers. This should ideally be clearly articulated in a written agreement, endorsed by both parties, that outlines roles, responsibilities and expected outputs.
- Make sure that MCPA personnel are fully involved and take part in the activities carried out by partner organisations or volunteers so that they learn from the experience.
- Encourage and enlighten MCPA managers and staff to utilise the services of volunteers and institutions (local and international). However, note that managing or engaging with volunteers can be taxing and take up important time of MCPA staff. Volunteers should be taken on in a way that benefits both parties.

Sources of further information

Bilateral aid funded volunteer programmes:

UK -Voluntary Service Overseas (VSO) – www.vso.org.uk

Japan International Cooperation Agency (JICA) – www.jca.go.jp/english/

Germany – GTZ – www.gtz.de/home/english

US Peace Corps – www.peacecorps.gov

Australian Volunteers International – www.australianvolunteers.com

Overseas programmes that may be able to provide international volunteers or volunteer groups:

Greenforce – www.greenforce.org; info@greenforce.org

Frontier Conservation – www.frontierconservation.org; info@frontierconservation.org

Coral Cay Conservation – www.coralcay.org; info@coralcay.org

Earthwatch: undertakes specific research projects with scientists and provides volunteers as a work force (has carried out a number of reef survey and assessment projects) – www.earthwatch.org

British Executive Service Overseas (BESO) – www.beso.org

Raleigh International – www.raleighinternational.org; staff@raleigh.org.uk

Global Vision International – www.gvi.co.uk; info@gvi.co.uk

Travellers Worldwide – www.travellersworldwide.com; info@travellersworldwide.com

i-to-i – www.i-to-i.com; info@I-to-i.com

Wells, S.M. 1995. Reef assessment and monitoring using volunteers and non-professionals. Report for the International Year of the Reef. Tropical Marine Research Unit, University of York/Coral Cay Conservation, UK/University of Miami, USA. 57pp.

CASE STUDY

The Use of International Volunteers in Marine Turtle Conservation by the Turtle Conservation Project, Sri Lanka

The use of volunteers on marine turtle conservation projects is one of the more popular and successful examples of volunteer use in coastal areas, as evidenced in many countries across the world, including India and Sri Lanka. The nature of marine turtle nest monitoring and survey work is appealing to foreign volunteers due to the often attractive locations of turtle nesting sites and interesting nature of the work. Marine turtle nest monitoring work requires only minimal training, making it an ideal activity for local and foreign volunteers with varying degrees of expertise.

The Turtle Conservation Project (TCP) was established in 1993 and supports sustainable marine turtle conservation through education, research and community participation, with field offices across the south and west of Sri Lanka. In 1996, after conducting a national survey, TCP established its basic programme by pioneering an in situ marine turtle conservation programme in Rekawa after finding it to be Sri Lanka's most important nesting beach. Rekawa is a small village located on the south coast where 5 of the 7 species of marine turtles come to nest year round. Volunteer service programmes were established in order to increase the working capacity of the TCP at reduced costs, and to benefit from the input of volunteers from various backgrounds. TCP now provides opportunities for foreign nationals as well as nationals and local researchers to gain experience in community based conservation by becoming volunteers.

Volunteers are usually assigned a specific area of focus within the project depending on their previous experience, skills, goals and personal preferences. Volunteer research assistants are required to work demanding night and day shifts, and are expected to be involved in the standard research and data collection. Although previous marine turtle experience is preferable, it is not essential as volunteer training is provided by qualified professionals from TCP when required. Volunteers are engaged in a number of different tasks, including: identifying different turtle species; collecting biometric data on each turtle; tagging of new migrants; locating nests; measuring and weighing eggs; identifying false crawls; performing nest excavations; collecting biometric data on hatchlings; using their language skills to produce promotional material for the project; and dealing with day-to-day communication tasks.

Source:

Turtle Conservation Project, Sri Lanka – www.tcpsrilanka.org/index.htm

Safety and emergency procedures D4

Coastal areas and the open sea are inherently dangerous environments. Injuries resulting from being in or on the sea are the most likely, but are not the only emergency incidents in an MCPA. Prevention is always better than cure. There is NO cure for lost life. This sheet provides an outline of some of the key issues to bear in mind when planning safety and emergency procedures.

EMERGENCY RESPONSE PROCEDURE

MCPAs should have a contingency plan or Emergency Response Procedure (ERP) that lays out measures to be taken in an accident. The objectives of this should be to safeguard life, minimise the impact of the accident on personnel, the environment and property, and speed up mitigation. The plan or ERP should be developed with the participation of MCPA staff and other stakeholders who will take responsibility for the logistics, communications and actions involved. Other MCPA staff should also be aware of the procedures as their equipment and skills may be called upon. The ERP should detail:

- Agreed strategies and lines of communication;
- Actions to be taken in order of priority;
- Individuals involved and resources required.

Insurance for staff, equipment and infrastructure should be included within the MCPA budget and should ideally include emergency or disaster cover. The inclusion of third party liability helps protect the MCPA from litigation.

Incidents that require the activation of an ERP include fire, flood, storms and cyclones, oil and other chemical spills (see sheet K3) and medical evacuation, as described below.

Fire – The best protection is prevention. Smoking must be banned near all fuel stores or oxygen storage facilities. The MCPA should have sufficient fire extinguishers (both type and number), including carbon dioxide (for oil and electrical fires), and dry powder and water (for other fires); sand is effective on small fires. Fire extinguishers must be serviced (recharged). Staff must have basic training in their use and fully understand evacuation procedures. Oxygen refilling/storage stations must be well ventilated and in an area free of hydrocarbons (oil based solutions) and fuels.

Flood – Keep a supply of sandbags or plastic shopping bags that can be filled with sand or soil, and placed along the bottom of doorways to prevent damage to property. Plan for the aftermath of flooding, which may include damage by mud and debris, and pollution of drinking water sources.

Storms and cyclones – A system of colour-coded alerts is often used by the construction industry and could be adapted for an MCPA.

- Green alert – A tropical low or cyclone within 500 nautical miles; MCPA staff should continue work but the manager will maintain a constant watch and consider the amount of time required to stop work and leave the site if necessary.
- Yellow alert – Forecasts show the site to be in the predicted path or dangerous influence of a cyclone within the next 24 hours; all equipment must be checked and made secure, with additional sea-fastenings installed as required. Work in progress should be reviewed and no work initiated that does not allow safe abandonment within 12 hours.
- Red alert – The MCPA is within 120 nautical miles of a cyclone, or forecasts place it in the likely path or recurvature area within the next 12 hours. All vessels must abandon their work and transfer crews to safe locations.

Tsunami – Although only a rare occurrence, preparation for such an event is important and simple. Evacuation routes to high ground should be known by MCPA staff, and highlighted to the public through signs or notices. A waterproof box should be kept in an elevated position containing emergency supplies such as medical kit, blankets, torch, dry and canned food, and fresh water. Explore options for early warning alarm systems to alert local communities and tourists. The Intergovernmental Oceanographic Commission (IOC) is working towards a coordinated Indian Ocean Tsunami Early Warning System (IOTWS). Be aware of announcements regarding seismic activity and respond as needed.

Medical Evacuation (medivac) – Required in cases of severe injury or sickness; air transport to a medical treatment centre is usually required and the MCPA should have all the information at hand to arrange this. Depending on location and access to medical assistance, evacuation routes must be predetermined with potential obstacles identified. An alternative option should also be preplanned in case the first option is not possible. The medivac plan should make provisions for patients with suspected Decompression Illness (DCI), who must not be flown or driven over elevated areas about 300 metres (1,000 feet) and may require alternative evacuation procedures.

DANGERS AT SEA

Weather – Changes in weather should be monitored and, where possible, forecasts should be obtained before going to sea. If the MCPA has access to Internet or radio weather forecasts, storm alerts should be communicated to the local communities. There are online Internet resources for weather monitoring, and the best source for the MCPA being managed should be identified and referred to.

Vessel seaworthiness – Unfavourable sea conditions and poor seamanship often result in the swamping and sinking of small boats. An MCPA can help local boat users to improve the seaworthiness of their craft, and must ensure the safety of their own. All vessels should be carefully maintained and checked periodically by qualified technical personnel or boat builders (see sheet F5). For small boats, safety and seaworthiness are normally the responsibility of the vessel operator and/or owner.

M. Richmond

Life jackets are essential for activities involving children as seen here on a snorkelling trip to Chumbe Island Coral Park, Africa

Safety equipment – Vessels should not go to sea without adequate safety equipment. Life jackets, life rings and first aid kits should be encouraged on boats operating in the MCPA and should be mandatory on MCPA boats. Flares, torches, radios and survival supplies (including fresh water) are recommended.

Search and rescue man-overboard – The MCPA should have procedures for dealing with a missing vessel, fishing or tourist dive boat, or person on foot. Procedures depend on the equipment, skill and experience available, and may include other stakeholders such as Scuba diver operations, coastguard, and air charter companies. Searches should begin from the last known location and sweep the proposed route, and search teams should include individuals familiar with the area. Man-overboard procedures should be well practiced.

Swimming – Fishers and MCPA personnel often cannot swim, and most deaths at sea are caused by drowning. An MCPA can organise swimming lessons for all those who regularly use the MCPA, and all MCPA personnel should be provided with basic swimming skills. In the case of local communities, it is good to start with children. As well as saving lives, this will help to forge good relations.

KEY POINTS FOR THE MCPA

- Good communications are essential (see sheet F7) and should cover the entire MCPA.
- Daily time and travel plans, with check-in times by radio, help to keep track of field staff and detect safety issues.
- GPS and pre-recorded tracks of standard routes with way points should be developed and referred to.
- A communication flow chart should be clearly posted and should include the names, all phone numbers and e-mail addresses, radio frequencies or channels, of the following:
  - Police, Navy and Coastguard
  - Airline and charter companies
  - Air ambulance
  - Doctor
  - Fire brigade
  - MCPA Warden
  - Airports
  - Weather station
  - Re-compression facilities
  - Hospital
  - Pollution specialists
- Maps and charts should be detailed enough to identify the location of an incident and any wider geographical implications.
- A coordinator should be appointed and made responsible for all initial off-scene tasks, classifying the incident level, activating the ERP and/or the Oil Spill Task Force (if necessary), providing proper document control, auditing trails and preparing a full post-incident report, including a review of plans and lessons learned.
- All MCPA staff should take part in regular boat and other drills, and be trained to use the emergency equipment and other essential procedures. They should be fully aware of their particular duties so that no time is lost in an incident.
- A full first aid kit should be maintained and its contents kept in date. All MCPA staff should learn first aid. Oxygen is often needed in diving accidents, and is essential for treating decompression illness, and may be available from scuba diving operators. A stretcher should be included among emergency equipment.
- Emergency boat – If possible, keeping an emergency boat on standby for search and rescue or evacuation operations can save time.
- Equipment should be carefully maintained so that it can be used effectively in an emergency (see sheet F4). Additionally, faulty equipment can be very unsafe and actually can be the cause of accidents.

CASE STUDY

Contingency Planning and Emergency Preparedness in MCPAs in Thailand

Following the devastating 2004 Indian Ocean tsunami, many MCPAs have prioritised contingency planning and emergency preparedness. After extensive multi-stakeholder dialogue, Hat Nopparat Thara – Mu Koh Phi Phi National Park is addressing the tsunami threat through the following measures:

Emergency recall procedures – To enable a rapid response in mobilising the ERP, a system of communications to alert both the mass public and specific areas is the key. In the Hat Nopparat Thara – Mu Koh Phi Phi National Park, a connected alarm system has been set up, placed at various elevated points around the island, to alert the island community to a potential Tsunami. This system has proved very effective during recent seismic incidences, and further prepared communities for a Tsunami situation.

Emergency landing/meeting points – Where an emergency helicopter landing area is necessary, it should be constructed in collaboration with the civil aviation authorities, regularly maintained and kept free from obstruction. In Koh Phi Phi, a helicopter landing area and emergency meeting point has been designated to facilitate emergency evacuations and is clearly sign posted.

Awareness – Awareness raising is the key to ensuring the communities' ability to respond in the event of an emergency. Posters and signs have been made visible in public places in the local area, in a number of languages, to instruct people on the course of action to take should they hear the alarm.

Emergency-mindedness - In all contingency planning it is important to think ahead and try to 'disaster-proof' the MCPA. This includes: keeping boats and engines in top condition, with working replacements; removing potential hazards such as old/obsolete materials; removing overhanging branches near trails and infrastructure; fire-proofing fuel stores with bunding; and setting back buildings from the foreshore.

Sources of further information

Eagles, P. F. J., McColl, S. F. & Haynes, D. A. 2002. Sustainable Tourism in Protected Areas: Guidelines for Planning and Management. IUCN, Gland, Switzerland and Cambridge. 183pp.

Lockwood, M., Worboys, G. & Kotari, A. 2006. Managing Protected Areas: A Global Guide. James and James Ltd/IUCN. 802pp

Petursdottir, G., Hannibalsson, O. & Turner, J. M. M. 2001. Safety at sea as an integral part of fisheries management. FAO Fisheries Circular. 966: 39pp.

www.safetyatsea.com – major supplier of maritime safety equipment.

www.sailinks.co.uk/safety – short booklet on 'Safety at Sea' produced by the UK's Royal National Lifeboat Institution (RNLI).

www.ndmindia.nic.in – National Disaster Management Division, Government of India, Ministry of Home Affairs.

www.adpc.net/v2007/Default.asp – Asian Disaster Preparedness Centre.

Financial planning E1

MCPA managers face a major challenge in managing funds efficiently and developing a sustainable financing basis for the MCPA. Good financial planning (comparing expected costs with the projected income and specifying the means by which the two will be balanced) is essential in order to determine which activities have sufficient resources and which need additional funding. This sheet provides general advice on preparing a long term financial or business plan.

Protected Area (PA) financial sustainability can be defined as "the ability to secure sufficient, stable and long term financial resources, and to allocate them in a timely manner and in an appropriate form, to cover the full costs of PAs and to ensure that PAs are managed effectively and efficiently with respect to conservation and other objectives" (Emerton et al. 2006). MCPA financing is therefore about far more than just money; it involves mobilising and managing funds to address a range of challenges associated with biodiversity conservation. The MCPA financial plan provides a means of addressing these issues, and setting in place the conditions for financial sustainability. It is very important that in addition to identifying sources of funds, the financial plan is very clear on the allocation of funds, as this is a big issue in protected area management.

MCPAs incur a wide range of direct and indirect costs. These include both the operational costs of the salaries, infrastructure, equipment and maintenance required to establish and run the MCPA (typically borne by the park managing authority) as well as the various benefits or economic opportunities that are diminished or lost due to the presence of the MCPA (typically borne by local communities). Monitoring, general administration, visitors, education and attendance at meetings and events also generate significant expenses. Few MCPAs in South Asia spend money on capital investments (e.g. property, visitor facilities, major equipment) unless there is donor assistance. In many countries the core operational budget of an MCPA is provided by central or local government, as management of marine and coastal resources is seen as a public service. However, few governments in South Asia are able to provide such support and most MCPAs face severe financial constraints.

It is unlikely that any single source of financing will be adequate and several will probably be required. Spergel & Moye (2004) described more than 30 mechanisms for funding marine biodiversity conservation, many of which are suitable for MCPAs, including:

- Governments;
- User fees and direct revenue sources (see sheet E3);
- Environmental trust funds (see sheet E4);
- Donors (see sheet E5).

FINANCIAL PLANS

A long term financial plan or business plan should be prepared to complement the MCPA management plan. Any MCPA management plan should be accompanied by a financial plan that: indicates how the various management activities will be funded; identifies financial constraints to park management or to the achievement of conservation goals, and instruments for overcoming these; outlines the institutional and operational mechanisms for fund-raising, retention and allocation to the various groups who bear the costs of marine conservation; and sets a number of financial targets and indicators for monitoring them.

Business plans are used in the private sector to attract investors, inform stakeholders and improve management, and thus are relevant to MCPAs. The plan is usually for 5-10 years (ideally it should cover the same period as the MCPA management plan) and should demonstrate to potential donors, government personnel and others how the finances will be aligned to the objectives and ensure they are implemented. It should incorporate scenario planning, evaluate the costs of operating the MCPA, and identify potential cost reductions. The plan can be used to help identify new revenue sources and a sustainable financing strategy and to ensure that the management plan is feasible. For example, many NGOs play a significant role in financing the conservation of Sri Lanka's coastal resources, including coral reefs, both at the national and grass root levels. The plan also guides fundraising efforts but, unlike a budget, it will be subject to change, given its longer duration.

The term 'integrated strategic and financial planning' is sometimes used for the combined process of developing a long term management and financial plan. Priority activities for funding will be a combination of those that are essential for ensuring compliance within the MCPA, those that can be implemented in the current circumstances (e.g. some activities may have to be reduced if there is insufficient capacity), and opportunism (e.g. taking advantage of a donor opportunity or particular situation in which a specific activity can be implemented). Short term tactical financial plans should be developed to support long term, integrated, strategic financial plans. These tend to be annual or three-year plans, and help to make sure that the objectives of the long term plans are met.

The long term plan will also look at the different sources of income, project these and assess the probability of receiving them. Funding sources should be matched with activities according to the type and duration of funding needed, and the financial plan should demonstrate how all costs incurred (both direct and indirect) will be met. Managing a newly gazetted MCPA is expensive, requiring funds for equipment and infrastructure, baseline assessments, training and research, which may best be met through a donor or by a large investment of funds from central government. Subsequent management costs are lower, involving recurrent operational and administrative support, patrolling, maintenance of equipment, monitoring, community outreach and education. For financial sustainability, the greater the amount of recurrent costs that can be covered by self-generated revenues the better. Funding mechanisms such as Government subventions, Trust Funds and revenue from user fees (described in subsequent sections) can go a long way to meeting these. It is important to remember that obtaining funds from donors can be slow, often taking six months to two years from the time of initial contact to actually receiving the funds. Donor funding is usually short term in nature, and is often tied to specific goals, target groups or activities, and thus cannot usually be considered a long term, secure source of finance or the sole source of funding for a MCPA. Potential financing mechanisms should also be checked to ensure that they are legal in the country concerned and do not conflict with the objectives of the MCPA; for example, if user fees are being considered, it is important that user numbers do not increase to the point that they cause damage to the MCPA (see sheet J2).

ESTIMATING COSTS

This is a key component of good financial planning and should involve administrative staff, technical staff and others involved in conservation activities, and the central management agency. It should also consider any needs to generate and allocate funds (or other material or qualitative benefits) to groups who are bearing indirect or opportunity costs of marine conservation, and who require financial or economic incentives to be willing and able to support the MCPA. There are three kinds of costs:

Management or programmatic activities (e.g. surveys, monitoring, patrolling). In well-established MCPAs, figures for ongoing or recurrent activities should be readily available from the accountant. For occasional activities, it is worth looking at previous budgets to see if costs have been estimated before. Quotes should be obtained for new equipment and for work that may need to be contracted out. The cost of the time of the MCPA manager and support staff spent on an activity should be factored in as well as that of those directly involved.

Administration (known as overheads, fixed costs, indirect costs or operating costs, e.g. maintenance of infrastructure and equipment, personnel and utilities). These costs should be estimated by the administrative personnel, with the manager. Administration (or a certain component of it) is sometimes expressed as a percentage of the overall budget and it is generally considered reasonable to charge 10-15%. This often has to be negotiated as donors may not want to pay such costs, or will only pay a portion. Nevertheless these costs must be fully estimated and accounted for, as they are real costs.

Opportunity costs can be defined as the benefits or economic opportunities that are diminished or lost by the establishment of an MCPA, and include both the value of foregone output from prohibited resource uses and from potential conversion of the area to an alternative use, as well as possible congestion effects on other sites and stocks that remain available for extractive uses and alternative developments. Meeting these costs may require a range of cash and non-cash mechanisms, such as revenue-sharing and benefit-sharing, involvement in economic activities, or negotiation of access rights. Unfortunately, because such costs remain largely unvalued, there has been little effort to consider them as legitimate components of MCPA budgets or to raise funds to meet them (Emerton 2005). They are however a critical part of MCPA financial planning.

KEY POINTS FOR THE MCPA

- **If there is no long term financial plan for the MCPA, initiate a process to prepare one, ideally when revising the management plan.**
- **Encourage the development of a financial sustainability plan for the whole MCPA system.**
- **Ensure that a range of sources of funding are assessed; do not rely on a single donor or financing mechanism.**

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CASE STUDY

Business Plans for Madagascar's Protected Areas

Madagascar, with assistance from the GEF, World Bank, USAID and international NGOs, is developing a long term financial sustainability strategy for its entire protected area system. A task force has developed a model to calculate the cost of each protected area as well as that of the national protected area agency, ANGAP. A financial projection of the costs over a 10-year period was generated, covering three main components:

- Operational expenses for the main programmatic activities at each site, e.g. ecotourism, education and conservation;
- Investment expenses for major acquisitions, maintenance and renovation of infrastructure;
- Management expenses for running ANGAP's headquarters and coordinating units.

In a separate but related initiative, a business plan was prepared for Masoala National Park with assistance from the Wildlife Conservation Society and US National Parks Conservation Association. The Park is large (2,300 km²) and comprises seven different units, three of which are marine parks covering 100 km². Annual operating expenditure for 2002 was US$ 263,000 of which 38% was spent on resource management and protection, 22% on management and administration, 17% on community development and outreach, 17% on facility operations and maintenance and 6% on public use. Additional investment expenses of US$ 180,000 were spent on construction work and technical assistance for setting up park management systems.

The business plan estimates that US$ 555,000 is required to operate the park effectively, indicating a financial shortfall of US$ 292,000. More than half the current funding comes from three NGOs (WCS, WWF and Zurich Zoo), 30% has come from a GEF project, 12% from the government (salaries and park operations), and the remainder from other foreign donors. The government will be unable to increase support in the near future and the remoteness of the park means that tourism will not provide significant revenue immediately (although this is being developed). The business plan therefore proposes building on the park's international partnerships with NGOs. Its innovative relationship with Zurich Zoo, in particular, may provide a stable source of revenue as a result of an exhibit at the zoo which raises funds through entrance fees. A Trust Fund is also being developed.

www.masoala.org

www.conservationfinance.org/WPC/WPC_documents/Tools_BusinessPlan_MasoalaNP_presentation.pdf

Financial management E2

MCPAs receive income from various funding sources. The efficient management of this income is vitally important both for effective management of the MCPA and to demonstrate to donors that funds are being well spent. This sheet introduces the main components of financial management.

Financial management involves forecasting, monitoring and reporting on income and expenditure, preparing and overseeing budgets and expenditures, cash flow management and projection, auditing, and stock-taking and inventory control. Demonstrating good financial management can help to win confidence; users are more willing to pay entrance and other fees, and donors to continue their funding if they are sure that their contributions are being used efficiently and for the right purposes.

BUDGETS

These are detailed plans that specify anticipated income and expenditure for the activities involved in running the MCPA over a certain period and usually complement annual work plans. A budget helps to clarify the relationships between programme and administrative costs, identify where financial resources are needed, and control expenses. An MCPA generally has two types of budget:

- The annual operating budget, which should not exceed the expected total income for the year. This may have to be adjusted if there is an unexpected shortfall or if extra funds become available;
- Budgets for activities of a specific duration, such as workshops or projects, for which funding may come from external sources.

Both the income and expenses sections are divided into budget lines (also called line items or accounts), reflecting the various types of expenditure. Examples include:

Recurrent costs – Staff salaries (plus benefits and insurance), maintenance of infrastructure, and consumables (e.g. stationery, fuel, water, electricity);

Capital expenditures – Infrastructure and equipment are common examples;

Occasional operational expenditures – Covering, for example, meetings or field trips;

Contingency – Typically 10% of the total budget to cover unforeseen price rises or additional costs.

Funds should not usually be reallocated between different budget lines without justification and approval of the relevant authority/ies. Donors may allow funds to be moved between budget lines related to one particular component of a project without consultation, and between different components within a certain percentage (e.g. 5-10%), but approval generally needs to be sought first. The terms and conditions of the funding should be checked carefully. A sudden need for a large re-allocation would indicate that the budget was inadequately prepared.

FINANCIAL REPORTING

This involves the preparation of a statement of income and expenditure. If the MCPA is part of a national system, or is managed by an NGO or other organisation, there will be standard procedures. Accurate and timely financial reporting is essential to help with decision-making (e.g. if new equipment is needed), ensure useful information is available for donors, and to give reassurance that funds are well administered. Standard financial reporting systems are often also required to meet legal and contractual requirements.

As with budgets, two types of financial reports may be needed: an annual report for the MCPA; and reports for short-term projects or separately funded activities (see also sheet C5). A basic financial report shows the income and expenditure in two columns according to the different budget lines. However, it may be more meaningful to report expenditures against objectives; therefore consultation with those preparing the activity report that generally accompanies a financial statement is advisable. If there is a delay in producing the financial report, this should be explained in advance with the reasons, since payment of further installments, whether from a donor or from the government, is generally linked to approval of the financial report from the previous work period.

MAINTENANCE OF ACCOUNTS

Accounting is the term used for financial record-keeping including book-keeping and the maintenance of ledgers. This is a specialist task, best carried out by a trained accountant who can also help with other financial activities such as paying salaries and suppliers. Various accounting methods are used but all require that at the end of the fiscal year, a financial statement is prepared that covers not only expenditures but also factors in all that is owed. Note the 'fiscal' year (i.e. the one-year financial accounting period) is not always the same as the calendar year. For the MCPA it may be useful to choose a fiscal year that matches that of a major donor or the government agency to which it reports; fiscal years may run July-June or April-March. Separate accounts may be needed for different sources of funding if they are bound by different conditions, and it is vital that these are kept separate.

The balance sheet is a snapshot of the organisation's financial condition on a particular date, often the end of the fiscal year. Discrepancies between the expected balance and the actual funds

held in a bank account should be investigated and corrected immediately. Two MCPAs could have identical balance sheets; however for one the financial situation might be improving, and for the other it could be declining. An income statement, showing 'financial activity' over a specific period is thus also needed. This shows the status of revenue and expenditures, determines surpluses or deficits, and shows any unusually large expenditures.

Invoices and receipts must always be kept and filed, and all financial records must be available for audits, with supporting evidence. Standard, approved accounting procedures should always be used, regardless of the size of the MCPA and its staff, with appropriate internal controls so that the audits are clean each year. 'Controls' are the policies brought in to make sure that funds are correctly handled, and to minimise the risk of mistakes and theft. For example, each financial transaction, such as receipt of cash, signing of a cheque or preparation of a financial statement, must require the involvement of at least two people. Major expenditures not in line with the budget should always be subject to approval by the oversight agency or Board. Where an MCPA is very small, the manager may be directly responsible for much of the financial management and is therefore likely to benefit from some financial management training.

CASH FLOW

Good cash flow management is required to ensure that funds are available when needed. Temporary disruptions are sometimes inevitable but should be minimised as suppliers may not be helpful if payments are not made on time, and operational activities can be disrupted if cash is suddenly unavailable (e.g. for patrol boat or vehicle fuel). The best way to prevent such problems is to do cash flow projections on an annual (using the budget) and quarterly or monthly basis. If a shortfall is predicted, fundraising can be started earlier, payments spread out in installments and warnings given about potential deficits. Recurrent operational expenditures tend to be fairly stable and so are easy to predict, but there should be a contingency for unexpected price rises or equipment repairs. If an MCPA is short of cash, the reserve or contingency funds could be used, or funds borrowed from other accounts, or from the bank (although this will incur interest payments), but all these options should be avoided.

COST SAVINGS

Keeping costs low is an important component of a sustainable financing strategy. Cost saving schemes might include using volunteers (and thus saving on salaries – see sheet D3), in-kind support from the tourism industry sharing resources (e.g. technical expertise, fuel or transport) among MCPAs, and organising local communities to help with enforcement.

INTERNAL AND EXTERNAL AUDITS

An audit is an examination of the accounts, fixed assets and accounting procedures to verify them, and is often undertaken when the annual financial report is prepared. Audit requirements vary from country to country, and often differ for government agencies, NGOs and commercial companies. Requirements and procedures for an MCPA will also depend on how it is being managed, and it might have its own internal audit or alternatively be part of a larger audit. For large grants over extended periods, donors may require an external audit at the end of the project and possibly mid-term as well. Such audits focus on how the donor funds have been spent and not on the MCPA finances as a whole, emphasising the need for separate accounts for project funds.

KEY POINTS FOR THE MCPA

- **Ensure that staff understand that good financial management is a prerequisite for effective overall management of an MCPA.**
- **Set up the standard accounting practices of the MCPA' s parent ministry/organisation, bringing in advice and expertise as needed, and ensure that administrative and accounting personnel understand and are fully trained in implementing these practices.**
- **Make sure that audits take place as required and implement any resulting recommendations.**
- **Look out for special reporting requirements of external donors and apply these rigorously.**

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User fees and direct revenue

E3

Revenue generated directly by the MCPA is an important source of funding for management and can sometimes be used to compensate stakeholders whose livelihoods are affected by the existence of the MCPA. There are a range of 'goods and services' that can be 'sold'. This sheet describes some of them and how they can be implemented effectively.

USER FEES

The main forms of user fees are daily tickets for tourists, seasonal passes for residents, and specific fees for activities such as diving, filming and photography, mooring of boats and overnight stays. It is usual to have a tiered system, with different rates for local, national, resident and international users. Activities that are traditionally a source of livelihood for local communities should not usually require a fee but access passes may be necessary, and are useful for monitoring use of the area.

A transparent consultative process must be used when introducing or changing a fee system, as this is often controversial. Stakeholders who are expected to comply with, and help collect fees need to understand how they were set and to agree with them. Various methodologies are available to help decide on the size of fees, including 'willingness-to-pay' surveys. Fees can help to limit levels of use of the MCPA (see sheet J2), for example, by charging more where sensitive ecosystems are involved and/or where mass tourism use is being discouraged.

MCPAs are sometimes perceived as a public resource and some visitors may expect free access. The tourist sector often does not appreciate the costs of administering an MCPA. However, visitors are usually happy to pay a fee if they understand that it is to be used for management. Visible 'services' such as patrol boats, demarcation and mooring buoys, brochures, signboards and litter bins help to show that revenue is being put back into management. Transparency is also important with local communities who quickly lose faith in an MCPA if they think that revenue is being misused. Where revenue is shared between an MCPA and local communities, the percentage share by each party and the purpose for which the funds may be used must be publicly and clearly agreed and specified.

Sometimes fees are retained exclusively for the use of the MCPA, and in other cases they go to a central agency. There can be good justifications for both systems. Where some MCPAs have more visitors than others (due to accessibility or attractiveness to tourists), a centralised system allows revenue to be shared across the system. User fees should be incorporated as a sub-component of an MCPA's financial plan (see sheet E1) as a source of funding, and this allocation process must be clearly stated. One of the common problems protected areas face is the difficulty of getting funding and approval of budgets when the allocation process is not specified.

LICENCES

A licence allows a particular activity to be carried out, normally in a specified area for a specified period. Licences differ from user fees as they are usually purchased before the activity is undertaken from the relevant authorised agent. They are usually required for fishing, cutting mangroves or other timber, developing tourism operations and conducting research (see sheet G11).

Licences may not provide revenue directly if the funds go to a different management agency, but if they are used for management of a particular resource, they can directly benefit the MCPA. Where there is a lack of harmonisation between licensing arrangements and MCPA regulations (e.g. fishing licences may be issued for areas that are closed to fishing under MCPA rules), close cooperation is required between the agency responsible for licensing and the MCPA itself. MCPA managers should raise the issue, and a suitable management arrangement should be developed. A proper management arrangement must be put in place, clearly specifying the revenue sharing arrangement. This should be linked to the financial plan, which will show where funds from this source will eventually be allocated.

CONCESSIONS

A concession is the leasing of an area or activity to a private individual or organisation for the provision of a service, such as sales of refreshments or souvenirs, transport to the MCPA, access points and launch ramps, or accommodation. Concessions can encourage private investment in the MCPA and help to attract visitors. If managed appropriately, they can provide employment for local people, but they should not compete with private services provided by local communities who depend on MCPA resources. A concession should be granted and renewed only if the activity meets appropriate environmental conditions and does not contradict the objectives of the MCPA.

SPECIAL EVENTS, SALES AND APPEALS

Open days, competitions and other public events can be used to generate funds, but tend to be time-consuming to organise. However, they have an additional benefit of awareness-raising (see sheet J3). Shops can sometimes be run very beneficially by the MCPA, providing not only income but also an opportunity for education and publicity, for example, through sales of T-shirts, postcards, guidebooks and other merchandise. A shop or refreshments kiosk can double as an information point, displaying notices about regulations and giving general information about the MCPA. Special appeals or the establishment of a programme for supporters to provide regular donations, such as a 'Friends Programme' may be appropriate for some MCPAs, particularly if they receive relatively wealthy visitors (e.g. overseas tourists or expatriate residents).

IMPLEMENTATION OF REVENUE MECHANISMS

Implementing fee and licence systems can be difficult (and costly) in an MCPA, where there is no single entry point, and, in general, revenue collection tends to be poor in MCPAs in South Asia. Tickets should be date-marked and random checks on boats and individuals may be necessary, although rangers will quickly become familiar with regular users such as fishers and should not harass them. Tickets for in-water activities are a problem unless armbands or plastic tags are available. Hotels adjacent to or within an MCPA, or boat operators taking visitors to the reef, may be able to issue tickets and remit the funds to the MCPA. Whatever revenue collection system is adopted, it should be carefully monitored, and if it is not adhered to, penalties should be imposed. The monitoring of revenue mechanisms should be a concrete part of the management plan (see sheet C3).

KEY POINTS FOR THE MCPA

- Ensure that all stakeholders are fully aware of any fees and how the revenue is managed and used, through publicity and notices at the entrance to the MCPA.
- Ensure a proper management plan is in place, and incorporate user fees and direct revenue sources as part of the overall MCPA management plan. The plan should clearly show sources, allocation patterns and monitoring procedures for these funds.
- If an MCPA has to introduce new fees or revise existing ones, obtain expert advice and consult widely with stakeholders.
- If the MCPA runs a shop, ensure that this provides a good selection of well-displayed, labelled and priced goods, does not over-invest in stock that deteriorates, and sells environmentally sound souvenirs.

Sources of further information

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CASE STUDY

Examples of Revenue Generation in Komodo National Park, Indonesia

There are no detailed studies assessing the success stories of different revenue generating systems in South or South East Asia, but many of the systems described above are in use.

In Indonesia, Komodo National Park (KNP) generates revenue through entrance fees. This revenue is then shared and distributed to government institutions – 40% to government of Manggarai Barat District, 30% to the government of Nusa Tenggara Timur Province, 15% to the Ministry of Forestry in Jakarta and 15% to the General Revenue Service of the Ministry of Finances. The actual amount of annual budget allocated for the park is determined by the Ministries of Forestry and Finance in isolation from the park's revenues shared with central government. The mean annual budget for KNP between 1990–1991 and 1994–1995 was US$ 218,000, whereas the mean annual tourism revenue from entrance fees during this period was only US$ 15,060. Thus, tourism revenues amounted to only 6.9% of total expenditure during that period.

From 2006, all visitors to KNP have been required to pay a contribution to a conservation fund to directly support and benefit conservation, ecotourism, international destination marketing and promotion. The level of contribution depends on the number of days spent in KNP. In addition to this, visitors pay a general entrance fee and a waste management compensation fee.

A willingness to pay survey to increase the visitor's fee showed that 10.3% were willing to pay the highest bid amount of $ 32. Visitors were willing to pay more than 10 times the current entrance fee, indicating a substantial potential for increased revenue. The potential negative effect of large fee increases on visitor numbers and the resultant effect on local economic benefits from tourism may limit the extent to which greater financial benefits from KNP can be realised. Results suggest that a moderate, tiered increase in entrance fees is most appropriate, and that partial revenue retention by KNP would help demonstrate the conservation value of tourism to both visitors and managers, and that it has the potential to increase visitors' willingness to pay.

Sources:

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Environmental trust funds

E4

Conservation or Environmental Trust Funds (ETFs) can be set up to provide a mechanism for releasing funding on a regular basis to support protected area management or conservation programmes. They are becoming an increasingly popular tool but considerable expertise is involved in their establishment. This sheet describes the basic form of these funds, and gives advice on other sources of information.

A trust fund can be broadly defined as a sum of money that: (1) can only be used for specified purposes; (2) must be kept separate from other funding sources (e.g. a government's budget); and (3) is managed by an independent Board. ETFs thus involve obtaining capital up-front, investing it, and using the interest to finance conservation activities, instead of seeking funding on a case-by-case basis. In theory, ETFs can provide financial security, covering basic operating costs of an MCPA, and allowing management to concentrate on conservation and other key activities. In particular, ETFs provide a mechanism for retaining and administering funding outside of normal government budget processes and administrative procedures. They are often used as a mechanism to share income, revenue or other benefits with local communities, or to receive private sector contributions and funding. However, ETFs are not always suitable and the following conditions should be met:

- The funding requirements are long term and sustained, thus urgent threats requiring much funding over a short period are not appropriate;
- Although ETFs can be set up for individual protected areas, they are considered most suitable for systems (e.g. MCPA network or national protected area system);
- Commitment from government and others to support the fund and participate in its work;
- Appropriate national legal and financial practices and supporting institutions to provide the confidence for raising the initial capital.

There are no true ETFs in South Asia supporting MCPAs, although there have been interesting advances in the use of ETFs in the region in conjunction with terrestrial PAs (e.g. in Bhutan). As more is learnt about their application, especially from examples in Latin America and the Caribbean, their use may increase.

TYPES OF FUNDS

The three main ways in which the capital of a fund is managed are described below. Independent funds and foundations set up to provide grants are described in sheet E5.

Endowment funds – The capital is invested and the interest is used to finance activities; thus an endowment fund of US$ 15 million might produce US$ 0.7 million – US$ 1 million annually (depending on the market and types of investments) over an unlimited period. A percentage of the earned interest must be re-invested to keep pace with inflation. These funds are most appropriate for long-term continuous funding needs, typically the case of an MCPA.

Sinking funds – The entire principal and investment income is disbursed over a fixed period (usually 6-15 years), enabling larger amounts of money to be used more rapidly. A sinking fund with a capital base of US$ 15 million might thus produce US$ 1.5-2 million annually but over a limited period. Such funds are most useful for large, urgent conservation issues and where there is enough capacity to use the funding rapidly and effectively.

Revolving funds – These receive new resources on a regular basis, such as proceeds of special taxes (e.g. on tourism), or fees or levies earmarked for conservation work, which replenish or augment the original capital of the fund and provide a continuing source of money. These only work if the source of funds is regular and predictable.

ESTABLISHING A FUND

Key factors involved in setting up successful ETFs, identified by the Global Environmental Facility (GEF), include clear and measurable goals and objectives, linkage between the fund and any national environmental action plan, a strong executive director, government support, high levels of stakeholder involvement and financial and administrative discipline.

Most Funds are managed by a Board of Directors or Trustees selected through a participatory process involving the fund's beneficiaries, local NGOs, community groups, the private sector, donors, and the government. Developing and running an ETF requires considerable investment in terms of staff time. As well as the board and the executive management, funds also need a financial manager and may require technical staff to assess the validity of activities to be funded. Some ETFs also set up Technical Advisory Bodies which help the board and hired staff.

It is best if the Board has a mix of governmental and non-governmental representatives, because although the Board needs the support of the government, it should not be controlled by the government. The Board needs to be responsive to the needs and concerns of NGOs and community groups, but should not be pulled in too many directions by a wide range of constituencies with conflicting interests. Representation of the private sector is also useful, increasing efficiency as the private sector often has experience serving on boards, and can bring a level of financial expertise not usually found in either government or the NGOs.

The Board should be selected in a participatory manner, with good representation by the Fund's beneficiaries, government, donors, and private sector, so that stakeholders have confidence in decisions that are taken. The roles and responsibilities of Board members must be very clear, and they should meet regularly (minimum annually), to set and approve the Fund's direction, provide leadership, and craft a vision. An executive director should be appointed to be responsible for day-to-day management of the ETF. The quality of the Board and executive director and the way in which they are selected and interact, are key factors in success. Often, members are expected to be volunteers but this is not a common concept in many South Asian countries, and it may be necessary to provide some form of incentive for their active participation.

There are a number of ways to build up the initial fund. The two most important sources in the past have been debt swaps and the GEF; bilateral aid donors have never been a major source, with a few exceptions (e.g. Switzerland, the United States, and Finland). The use of new and innovative sources, such as water usage fees, carbon sequestration credits and taxes on tourism, are now being considered to capitalise funds. An appeal could be launched with a special event (e.g. anniversary of the MCPA).

KEY POINTS FOR THE MCPA

- Setting up an ETF is not something that an individual MCPA manager should consider, however MCPA personnel can play a major role in any assessments as to whether this might be an appropriate mechanism for the MCPA itself or for the national protected area system as a whole.
- Expert advice must be sought from the very beginning of the process, if it seems that this might be an appropriate approach to sustainable financing.
- If it is decided to go ahead with an ETF, MCPA managers can assist by helping to develop alliances with businesses, government agencies, NGOs, donors and others to stimulate interest.
- The legal and institutional arrangements required to establish and run an ETF are often complex – especially where government agencies are involved as MCPA managers and administrators. It is necessary to consider carefully the relevant laws, regulations and permitted operating mechanisms.

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CASE STUDY

An ETF for Protected Areas in Madagascar

The Madagascar Protected Areas and Biodiversity Foundation is being set up to provide sustainable funding for the country's protected areas system as part of a national sustainable financing strategy. Currently, all protected areas depend on external funds, mainly from donors, and it is expected that such assistance will substantially decrease within the next five years. With an estimated future capital of US$ 50 million invested, the Foundation is expected to cover a significant part of the costs of protected area management. In addition to revenue from an endowment fund, sinking funds raised by the Foundation will provide additional resources. The Foundation will also manage funds on behalf of donors; for example the World Bank's contribution to the biodiversity component of the last phase of the Madagascar Environment Programme will be channelled through the Foundation.

The Foundation will provide financial support for all major management activities such as conservation, ecotourism, education, and to a lesser extent, research. Development activities in protected area buffer zones, however, will not be a priority as there are already national development programmes that reach these regions. One part of the Foundation's endowment fund is earmarked for the creation of new protected areas, including MCPAs.

Donor proposals

E5

Most MCPAs in South Asia will need external funding, and there are many potential donors. Funding organisations obviously like to support potential successes rather than likely failures but application processes can appear daunting. This sheet provides general guidance on preparing proposals for donors.

Donors vary considerably in their interests and what they wish to fund. Poverty alleviation is currently a priority for many bilateral donors, with an emphasis on good governance, institutional strengthening, public sector reform and integration of biodiversity issues with sustainable development and gender. Foundations and NGOs also support sustainable development, but many have a strong focus on biodiversity conservation. Many funding organisations look for programmes rather than individual projects, and there is an increasing expectation of professionalism, good performance, and strong emphasis on learning and sharing of lessons. Bilateral and multi-lateral donors and foundations generally deal only with large-scale funding, but local companies, NGOs, and embassies often give small grants. Scholarships for staff training and development are available, usually on a competitive basis, from some embassies and international organisations.

A long period may lapse between submitting a proposal and hearing if it has been successful, so it is important to start the process well in advance of any potential funding shortfall, and to engage with several potential donors. Long-term support by a donor providing regular small sums of money for specific activities can be as valuable and often more cost-effective than a one-off large grant that may be difficult to manage and is not renewable. Reliance on donor funding can result in fluctuations in activity levels, unless attention is paid to ensuring that there are no gaps between projects.

SOURCES OF FUNDING

Bilateral donors – The USA, Canada, Japan, Australia, some Arab countries and most member States of the European Union plus Norway and Switzerland offer bilateral grants. Aid is often channelled through rolling 'partnership agreements' with the recipient governments, which are usually reviewed annually and planned up to five years ahead. Individual programmes address the priorities of both donor and recipient and now concentrate more on sector wide support (e.g. education, environment, health, private sector development) than on individual projects. Proposals should usually be in a specified format, often with a supporting logical framework (see sheet C4), and be submitted through the parent ministry or government agency of the MCPA. Local embassies and websites can provide details, and embassies may provide small grants for which there are simpler application and reporting procedures.

Multilateral organisations – Grants and loans from these organisations (e.g. World Bank, United Nations and the European Union) are usually tied to a rolling framework of cooperation with the host government. Applications have to be submitted through the parent ministry. The Global Environmental Facility (GEF) supports projects in four focal areas – biological diversity, climate change, international waters and ozone depletion. GEF project proposals are prepared jointly by the country (which must be a party to the Convention on Biological Diversity) and either the World Bank, UNDP or UNEP. There is also a GEF Small Grants Programme supporting NGOs and smaller projects.

International organisations – NGOs such as WWF, The Nature Conservancy (TNC), Conservation International (CI), and Fauna and Flora International (FFI) have their own priorities and agreements with recipient governments and their own formats for applications. Proposals sometimes have to be channelled through the parent ministry. These organisations often develop proposals jointly with local and national partners (sometimes as a result of previous on-site collaboration) and tend to stay involved in project implementation, providing technical, management and administrative assistance.

Charitable foundations – Numerous examples exist, such as the Pew Charitable Foundation, Ford Foundation and Packard Foundation, that support MCPAs. They generally offer direct grants and are less likely to have a fixed programme, but they may have particular areas of interest or priorities. Most foundations prefer to fund particular projects or activities, rather than operational costs.

Academic and research institutions – These may support MCPAs through research grants for management-oriented studies. This is likely to be most successful if the MCPA collaborates with a national academic organisation or research institute. Research grants are competitive and proposals must demonstrate competence in the proposed field.

Private sector – Examples such as tourism companies, scuba institutions and dive operators, airlines and hotels may provide funding, particularly for equipment, infrastructure, community development and environmental education. Success is more likely if there are opportunities for publicity (e.g. advertisement of logos, or launch events with media coverage). In some cases, tourism operators may cover most running costs of an MCPA or make in-kind contributions.

PREPARING A PROPOSAL

Proposals should not be written as begging letters, but rather as an invitation to a donor to share in achieving a particular goal. Donors receive numerous applications. Transparency, clarity and accountability are key elements, and the more focused and concise the application, the better the chance of success. Proposals for small grants should be short and to the point. For larger grants, a maximum length of about 15 pages is appropriate, depending on the format required. The proposal should be comprehensive, refer to partner organisations that the MCPA is working with, and have an adequate budget for all the activities envisaged: there may be little opportunity for extensions or upward budget revisions once a funding agreement is in place. If funding is needed for only a part of a larger project, this needs to be clear.

KEY GUIDANCE FOR MCPA MANAGERS

- Avoid 'cold-calling' potential donors, i.e. submitting a proposal without any prior discussion. Make contact first to establish their interests; be clear about what is special about the MCPA and have materials to support this, but do not overstate previous achievements or future plans; ensure that the proposal relates to the objectives and management plan of the MCPA.
- Obtain the required format, dates for submission, main areas of interest, policy criteria, and other requirements from donors before starting a proposal, and ensure approval from MCPA management agency and other responsible bodies.
- Check whether visitors to the MCPA have contacts with relevant organisations or will be able to help.
- Make sure that the funding agency being approached does not have aims or ongoing activities that contradict the objectives of the MCPA, which could be used against it.
- Consider appointing one MCPA staff member to assist or lead in fundraising; use individuals with good writing skills and use external assistance if necessary (e.g. consultant or volunteer); look at examples of proposals that were successful. This member of staff should either be in contact with donors or monitor donor trends (e.g. donor websites, strategic plans) to get an idea of the kind of projects that donors are interested in funding.
- Consider preparing joint funding proposals with partners and other institutions, incorporating broader development issues if appropriate.
- If successful, remember to thank donors and ensure their contribution is acknowledged in publications and media items (e.g. use their logo).

Sources of further Information

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Spergel, B. & Moye, M. 2004. Financing Marine Conservation: A Menu of Options .Center for Conservation Finance, WWF, Washington D.C., USA. www.worldwildlife.org/conservationfinance

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Bi-lateral donors include: US-AID – www.usaid.gov; NORAD – www.norad.no; DFID – www.dfid.gov.uk; FINNIDA – http://global.finland.fi; CIDA – www.acdi-cida.gc.ca; SIDA – www.sida.se; JICA – www.jica.go.jp/english; DGCID (France) – www.cooperation.gouv.fr/cooperation/dgcid; Netherlands

Development Cooperation – www.minbuza.nl; The Foundation Center www.fdncenter.org – commercial website with information on foundations (subscription basis).

GEF - www.gefweb.org

ELEMENTS OF A FUNDING PROPOSAL

Title, proposed length of project, contact person with contact details.

Summary, emphasising importance of the project and results to be achieved.

Background information giving a description of the status, trends and issues related to the ecological and socio-economic aspects of the project (a situation analysis); a stakeholder analysis and a problem analysis (identification of root causes) may be appropriate.

Justification for the work and description of related ongoing initiatives.

Overview of project design process, showing planned stakeholder participation.

Project intervention logic (objectives, activities, expected results, outcomes), with a logframe if required.

Implementation procedures including a description of partners and beneficiaries with their roles and responsibilities, and accountability and capacity to deliver.

Timetables and workplans.

Preliminary monitoring and evaluation strategy.

Human resources, existing and required, with TORs if appropriate.

Budget, often in US dollars, but check donor requirements; describe other sources of funding that are available or being sought, in-kind contributions and their sources, and how the funds will be managed.

Annexes with any essential detailed information.

Economic valuation E6

MCPAs are unlikely to be sustainable unless they make economic sense and generate benefits that are at least equal to the costs they incur. It is important that MCPA managers have a basic understanding of the economic value of the sites for which they are responsible. This sheet introduces the concept and tools of economic valuation and demonstrates the use of this concept in MCPA management.

Marine ecosystems have many benefits that provide an important economic justification for establishing MCPAs, but these are often not fully understood by decision makers and stakeholders. For example, it has been estimated that coral reefs provide nearly US$ 30 billion annually in net benefits in goods and services globally. Coral reef fisheries alone may provide benefits estimated at US$ 5 billion-US$ 7 billion a year. Marine and coastal tourism in the Maldives directly accounts for 20% of GDP and 40% of employment, and its wider effects produce three quarters of national income. On the Balochistan coast of Pakistan, mangroves contribute around US$ 1,300/ha/year to inshore fisheries and US$ 900 to offshore commercial fisheries, and coastal wetlands in Sri Lanka provide flood protection and wastewater treatment services to surrounding settlements worth some US$ 2,500 per hectare. Being able to demonstrate to local communities, donors, governments and other stakeholders that an MCPA has significant economic benefits from the tourism or the fisheries it supports can greatly facilitate management, particularly fundraising and enforcement.

PURPOSE OF ECONOMIC VALUATIONS

An economic analysis and valuation of an MCPA is useful to:

- Demonstrate and quantify its economic value in terms of raw materials, ecosystem services such as protection of shorelines and settlements or contribution to fisheries productivity, and maintenance of options for future economic production and growth as well as the costs associated with the loss of these benefits through resource degradation;
- Integrating business and economic concerns into conservation planning and practice;
- Identifying and developing potential financing mechanisms and economic incentives for management;
- Obtaining funding from insurance companies for mitigation measures if resources are damaged through an accident, such as an oil spill or shipwreck; for example, the Egyptian Government has received considerable sums of money to compensate for ship-related damage to their reefs on several occasions;
- Strengthening EIAs;
- Developing mechanisms to ensure that costs and benefits of an MCPA are more equally shared, e.g. income generating activities for local communities who have insufficiently benefited from the MCPA, disincentives for damaging activities through taxes or bonds, and funding from groups who benefit from an MCPA at little or no cost, such as user fees for tourists and visitors.

Quantifying the economic value of an MCPA should not be seen as an end in itself. An economic valuation will always be an estimate as some benefits and costs cannot be measured accurately. For example, it is difficult to measure the full cost of species and habitat loss, which is one of the measures that should be factored in, although techniques are now being developed to address this issue. Some values are not necessarily related to real monetary transactions, and so non-economists often have difficulty in accepting them. However, if measured appropriately they are "real" values, although it is vitally important to state the assumptions and suppositions that have been used in their determination. Furthermore, it must be remembered that some quantified economic values may not be relevant to all stakeholders, as people have different perceptions of the value of natural resources and these perceptions may vary over time.

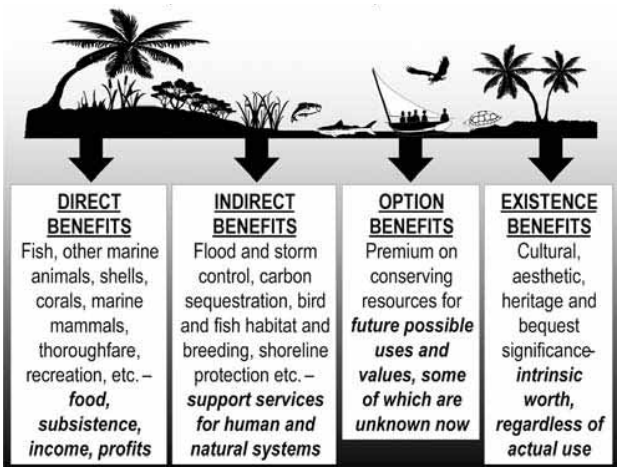
CARRYING OUT AN ECONOMIC ANALYSIS

This involves the following steps:

1. Identify the total economic value (TEV) of the MCPA, which is the sum of:

- Direct values – raw materials, services and products that can be consumed, traded or enjoyed on site, e.g. fish, building materials;
- Indirect values – maintenance of natural and human systems through, for example, coastal protection, storm control, and for provision of habitat for economically important species caught off-site;
- Option values – the value of maintaining the area to allow for potential, but currently unknown, future uses e.g. tourism, pharmaceutical uses, industrial activities;
- Non-use existence values – the intrinsic value of the area accruing to people who may not use the site, based on existence, bequest and altruistic motives, and sometimes including components of social, including cultural, scientific and heritage values.

MCPA benefits

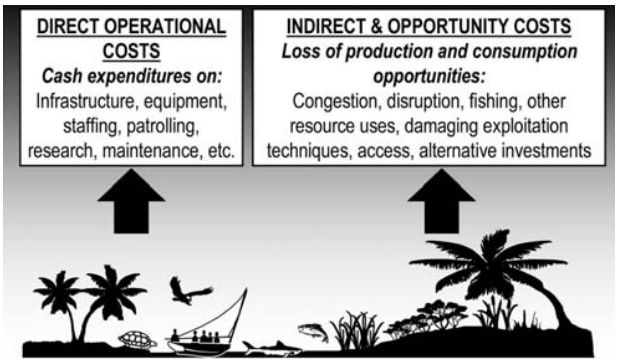


Source: Emerton 2005

2. Identify the total economic cost incurred in establishing and running the MCPA, which is the sum of:

- Management costs – direct expenditures on, for example, equipment, infrastructure, human resources;
- Opportunity costs – the value of the uses of the area that are foregone or precluded because it has been protected;
- Indirect costs – other indirect costs of actions, e.g. tourism related impacts.

MCPA costs



Source: Emerton 2005

3. Quantify the values and costs listed in (1) and (2) above, to obtain the economic value of the MCPA; techniques for this can be found in the sources and references below.
4. Identify the distribution of benefits and costs between different stakeholder groups. This shows who gains or loses from an MCPA and thus what economic incentives or other benefit mechanisms are needed; for example, tourism operators may benefit more from an MCPA than fishing communities if the latter can no longer fish in the area.

KEY GUIDANCE FOR MCPA MANAGERS

- Carry out an economic valuation if this has not been done, but obtain advice from a professional environmental economist with experience in carrying out such tasks; the full range of costs and benefits should be included and ways explored of enhancing benefits, capturing values and minimising costs.
- It is not always possible (or even necessary) to provide monetary values of all the economic costs and benefits of a MCPA. However, when carrying out a total economic valuation (TEV), all economic values should always be identified, described, and where possible quantified.
- In many cases, for example in order to make a decision on specific issues (such as different user fees and rights depending on the type of use) it is not necessary to carry out a TEV, but rather undertake a more targeted and specific economic valuation study, which will increase its usefulness in the decision making process.
- MCPA personnel should work closely with the economist during the valuation, providing accurate information and ensuring that the aims of the study are achieved.
- Economic valuations should be repeated periodically, to monitor changes.
- The results of economic valuations should be widely disseminated, especially to decision makers to strengthen their support for the MCPA, and the recommendations should be followed up.

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CASE STUDY

The Economic Valuation of MCPAs in the Philippines

There are few solid examples of the use of economic valuation in decision making for MCPA management in South Asia, but much work has been carried out in this field in neighbouring South East Asia. The following case from the Philippines looks at the Bohol Marine Triangle (BMT) – an area spanning over 112,000 ha, including the three islands of Panglao, Pamilacan and Balicasag in the three municipalities of Baclayon, Dauis, and Panglao. This ecosystem is considered to be one of the most ecologically significant and diverse areas in the region owing to the fact that the surrounding deep sea environment provides migratory routes for whales and dolphins as well as habitats for these species and variety of other fish species. With the support of UNDP-GEF, the BMT Project was implemented in order to provide better socioeconomic opportunities to local stakeholders while still supporting the sustainable management of marine and coastal resources.

As part of this effort, an economic valuation study was carried out to better understand how to manage coastal and marine resources in order to ensure a positive impact on the local economy, in terms of income or value added. Studies showed that in 2004 the annual net benefits of the coastal and marine resources of the BMT amounted to US$ 3.38 million. Total annual net benefit is accounted for by net market or direct use values of US$ 2.99 million and non-market values of US$ 384,538. The main direct use value or market benefits of coastal resources were found to be tourism and fisheries and the net revenues from tourism and fisheries were valued at US$ 1.48 million and US$ 1.33 million respectively. These values account for more than 70% of the net benefit of the BMT. Annual revenues attributed to ecosystems were as follows: coral reefs, US$ 1.26 million; beach/intertidal area, US$ 1.12 million; marine waters, US$ 646,501; mangrove, US$ 239,561; and seagrass, US$ 105,990. In an effort of the local government and communities to protect coral reefs and sustain local fisheries, twelve MCPAs were established in the BMT covering a total area of 160 ha. The cost for managing these MCPAs ranges from US$ 3,034 to US$ 12,933 per year for MCPA areas ranging from 3–70 hectares. The valuation was also able to demonstrate that the most important non market benefits are shoreline protection and biodiversity values. Multiple uses of coastal ecosystems provide more benefit than a single use.

The local government units have appreciated the economic valuation results and have considered the valuation in all management planning decisions in their respective municipalities, in zonation planning and ecotourism planning, and in the development of the 10-year BMT Management Plan (2006–2015).

Source:

Samonte-Tan, G.P.B. White, A.T., Tercero, M.A., Diviva, J., Tabara, E. & Caballes, C. 2007. *Economic Valuation of Coastal and Marine Resources: Bohol Marine Triangle, Philippines.* Coastal Management 35:319–338, 2007

MCPA buildings F1

An MCPA requires a range of buildings to meet its objectives, and the style and layout of these will have an impact on how the MCPA is perceived, particularly by visitors. This sheet aims to give the MCPA manager some guidance on key issues to consider when planning buildings.

An MCPA may need some or all of the following buildings and facilities:

- Offices, library, documentation centre, meeting rooms (see sheet F3) and laboratory;
- Staff and visitor accommodation;
- Restaurant, kitchen, snack bar, picnic area;
- Visitor centre, souvenir outlet, exhibition and conference areas;
- Storerooms, maintenance and repair workshops, generator house, air compressor, room for dive bottles and other dive gear;
- Garages, boat sheds, vehicle and boat parking;
- Watchtowers or hides to observe birds and other wildlife.

When planning buildings, compromises will have to be made between cost, availability of materials, aesthetics, environmental considerations, and functionality. Lighting, power and energy needs (see sheet F2) need careful thought. Other factors to consider are discussed below, many of which are interrelated and all of which will have cost implications.

LOCATION AND SIZE

Minimising the environmental impact of buildings is essential, and for new buildings or other major construction work, an Environmental Impact Assessment may be required and is strongly recommended even if there is no legal obligation (see sheet A6).

Buildings need to be accessible to roads, harbours and boat landing facilities as appropriate. However, they should not be too close to the sea, where beach erosion may cause problems, nor to sites of ecological importance where there is a risk of disturbance to wildlife (e.g. turtle nesting by lighting, or bird roosts by noise). Buildings sited close together will permit easier management, better security, and cheaper connection of water, power and communication services. Privacy, risk of fire spreading and adequate ventilation, however, favour separating them and so a balance must be sought.

Buildings should be located where there will be a low risk of storm damage, falling trees and flooding, but oriented to catch seasonal prevailing breezes. Adequate capacity with some flexibility for change of use is important. Shipping containers can make cost effective 'instant' and secure storerooms and longer term 'buildings' if shaded, camouflaged, ventilated and properly mounted.

SECURITY

The appropriate levels of security will need to be judged locally. Try and establish the 'weakest link' in security, and if it is judged to be a real issue, seek professional advice. Cost effective, passive security, to incorporate into buildings, preferably during construction, include: unobtrusive metal bars across windows; outer metal grills on doors; concrete ceilings over rooms that may contain valuable items such as offices and storerooms (if the roof is thatching); built-in concrete safes; good quality locks; and low power security lighting.

DESIGN AND CONSTRUCTION MATERIALS

It is important to determine the local architectural styles and those that will have minimum environmental impact, and then to assess whether they are suitable for the MCPA's needs. Consideration of locally available building materials is also important. Traditional construction techniques will usually be cheaper due to locally available materials and skills, but can deplete resources like mangroves and other timber. However, maintenance may be greater and building life shorter than with more modern materials. Consider making cement blocks on site, but not with beach sand. When using timber, find out the source and whether it is sustainable. Ensure timber is treated against termites and other wood borers. In some situations, buildings can be constructed from recycled materials.

Galvanised sheet metal roofs are ideal for catching rainwater but eventually rust, are noisy during heavy rain, and need insulation. Thatched roofs offer insulation, but quality, maintenance and fire risk may be an issue. Tile roofs can provide insulation and catch water but are often more expensive.

Advice should be sought on external and interior surface finishes. Many paints and wood treatments are highly toxic and do not last long in the salt laden air and strong ultraviolet light experienced in the South Asian region. Natural finishes or eco-friendly labeled products should be considered where possible.

VENTILATION AND CLIMATE CONTROL

It is important to decide at an early stage whether natural ventilation will be adequate or if climate control is needed. Effective natural ventilation in the tropics requires open plan spaces with high ceilings, and windows and doors located to maximise air movement, with usually at least two windows per room, on different walls. Climate controlled spaces by contrast are sealed and of minimum volume compatible with their function. Sometimes local climatic factors or equipment that is sensitive to dust or salt laden air will dictate the decision. Dehumidifiers or air conditioning can, however, require a lot of power. As much as possible, natural ventilation should be used to minimise the need for artificial lighting and air conditioning or electric fans.

WATER AND SANITATION

Freshwater is often a scarce resource in MCPAs. If piped water is not available at the site it is important to establish if seasonal or permanent streams or springs, wells or boreholes exist in the vicinity. If water is available locally, an assessment should be made of extraction impacts on ecosystems or users downstream. Groundwater aquifers can be accessed relatively inexpensively, if not deep, but must not be overused, as in coastal situations this often leads to saltwater intrusion. Check the quality of locally available water, particularly salinity.

If mean annual rainfall is more than 700mm and spread over three months or more, rainwater harvesting may be feasible. This requires a catchment area (roofs), capturing system (gutters and drains) and storage (ground or surface tanks). A roof of 50 sq.m, with an annual rainfall of 1,000mm should provide 50 tonnes of freshwater a year, or about 140 litres per day.

Minimise water consumption and wastage. Recycle water by separating drains carrying 'grey water' (from washing and kitchen facilities) from toilet drains, and using the grey water on gardens or vegetables. Ensure none remains stagnant to attract mosquitoes. Consider water saving devices for flush toilets and showers (see sheet K2). Ensure that any sewage discharged does not contaminate or degrade the environment and is not a nuisance to MCPA staff or visitors.

KEY POINTS FOR THE MCPA

- **Buildings are a major investment, hence careful planning is required; construction often damages the environment and mitigation may be needed. Consider carrying out an EIA prior to construction (see sheet A6).**
- **Respect set-back and other building regulations and favour eco-friendly options wherever possible.**
- **MCPA buildings can illustrate valuable environmental approaches to construction (see case study).**

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CASE STUDY

Environmentally Sound Buildings at Chumbe Reef Sanctuary, Zanzibar

There are not many good examples of environmentally sound MCPA buildings in South Asia, but experiences from the Western Indian Ocean region provide some interesting ideas that could be applied to this region. The experiences of Chumbe Reef Sanctuary provide one such example. Chumbe Island has a variety of buildings – seven tourist eco-bungalows, visitor and education centre, library, dining areas, kitchen, office, beach shelters, staff accommodation, maintenance shed, snorkel hut, boat maintenance stores, compost recycling area and historic buildings (lighthouse and mosque). There is a separate head office on the mainland of Zanzibar.

The eco-bungalows are built 50m from the high-water mark, have an open front to maximise air circulation (no fans or air-conditioning) and the roofs have maximum surface area for rainwater collection. Construction used local materials (mangrove and termite treated *Casuarina* poles with palm-thatched roofs). Each building is a self-sufficient unit generating its own water and energy, with rainwater catchment and filtration, solar water heating and photovoltaic electricity. The decentralised energy and water generation helped to lower building costs and minimised environmental impact.

There is no natural source of freshwater so rainwater is collected in tanks under each eco-bungalow, visitor centre and staff quarters and filtered through natural gravel and sand. Seasonal rains are usually sufficient to maintain the supply all year round. The eco-bungalows and staff quarters have composting toilets (see sheet K2), so there are no flush toilets or septic tanks. Wind-powered extraction fans on the composting toilets create an outward draught that helps aerobic decomposition and extracts odours. Shower and kitchen grey water is channelled into clay-encased plant beds that absorb nutrients before the cleaned water drains naturally through the coral rag. Organic kitchen waste is composted and used in the toilets and grey water filtration plant beds. Any other waste is removed from the island.

Photovoltaic and solar thermal energy provides for lighting, water heating and VHF radio communication. The visitor centre and eco-bungalows are powered independently by 12V units consisting of 48W and 52W solar panels, regulators, solar batteries and energy-saving halogen bulbs. Solar-powered torches are provided for guests to find their way along the path to the visitor centre (approximately 100m) to prevent disturbance of nocturnal species.

www.chumbeisland.com

Energy sources F2

MCPAs offer a range of activities and provide an opportunity to demonstrate alternative, environmentally sound energy sources. Where an MCPA is remote from the mains electricity supply, such sources may be the only option. However, the use of such systems has to be balanced against a range of other factors such as cost, availability of technical expertise, and reliability. This sheet provides some general principles and an overview of the issues to be considered, assuming that in general a park manager will wish to invest in 'renewable' energy sources.

The management of an MCPA requires a reliable energy supply to provide power for many activities and facilities, ranging from remote radio communications to staff accommodation, offices and visitors' centres. Energy requirements are likely to include lighting, charging batteries, air compressors, computers, fridges and possibly laboratories.

Many MCPAs do not have access to mains electricity supplies and, although generators are available in every size, they require fuel and regular maintenance, and produce noise and pollution. Traditional electricity generation from fossil fuels contributes to carbon emissions and thus to global climate change. An MCPA will wish to conserve energy, reduce costs and contribute to environmental sustainability. The two sources of small scale renewable energy most likely to be available to an MCPA in South Asia are solar and wind. They can be combined in what is called a hybrid energy system.

Before investing in a solar or wind energy system, an estimate should be made of the likely maximum load and total daily power needs. Electrical equipment usually has a label indicating the load in watts or current in amps. Multiplying the current by the voltage gives the power in watts. For example, a desktop PC will need 200-300 watts, a low energy light, 10-20 watts. The total power needs in watt hours for a typical 24 hour period can be estimated by multiplying the average load in watts by the expected hours that the equipment is being used. A supplier of solar or wind energy equipment will then be able to offer the optimal solution. If the basic design is correct, additional solar panels and batteries can usually be added later if there is a need to increase the capacity of the system. As long as a solar or wind energy system is properly designed and installed, it should offer many years of trouble free operation with minimal, but careful, maintenance.

However, not all appliances may be suitable for such systems, and this will need to be checked carefully. Some standard office equipment, such as photocopiers and laser printers, has thermal elements with a high temporary power load. It is also useful to invest in energy efficient appliances. For example, compact fluorescent lights (CFLs) are four times more efficient and have a much longer life span than ordinary light bulbs. Another way to conserve energy and reduce costs is through landscaping and careful building design. For example, buildings can be designed so that they stay cool, and they can be shaded with vegetation.

An MCPA manager should also be aware that the set-up costs of many of the alternative systems are high, and a back-up generator is usually essential where alternative sources of energy are being used.

WIND ENERGY

Although wind speeds in the tropics are generally lower than in temperate latitudes, making wind energy less attractive, in parts of South Asia, seasonal 'monsoon' winds are reliable and strong enough to make wind energy feasible (Beaufort 4 and above).

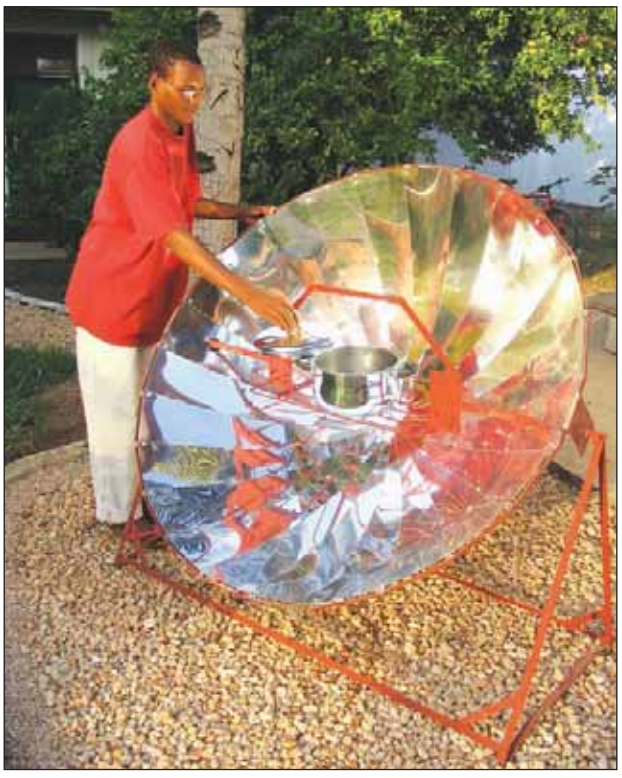
Before investing in wind energy, guidance should be sought on local wind speeds and duration to be expected during a full year. Local knowledge, weather station data plus site measurements with an anemometer can contribute this information.

Wind energy can be used for physically powering water pumps or for generating electricity through turbines. A wind turbine should be mounted as high as possible and away from the 'wind shadow' of buildings and trees. It is recommended that 'marine turbines', available from a number of manufacturers, be used in an MCPA as the components are selected to withstand the corrosive operating environment of salt-laden wind. The advantages of wind energy over solar include the ability to generate power at night and a lower unit cost, as wind turbines are cheaper than the equivalent power generated from solar panels. They do, however, produce some noise and may disturb birds if wrongly sited.

SOLAR ENERGY

South Asia is blessed with reliable and plentiful sunshine, and solar energy is the logical choice for most renewable energy installations, possibly supplemented by wind.

Solar energy can be used directly to heat water for washing and cooking. The simplest method is a black plastic container but, for a continuous supply, thermal solar panels are available comprising an



M. Richmond

Solar cooker being used to boil water

array of water pipes under a glass cover that can be connected to the water supply. Many good products are available to meet any of these requirements, including more sophisticated heat exchange systems.

Electricity generated by solar energy has relatively high capital outlay costs but low operating costs. Photovoltaic panels, which generate electricity when exposed to light, are available in many sizes and when linked together, form an array. Individual panels are typically rated at 60-80 watts. The panel rating represents the maximum power output that occurs when the panel is perpendicular to direct sunlight. Solar panels mounted so as to 'track' the sun, for example, with morning, midday and afternoon positions, greatly increases efficiency. They need to be kept clean if they are to remain efficient. This may occur naturally through rain, but cleaning may need to be made part of the maintenance schedule.

BATTERIES

While both solar panels and wind turbines can directly drive small loads, including borehole water pumps, normally the energy generated is used to charge batteries and the load drawn from them. This means that power will still be available when the sun is not shining and the wind is not blowing. Batteries can be ordinary lead acid vehicle batteries but preferably should be deep cycle batteries, designed for a renewable energy installation. Batteries are 12 volts or 24 volts if linked together. For small-scale uses, such as radios, power can be drawn directly from the batteries. For larger uses, such as computers and lighting, an inverter is normally used to convert DC to AC. This takes low voltage direct current from batteries and produces mains voltage alternating current, allowing ordinary domestic equipment to be powered. Suitable inverters come in output power sizes of between 1 and 3 kilowatts.

KEY POINTS FOR THE MCPA

- **Investigate alternative energy options carefully.**
- **Ensure that adequate expertise is brought in to design, choose and install the appropriate system.**
- **Be aware that both solar and wind systems can be relatively expensive to purchase.**
- **Ensure that staff are adequately trained in the use and up-keep of the system.**
- **All the equipment, particularly solar panels, must be robust and adapted to withstand the harsh environmental conditions prevalent in tropical MCPAs.**

CASE STUDY

Lessons Learnt from Solar Energy Systems in Seychelles

The use of more sustainable energy sources in MCPA management is in its infancy in South Asia, however, there are some interesting experiences from the Western Indian Ocean region that can be drawn from. Diesel generators have served the electricity needs of protected areas in Seychelles for many years but, because of noise and pollution, a few MCPAs have opted for solid state solar panels. Cousin Special Reserve, Aride Special Reserve and Curieuse Marine Park, for example, recently introduced modern integrated systems. The high cost of the equipment (which had to be imported) meant that external funding was sought from the Italian Government and the Dutch Trust Fund for Seychelles for Curieuse and Cousin respectively. As the MCPA management authorities had insufficient expertise to design the systems, staff of the Energy Affairs Division in the Ministry of Industry and International Business assisted in ordering appropriate equipment and installing the systems.

Since 2000, these MCPAs have had electricity 24 hours a day, a big improvement on the previous systems where noisy diesel generators provided power for only a few hours in the evening. On Cousin Island, each building has a set of solar panels as well as a bank of batteries to store the energy for use after sundown. The new systems provide enough power for each house to run several lights and a TV. However, initial problems with some of the systems, burnt-out lights and inverters and difficulty of procuring spare parts in Seychelles, emphasise the need for proper design and installation by personnel suitably experienced in renewable energy systems.

Sources of further information

Corfield, T. 1993. The Wilderness Guardian: A Practical Handbook. African Wildlife Foundation/The David Sheldrick Wildlife Trust. Longman, Kenya. 701pp.

Grange, N. & Odendaal, F. 1999. Guidelines for the Environmental Assessment of Coastal Tourism. Chapter 6. SEACAM, Maputo, Mozambique. 197pp.

http://energy.sourceguides.com – lists worldwide renewable energy suppliers by country and by specialisation.

www.bpsolar.com – a major supplier of solar equipment worldwide.

www.dulas.org.uk – consultants in renewable energy with worldwide small scale power experience.

www.greenbuilder.com – sustainable building technology.

www.uneptie.org/pc/tourism/library/energy.htm – a handbook on renewable energy

www.windenergy.com – a major low power wind turbine manufacturer.

The MCPA office F3

A professional and well-organised office creates good first impressions, and will save time and ultimately money. It is important to establish some standard procedures for maintaining up-to-date records of all management activities and to create a comfortable efficient working environment. This sheet provides advice on some of the activities involved and suggests ways in which office efficiency can be improved.

The MCPA office is the focal point for day-to-day operations. Many, if not all, the administrative duties are carried out there. Ideally, the office is situated within the MCPA, but this is not always possible and it may be in a nearby centre where communications and other facilities are better. Even in this situation, those who staff the office need to be in regular contact with the field staff, at minimum by radio. The office generally has to have some or all of the facilities listed below.

COMPUTERS AND ASSOCIATED EQUIPMENT

While computers are nowadays more user friendly, with plug and play hardware and easy to use software, setting up local networks (LANs), problem/trouble shooting and maintenance all require particular skills. Ideally, an MCPA should have at least one employee with basic information technology (IT) skills training, with back up from a computer specialist in a nearby town, possibly on a retainer contract. With some basic operator and diagnostic training in house, external help can often be effective by telephone or radio. It is important that computers are properly protected from:

- Power cuts, lightning power spikes, damaging high or low voltages. Use commercially available power protection equipment such as voltage stabilisers, UPS or power from inverters;
- Viruses, transmitted from portable storage devices or from the internet. Install and update commercial antivirus and firewall software;
- Unauthorised users. Use passwords and other blocking methods;
- Environmental factors such as extreme temperature changes, excessive humidity and ants.

Make sure that staff who use computers have adequate training for the work they are expected to do. Support staff should be appropriately trained in preparing documents, managing email and maintaining general correspondence.

DOCUMENTATION AREA

The MCPA office should include a small library or documentation centre, with the contents catalogued and carefully maintained. This centre should contain all the key references relating to the MCPA, all data and reports concerning the MCPA, as well as more general field guides, relevant maps and remote sensing images, reference books and manuals on research and monitoring techniques. Many key references can be obtained free of charge as indicated in this toolkit. A recognised cataloguing system should be used by preference.

RECEPTION AND INFORMATION AREA

The office is often the reception point for visitors, where tickets, brochures and other items are sold, and it may act as an information centre. A welcoming atmosphere is particularly important here, and staff should be aware that a friendly, helpful manner is essential. Training for those regularly welcoming visitors may be valuable. The area can be used to display materials about the MCPA, providing an excellent opportunity to educate visitors on how to behave and interact responsibly with the environment. A notice board is often useful to display key information (e.g. meetings, staff leave and absences, staff travel, visitors, events in the MCPA such as sightings of rare species), as is a calendar of key dates and events in the year.

MEETINGS AND PRESENTATIONS

The office is likely to be where most meetings take place and an area should be made available for this purpose. Meetings will include discussions with visitors and advisors, regular staff meetings and larger events involving stakeholders. It is easy to waste time on meetings but this can be avoided by preparing for them carefully, conducting them efficiently and ensuring that they are followed up in the right way. Meetings can be one of the best ways of communicating, sharing ideas, reaching decisions and planning future activities.

It is important to clearly define the purpose of the meeting and inform the participants, either verbally or with a written agenda, distributed in advance. Make sure that minutes, or at minimum, notes are taken during the meeting, and that a summary of the decisions taken and action points agreed on are circulated to all participants as soon after the meeting as possible. Staff meetings should be held regularly, preferably at a predetermined and fixed time in the week or month. Other opportunities, whether formal or informal, should be encouraged to promote communication and information sharing between MCPA staff, and between the MCPA and the stakeholders.

OFFICE PROCEDURES

Consumables (i.e. items that are used in day-to-day management such as fuel and stationery) need regular replacement and the office manager is likely to be responsible for stock control. Ensure that a dedicated person is assigned responsibility for these tasks. Overstocking is to be avoided as supplies may have a limited shelf life, especially in hot or humid conditions. Equally, under stocking may lead to delays and problems in other work if certain items run out at key moments (e.g. basic stationary). Aim to recycle materials (e.g. paper) whenever possible.

It is also important to ensure that the storage conditions are appropriate – e.g. secure, dry, cool, out of direct sunlight and protected from pests such as insects or rodents. Often, separate

wet and dry storage areas are required. Older supplies should be issued first – the 'first in, first out' principle will reduce losses due to deterioration. If the office is the place where equipment is issued for use in the field, logbooks should be carefully maintained and checked.

Sheet F4 covers the purchase and maintenance of equipment. In general, broken computers and photocopiers can seriously hinder the technical and management work of the MCPA and progress of the MCPA in meeting its objectives. Phone, fax, e-mail, Internet access and other communications issues are covered in sheet F7, and maintenance of a good information system is described in sheet G8. Office procedures should be designed to ensure that the MCPA provides a good working atmosphere, where information sharing and networking can flourish. Some simple ways to encourage this include:

- Emails, memos and other correspondence should be friendly, informative and to the point, and copied to relevant individuals;
- Set up a system to ensure that phone and other messages are given to staff if they are out of the office;
- Provide a refreshments area, where staff and visitors can obtain tea or coffee; keep the area clean and tidy;
- Provide a seating area for general visitors, and desk and working space for consultants and advisors;
- Promote a culture where individuals respect each other; acknowledge good work done, ensure that staff respect each other, and thank people for their contributions to the good management of the MCPA.

KEY POINTS FOR THE MCPA

- **Ensure all equipment is regularly maintained and that it is repaired when necessary.**
- **Staff should be trained in use of equipment, and may need further training to keep them up-to-date in new techniques or materials, e.g. in the use of new computer programmes.**
- **Make sure that good office procedures are in place and that staff are familiar with them. Provide refreshment areas, where staff and visitors can make tea or coffee and eat food; keep the area clean and tidy and request staff to use this area, rather than their desks and offices, at meal times.**
- **Ensure that everyone is aware of the MCPA schedule and calendar of activities.**
- **Ensure that all office staff are aware of, and understand the standard procedures that are required by the head office (if it exists), by donors supporting the MCPAs, and others who may have authority over or be supporting the MCPA.**
- **Create a friendly, welcoming environment with good team spirit between staff; hold regular staff meetings and make sure that new staff members have an induction course to learn the MCPA management and office procedures.**

Sources of further information

Corfield, T. 1993. The Wilderness Guardian: A Practical Handbook. African Wildlife Foundation/The David Sheldrick Wildlife Trust. Longman, Kenya. 701pp.

Humphrey, S. 2003. Module 6: Administration and Management. Module 7: Financial Management. In: Francis, J. et al. (eds.) Training for the sustainable management of Marine Protected Areas: A training manual for MPA managers. CZMC/Univ. Dar es Salaam, WIOMSA, World Bank.

SEACAM 1999. From a good idea to a successful project: A manual for development and management of local level projects. SEACAM, Maputo, Mozambique. 152pp.

Equipment purchase and maintenance

F4

An MCPA manager will normally have overall responsibility for the procurement, operation and maintenance of all equipment needed in the MCPA. This sheet provides a general introduction to this topic, stressing the need to buy appropriate, cost-effective equipment, develop maintenance plans, and train personnel in and provide guidelines for its use and maintenance.

Equipment purchases made without careful consideration of what is really required, what is most appropriate for the operating environment, and whether the skills and funding are available to operate and maintain it, will lead to the inefficient use of often limited MCPA resources. The types of equipment likely to be required in an MCPA are:

- Electrical power generating equipment including solar and wind power (see sheet F2);
- Boats and engines (see sheet F5), vehicles and trailers (see sheet F6);
- Radios and other communications equipment (see sheet F7);
- Diving gear and air compressors (see sheet F8); cameras and binoculars;
- Office information technology equipment (computers and other hardware, TV, video);
- Specialised laboratory analysis, glass/plastic containers for storing and displaying specimens, preservation solutions, field monitoring and meteorological equipment, and GPS;
- Domestic household equipment, lighting, water supply and pump systems.

The three key words governing the procurement and management of equipment are Availability, Reliability, and Maintainability or ARM, all of which are equally necessary for effective MCPA management. They can be further explained as follows:

Availability – enough suitable equipment is ready and available from local/national suppliers for use when needed;

Reliability – equipment works immediately and does not breakdown or fail when used;

Maintainability – service and repairs are straightforward, staff are trained, and spare parts are in stock or readily accessible.

PROCUREMENT

There are two main steps in procurement – deciding what to buy, and obtaining estimates.

Deciding what to buy – think ARM and make a note of the key technical requirements for the equipment. It helps to think ahead, e.g. one to two years for a computer, longer for a vehicle or a boat. Equipment manufacturers and suppliers are always keen to offer equipment specifications, which can then be used as guidelines or for comparison, and are useful later when tendering.

Consider the level of sophistication that is appropriate for the MCPA, particularly if access to technical support, advice and troubleshooting may be difficult. It is best to avoid being tempted by suppliers offering equipment with attractive features that are not needed. Where relevant, try and balance quantity versus quality. For quality, the old adage "you get what you pay for" still applies.

If there is a choice of suppliers, which one can offer the most cost effective backup and support? Which critical spare parts should be purchased? What guarantees are being offered, and against what failures or breakages? If an overseas purchase is being considered, how will the guarantees be honoured? If second hand purchases are being considered, what are the implications of this (e.g. with regards to durability, insurance)? Seek advice from other MCPA managers and learn from their experiences.

Think about standardising on one product type/range/manufacturer, if this is likely to simplify operation, maintenance and spare part inventories. What level of skill is required to operate and, more importantly, maintain the equipment. What level of maintenance can realistically be carried out on site in the MCPA? If staff training is considered necessary, who will provide it and where?

Obtaining estimates – it is essential to get more than one quotation, and three are advisable, and often required by government departments and donor agencies. It is equally important to be clear on what is requested, otherwise comparisons between quotations become difficult or impossible. An open invitation to tender may be required for the procurement of expensive items such as boats and vehicles. Establish the tax position of the MCPA with respect to Value Added Tax (VAT).

When comparing apparently 'attractive' overseas prices with local prices, ensure that reliable estimates for freight costs (usually termed FOB) are included, plus all the other insurance, handling and storage (demurrage) costs, particularly those associated with sea freight, as well as import duties and taxes (if applicable).

Purchasing from a local agent or dealer may save a lot of time and effort in dealing with freight and clearing agents if the equipment is to be imported. Local agents should be willing to provide the names of other customers whose opinion on the agent's level of customer care, during and after the sales can be valuable.

Equipment has several costs including the initial purchase price (usually the main focus of attention), the through life running and maintenance costs, and the residual value, if any, on sale and disposal (a credit). For large and expensive items such as vehicles and boats, the through life running costs can be equal or greater than the purchase price, especially if labour for operation and maintenance is taken into account. When comparing quotations and tenders ask questions about running costs, i.e. fuel consumption and replacement of spare parts.

INSTALLATION

All new equipment should be unpacked and handled carefully whether it is obviously delicate or not. It may have already been paid for and may have travelled round the world to reach the MCPA. The last thing any one wishes to see is it being dropped off the back of the MCPA pickup!

All components must be checked (if possible) before delivery is accepted, or notes made of any missing or damaged components. Instruction manuals should be read carefully. Installation may require the supplier or someone professionally competent. This is a small price to pay for increasing the chance of trouble free service. Instruction manuals are usually available in major languages, and individual requirements should be specified at the time of purchase.

Purchasing equipment without having sufficiently trained staff to operate and maintain it is a waste of resources and will quickly lead to problems. In some cases, training may be available from the supplier, but the MCPA manager should try to recruit staff with the necessary skills or to plan a training programme that can start as soon as the equipment arrives. Local technical and vocational training to meet most of the basic operator skill needs of the MCPA is generally available in most countries. Some training will lead to nationally recognised qualifications. Training areas to consider include:

- Vehicle drivers and mechanics;
- Boat operations and maintenance;
- Radio operations and maintenance;
- Information technology and computer skills;
- Scuba diving, mooring installation and maintenance;
- Electrical installation and maintenance;
- Water plumbing and piping systems;
- First aid, secretarial and office management, foreign languages;
- Emergency response planning and evacuation.

MAINTENANCE

Equipment manuals usually provide the manufacturer's recommendations for care of the equipment, including periodic servicing (called planned or 'preventative' maintenance). It is vital that these recommendations are carefully read and followed, particularly with new equipment. There are often specific recommendations to 'break-in' equipment (e.g. running of a new outboard engine at low revolutions for so many hours).

For major industrial plants, maintenance is often the largest single controllable expense. There are far fewer items of equipment in MCPAs but the fact remains that maintenance is critical to ensuring a long useful life for equipment. Maintenance records for all major equipment should be carefully kept and a maintenance plan developed, perhaps linked to the busy and quiet seasons during the year, with their corresponding demands on equipment. The emerging approach in industry is for 'proactive' maintenance whereby attention is given particularly to cleanliness, at all times, with a focus on the causes of equipment failure (e.g. contamination of fuels or oils, and dust intrusion).

To prevent damage and accidents, only MCPA staff with the required skills should have unsupervised access to key equipment. Adequate controls regarding access to keys, storerooms, boats and vehicles, need to be established.

Equipment, buildings, furnishings and even supplies are part of the assets of the MCPA and may be examined in the course of the annual audit. An up-to-date inventory of all assets should be maintained and revised at least annually, to incorporate new equipment and remove from the list items that have been disposed of, making sure a record of how and where they were disposed of is kept where required for donor reporting. All equipment and furnishings should be labelled in a permanent manner. A good storekeeper is recommended to maintain stocks and spares.

KEY POINTS FOR THE MCPA

- **Identify what equipment is really needed; it may not be what people think they need.**
- **Take advice and ask questions before committing funds.**
- **Develop and follow maintenance plans; an operations person should oversee the management of all the equipment.**
- **Keep an asset tracking record of all non-expendable equipment to prevent loss, and aid in donor reporting if required.**
- **Assign individuals (e.g. driver, boat captain, mechanic and plumber) responsibility for the equipment they use and provide the necessary training.**
- **Construct appropriate storage and maintenance areas for different types of equipment (see sheet F1).**

Sources of further information

Corfield, T. 1993. The Wilderness Guardian: A Practical Handbook. African Wildlife Foundation/the David Sheldrick Wildlife Trust. Longman, Kenya. 701pp.

Kareko, J. & Musyoki, B. 2003. Module 3. Marine Protected Operations. In: Francis, J.et al. (Eds.). Training for the sustainable management of Marine Protected Areas: A training manual for MPA managers. CZMC/Univ. Dar es Salaam, WIOMSA, The World Bank.

Use a search engine on the internet to find websites of manufacturers of equipment and procurement guidelines.

Boats and engines F5

Most MCPAs need some form of vessel to carry out many of the management activities. The choice of boat design depends on its use, the sea conditions it will be operating in, and operation and maintenance costs. With this information, the design options available can be matched against the budget. This sheet outlines some of the issues to be considered.

Within an MCPA, boats are used for many activities including: patrols; transporting equipment, personnel and visitors; search and rescue operations; and research, surveys and monitoring. A boat for transporting equipment needs a large cargo area but few furnishings, while a boat for personnel transport should have seating and preferably shade, with enough life jackets on board for the boat's maximum carrying capacity. Boats used for scuba diving should have space for equipment and diver access. Rough open sea conditions require boats with greater stability, higher freeboard, stronger hulls and more powerful engines than those operating in sheltered waters. Where boats have to operate in both situations, the design should be appropriate for the more difficult conditions. Multi-purpose boats may be appropriate but, in some cases, it is more efficient and cost effective to have different boats, each for a specific purpose.

PERFORMANCE AND RANGE

The requirements for boat speed and range will be determined by the distances to be covered, whether fuel has to be carried (e.g. for the return journey or for days away from base), and whether daytime trips only are essential (for navigation and safety reasons). Suppliers can offer a boat and engine package to meet the expected operating scenarios. Note that the top speed quoted by suppliers will be that obtained in flat calm conditions; the top speed in open sea conditions may be less than half that speed.

BOAT MATERIALS

Materials commonly used to build the main structure (the hull), are wood (including marine ply), rubber, fibreglass, Ferro cement, aluminium and steel, some of which can be combined, e.g. fibreglass hulls with rubber sponsons (called rigid inflatables). Weight is a consideration; for example, an aluminium dinghy is lighter than a fibreglass one of the same size, and so is easier to transport on land and haul ashore. In general, select hulls that are the thickest and strongest that the construction material will allow, ensuring a long service life. The material used also influences the maintenance schedule and the need for spares; wooden hulls may require more maintenance. Fibreglass hulls are vulnerable to rapid wearing when boats are dragged over sand without using protective boards or runners.

MODES OF PROPULSION

The length and weight of the vessel determines the minimum power unit required. Outboard engines are now common in boats up to 10m. They come in sizes from 6 to 250 HP (horse power), and should be selected in relation to the expected hull speed, but taking account of fuel consumption. A large engine used at 50% of its power will generally consume less fuel than a smaller engine used at full throttle to achieve the same speed. Outboard engines are often 2-stroke, and run on a mixture of 1:50 (1 litre oil to 50 litres of petrol) or 1:40. 4-stroke outboard engines are more expensive and require more skilled maintenance but are generally more economical to operate and quieter. If budgets allow, twin engines should be purchased to provide additional security for offshore operations in case one of the engines fails. If the boat is to travel in the open ocean and has a single outboard, a small backup should always be carried. Manufacturers of outboard engines include Yamaha, Mariner, Evinrude, Honda and increasingly Suzuki. Agents for these are present in most South Asian countries and should stock spare parts.

Larger, heavier boats usually have inboard diesel engines that are efficient in fuel consumption but slower. Common names of engines distributed in South Asia are Yanmar, Lister-Petter, Volvo-Penta and Mitsubishi. The operator must fully understand the engine which may be more complex to run than outboards (e.g. complicated electrical systems and, in some cases, are turbo powered). For shallow waters, where propellers are regularly damaged or cause damage to marine life, or where other MCPA users are present, water jet propulsion systems should be considered. Sail is unlikely to be the main means of propulsion for reasons of efficiency and convenience, but can be a useful backup to engines and thus provide a safety measure.

HULL DESIGN

The design and shape of the hull is very important to consider, especially in relation to:

- Shallow keel – preferable where the mooring dries out at low tide.
- Flat bottom shallow draft – ideal for shallow waters.
- Solid shallow keel – preferable for regular beaching.
- Flared bow, with high stability and freeboard – safer, more efficient and more comfortable in rough, open seas. A round bottomed hull would be better avoided in these conditions.
- Large hold or seating capacity, good stability and a high freeboard – preferable for transportation of large amounts of cargo or passengers.
- Twin hull – useful when a large working deck area is needed for research or diving.

MAINTENANCE

As with any equipment used in the sea, washing engine(s), hull, and trailer (where this is used to remove the boat from the sea) with freshwater (if available) is essential. Regular freshwater rinsing

S. Mithapala

Anchored fishing boats at the Negombo harbour, Sri Lanka

of the internal cooling system after use will prolong engine life. A small outboard engine can be rinsed by running it for a few minutes in a drum of freshwater. Rinsing the internal part of a larger engine requires connecting a freshwater hose to the water intakes of the engine. Large outboards, inboards and diesel engines are not rinsed.

Outboard engines should be maintained in accordance with the users manual, original spare parts used where possible, and regular services carried out by an experienced mechanic. Check fuel is of good quality and not dirty or mixed with oil, and use fuel filters. Ensure that the right mixture of oil and petrol is used. Marine grease must be used on external moving parts of the engine.

KEY POINTS FOR THE MCPA

- **Boats are a major investment, so think carefully and consult colleagues and other MCPAs on what is really needed.**
- **In selecting the type of boat, look carefully at the skills available for both maintaining and using it, and the distance of the MCPA from maintenance and support facilities.**
- **Ensure that all personnel who use or maintain boats are adequately trained, and that their responsibilities are clearly defined. Ideally have one main boat operator per boat and, where necessary, a deck hand. If possible have a trained boat mechanic on staff.**
- **Funding for boat purchase is often not available in the MCPAs operating budget, and comes from external sources. In such situations, it is important that donor requirements or the interests of a commercial sponsor do not result in a compromise in the type of vessel selected.**
- **Develop operational and maintenance routines for all MCPA boats and have key spares available (e.g. propeller pins, propellers, fuel filters).**
- **Large vessels should go into dry dock at least once a year for examination and preventative maintenance measures.**
- **Consider the role of MCPA staff in helping local boat users to improve the seaworthiness of their craft.**
- **Consider the need to budget for, and carry out maintenance activities (e.g. use and re-application of anti-fouling agents for the hull, regular boat cleaning/scraping/repainting).**

Sources of further information

Corfield, T. 1993. The Wilderness Guardian: A Practical Handbook. African Wildlife Foundation/The David Sheldrick Wildlife Trust. Longman, Kenya. 701pp.

Gubbay, S. (ed). 1995. Marine Protected Areas: Principles and Techniques for Management. Chapman and Hall, London, 232pp.

Use a search engine on the Internet to find websites for manufacturers, importers, resellers etc.

CASE STUDY

Use of Boats at the Hoga Marine Research Station, Wakatobi Marine National Park, Indonesia

The Wakatobi Marine National Park was established in 1996 to protect the livelihoods of island communities from over-fishing and habitat destruction, and to protect the naturally high biodiversity of the area. The park covers an area of 1.39 million hectares, and has recently been rezoned under the WWF/TNC joint programme, in collaboration with the National Park Authority and District Government. Tourism is minimal in the park due to its remote location, with approximately 1,000 visitors per year.

Operation Wallacea, a biological and conservation research management organisation, has been bringing large teams of academics and researchers to the area to undertake biological, socioeconomic and fisheries projects since the area was declared a national park in 1996. The Hoga Marine Research Station, managed by the Operation Wallacea Trust, is the centre point of this programme in the Tukangbesi Archipelago, and it provides facilities for other organisations undertaking activities in the area.

Essential to the smooth running of the research operation is the station's boat fleet. Several types are needed to cater for its various requirements such as:

- Monitoring and research around the immediate islands;
- Monitoring and research around the outlying islands;
- Transferring visitors, personnel and cargo to shore from vessels that have to anchor outside the reef;
- Transferring visitors, personnel and cargo between islands within the Tukangbesi Archipelago;
- Rescue and emergency evacuations;
- Diving trips.

The station maintains a fleet of seven boats, six of which are used daily for transporting researchers, community members and goods. There are four flat-bottomed, fibreglass hulled boats of varying carrying capacities of 8-14 persons. They are fitted with outboards, two of which have twin engines for greater distances. The remaining two boats are restricted to the inner reefs, have a carrying capacity of 20 persons and require only one outboard engine. For the more remote reef monitoring sites and marine mammal surveys, the Bintang Sedang, a live-aboard research vessel that caters for 20 personnel and uses a large inboard diesel engine, is used. All boats have radios.

For the main project period, a speedboat is hired from WWF and kept on standby for rapid response in an emergency. This vessel has a marine radio and is able to withstand the majority of conditions during the monsoon season to transport any patient to a private airstrip on Tomia, an island approximately 35 km away. When this boat is unavailable one of the twin outboard general use boats is kept on standby for this purpose. In the event of a non-emergency evacuation, the Bintang Sedang is used for transport to mainland Sulawesi.

The head of local staff oversees the boat maintenance programme, helping to ensure the needs of the research station are met. The team of site based boatmen and mechanics are familiar with the engines and are able to maintain them in the remote location. All boats are allocated to a particular pair of boatmen and receive careful operation and regular maintenance, as unless spares are collected, the supply chain to Hoga is notoriously slow and unreliable.

www.opwall.com

Vehicles, like boats, represent a necessary and large investment for the MCPA. The purchase of appropriate vehicles that can meet clearly defined requirements will make a valuable contribution to the management of the MCPA, whereas the purchase of unsuitable ones will not only be a waste of money but is likely to make management more difficult. This sheet offers guidance on the vehicle procurement process.

Most MCPAs use vehicles to transport personnel, equipment and supplies or to tow boat trailers. The range of vehicles used might include mini-buses, saloon cars, four-wheel drive (4x4) vehicles, small trucks and tractors, motorcycles and even bicycles. Before investing in new or additional vehicles, the MCPA should first consider what requirements it has for land transport, both inside and outside the MCPA. In particular, it is important to decide on journey distances, frequency, type and size of loads, and to take into consideration the geographical area to be covered, the existence and condition of roads and tracks, and what tasks can be best carried out by vehicle or by boat (see sheet F5).

Once the requirements are known, identify the vehicle or combination of vehicles that can most effectively meet these needs within available budgets. Vehicles cost money even when not being used, through depreciation and insurance; thus the MCPA should aim to have the minimum number necessary to meet its requirements, with each having a high utilisation rate.

Costs of new vehicles vary depending on model availability and type, demand and import duties and other local taxes. Older vehicle models can sometimes be purchased at a discount when new models appear. Like boats, an MCPA vehicle is a potential item for sponsorship.

MANUFACTURER AND MODEL

Manufacturers of 4x4 vehicles in use throughout South Asia include Toyota, Land Rover, Jeep, Mitsubishi, Ford, Nissan and Suzuki. Agents for these are present in most countries and should stock spare parts. Before deciding on the most appropriate 4x4 vehicle to buy, it may be useful to seek advice on those that are already in use in the area, how long they have been used and whether there are problems in acquiring spare parts. For other vehicles, such as minibuses, saloon cars and motorcycles, it should be readily obvious from the nearest large town, what makes are locally available and easy to support and maintain. It must be noted that import tax can contribute significantly to the overall cost and must be factored in to budget considerations.

Some new vehicle designs come with complex electronic fuel control and management systems, which require highly specialised diagnostic and maintenance equipment and appropriately trained personnel. Avoid buying such models as they are likely to be unsuitable for an MCPA, and a headache to operate. Even 'standard' features, such as electric windows, central locking or air conditioning, may not be appropriate for harsh operating environments. Select more basic vehicle models where a choice is available, such as the Suzuki Jimny, which lacks the gadgets and luxuries of a standard 4X4 and is reportedly very reliable.

ENGINE

Engine size, performance and range will be determined by the requirements within the MCPA. For example, a saloon car may appear to be the best vehicle for regular trips on metalled roads to towns and cities; but if it sits idle the rest of the time, unable to operate on the bad roads within the MCPA, then it is the wrong choice. A heavy duty 4x4 that operates daily within in the MCPA and occasionally goes to town, would be better.

FUEL

Modern engines are very reliable, so the choice between petrol and diesel is not really a technical one. Diesel engine vehicles tend to be slightly more expensive than petrol ones but are, in general, easier to maintain and can cope better with extremely wet conditions. What matters more in the decision is:

- The quality of the locally available fuel and oil, and the reliability of its supply;
- Engine spare part availability;
- Whether the MCPA wants to standardise on either just petrol or just diesel (including for the generator, boat engines and any other engines).

Diesel, with its lower flammability, is safer to transport. When filling vehicles or other fuel tanks, the use of basic strain filters is recommended. New vehicles with petrol engines are usually designed to run on lead free petrol and often have catalytic converters fitted to meet European import requirements. If only leaded petrol is available, the vehicle will run, but the exhaust filtration will not be effective.

ACCESSORIES

Boat trailers and the corresponding tow bars are a common requirement of MCPA vehicles. Although their use is fairly simple, there are differences in design that need to be considered before fitting a tow bar. For example, a boat trailer fitting may be different from that of a standard goods trailer, i.e. one being a 'pin hook 'and the other being a 'ball hook'.

MCPA vehicles may need to be equipped with auxiliary equipment such as radios (and relevant antenna) and searchlights. A complete tool kit, tow rope, jump leads and other items such as flares, torches, first aid kit and fire extinguisher should also be considered,

J. Tamelander

Vehicle in use for field work in Gwadar, Pakistan

factored into the costs, and fitted accordingly. Many other potentially useful vehicle accessories are available, particularly for 4x4 vehicles used in research, such as roof racks, heavy duty and high suspension systems, winches, mounted water tanks, external air filter extension pipe, diving bottle holders, spot lights, glass fibre covers for pickups, secure storage bins and 12V cool boxes.

MAINTENANCE

The objective of regular preventive maintenance is to minimise the time the vehicle is non-functional and ensure a long service life. Lack of maintenance, and wear and tear are the major causes of vehicle failure. Damage from accidents sometimes happens and cannot always be prevented, but breakdowns due to lack of maintenance can be minimised. Every vehicle manufacturer produces a maintenance manual and schedule that should be studied, understood and followed.

Without planned, preventive maintenance, associated costs over the life of a vehicle can be doubled. Maintenance failure is the greatest cause of operational failure in transport activities throughout the developing world. If vehicles are used in rough terrain, constantly working in mud, dust and water, oil changes should be more frequent (including engine, gearbox and differential oils). The air filter should also be cleaned more frequently, and wheel bearings and drive shaft, steering joints more regularly re-packed with suitable grease.

As with any equipment used by the sea, washes with freshwater are an essential part of preventive maintenance. In addition, the main areas to inspect regularly are:

- Bodywork for rust;
- Tyres;
- Cooling systems;
- Electrical systems.

Another simple measure that can enhance the value and working life of vehicles is to fit removable seat covers. These can probably be locally made from heavy duty canvas.

In remote areas the MCPA may have to maintain a fully equipped workshop to service vehicles and other equipment. A range of spare parts needs to be kept to link with the servicing of the vehicle. Of these, oil and fuel filters will be the most regularly consumed. The standard recommendation is to buy genuine manufacturer's spare parts from an authorised dealer, although this may not always be practicable, particularly in small islands or remote places where obtaining supplies is difficult. Planning ahead for the purchase of spare parts reduces the need for urgent spares when there is a breakdown. In some instances, it may be possible to bring a specialist mechanic to the MCPA for major servicing of certain components, but in general the MCPA should have a trained mechanic, competent in the general maintenance of all MCPA vehicles. The MCPA should identify and list key workshop tools required, i.e. a ramp where work can be carried out underneath the car, good lighting and security, and puncture repair kits.

VEHICLE USE

MCPA drivers should have a valid local driving licence issued by the relevant authorities. Training in additional car handling skills may be necessary where difficult off road driving, including water crossing and sand driving, is a necessary and regular part of vehicle operations. A training programme for drivers should be built into the annual work plan where appropriate.

It is recommended that a logbook is kept with the vehicle and completed by the driver. Basic information to record, on a daily basis, includes start and end of day kilometres, fuel taken, basic checks (oil, tyres, battery) carried out and punctures or other problems. A separate maintenance logbook should be kept by the MCPA mechanics, recording the date, kilometres and details of all servicing of the vehicle.

KEY POINTS FOR THE MCPA

- **Develop a set of land transport needs for the MCPA, in as much detail as possible, and use this to focus decision-making about vehicle procurement; do not buy extra features that will not be needed.**
- **Aim for maximum usage and flexibility in MCPA vehicles, but use the vehicle primarily for its correct purpose; do not overload or overuse.**
- **Encourage a 'maintenance' rather than 'repair' culture amongst MCPA staff.**
- **Adhere to the insurance points; e.g. avoid using an open pick-up to transport personnel or local community members, as this can easily be overloaded and accidents can occur.**
- **Consider community requirements as part of the schedule and develop a protocol for this.**
- **Security may be an issue in some areas, and should be taken into consideration, i.e. a new vehicle is a potential target for bandits or thieves.**

Sources of further information

For country specific advice and product information, visit: www.bukkehave.com, www.kjaer.com

For test reports and reviews on 4X4 vehicles, visit: www.testreports.co.uk/motors/4x4/default.asp

Use a search engine on the Internet to explore further websites for manufacturers of vehicles and accessories.

Radio and telecommunication F7

Good communications are vitally important both within an MCPA, between the MCPA staff and stakeholders, and others outside the boundaries. Radio, telephone and Internet are the primary forms of communication available to MCPAs. Key principles in their selection and use are outlined in this sheet.

MCPAs need good communication links with:

- MCPA staff in vehicles or boats or undertaking other field activities;
- Local and national government offices, the police and the Navy;
- Villages within or adjacent to the MCPA;
- Visiting vessels (e.g. yachts, commercial shipping or fishing vessels);
- Oil spill task force and/or emergency response contacts;
- Other MCPAs, donors, NGOs and other external organisations.

RADIO COMMUNICATIONS

Radio communication is based on the reception and transmission of signals (electromagnetic waves) that travel through the air in a straight line, or by reflection from the ionosphere or from a communications satellite. The radio-wave spectrum is divided into eight frequency bands, ranging from very low frequency (VLF) with a long wavelength, to extremely high frequency (EHF) with a very short wavelength.

The range of a radio unit is determined mainly by the frequency used and the transmission power of the set (measured in watts). Other factors are the height of the antennae, location of the base station, atmospheric conditions, time of year and even the presence of sunspots. A typical Marine MF/HF radio transceiver permits radio communications across many thousands of kilometres. VHF radios have much shorter ranges (a maximum of about 50 nautical miles offshore to the coast) depending on the height of the antennae and obstructions in the line of sight between radio sets.

The VHF band is ideal for most MCPAs. It is divided into 55 numbered channels, with Channel 16 set aside as the standby channel for opening communications between different operators, before users switch to other selected channels. As the designated standby channel, with all users set to it when they are not on air, it is crucial for emergency communications. One of the main advantages of radio is that running costs are very low and it is usually long lasting.

Obtaining a radio frequency

The International Telecommunication Union (ITU) tightly regulates use of the radio spectrum to prevent interference caused by two users on the same frequency: there should be no duplicate frequencies within a 50km radius. A user is allocated a frequency band in which to operate, a transmitter radiation pattern and a maximum transmitter power. National agencies are responsible for regulating domestic radio links and selling licences. Annual fees are also paid to maintain the frequencies, as well as a fee (US$ 40-80) for every radio in use on that specific frequency.

Repeater communications

A 'repeater' is a relay-base (often unmanned) located on elevated ground, with more transmission power than a single radio unit. It re-transmits messages by using radio waves on different frequencies (a frequency pair) thus transmitting and receiving simultaneously.

A 'community repeater' is a repeater that uses different codes (either tones or digital) to separate users, thus allowing many users. By using a repeater station (and its antenna to gain height), the effective communication range of relatively low-powered sets is increased.

Radio components

Antennas – These are essential for transmitting and receiving signals, require power, and vary in length, with handsets and satellite transponders having the smallest antennas.

Transmitter-receiver – This comprises an electronic circuitry of transistors, printed circuits and dials. Modern radios are programmable and only specialised technicians should open or alter radio settings and components.

Marine Radios – These are generally more expensive but are essential for boat use. The units are made with non-corrosive materials, and waterproof.

Power supply – Mains electricity, wind-up dynamos and batteries can be used. Handsets are powered by rechargeable batteries or use adaptors to connect to vehicles, 12V batteries and solar panels. Base stations normally take 240V mains power. If disposable batteries are used, ensure responsible disposal.

Radio maintenance and safety

Most radios do not require much maintenance, but an annual service by a qualified technician is recommended. The components should be kept clean and dry, and away from direct sunlight and heat. Rechargeable batteries last longer if they are regularly fully discharged. Electrical problems and lightning strikes are the main dangers but both can be prevented with qualified installation.

Radio and telecommunications for outreach

Radios have addition uses beyond communication amongst staff of the MCPA they are also an excellent tool for outreach activities with the potential to reach communities throughout the protected area. Community radio is used for outreach activities throughout the developing world. In the Wakatobi National Park, Indonesia, the WWF/TNC joint programme, working with the National Park Authority and District Government, used radio as part of their community outreach programme, aimed at helping communities understand the process of re-zoning the park, and encouraging participation.

TELEPHONE

Fixed land telephone lines are cheapest and installation costs are generally low. Mobile, or cell, phone use is restricted by the location of the transmitter network, but is increasingly available, although it can be expensive. In remote areas with suitable satellite coverage, a satellite phone may be appropriate. These phones can be used anywhere, including in vehicles or boats but can be very expensive. Another potentially cost-effective option for low-quality voice communications is the Inmarsat-M communications service.

INTERNET

Email and the Internet allow remote locations to be connected to the rest of the world. Internet Service Providers (ISP), who are available in most cities in South Asia, are companies that provide connections to the Internet and host email addresses. In South Asia, the shift away from traditionally state owned services to deregulation and privatisation has promoted competition and vastly increased the delivery of communications services. Connections to the Internet can be made by:

Fixed land telephone lines – The cheapest option, but it can be too slow to be useful in many cases.

Mobile phone – More expensive, and so not very suitable for Internet browsing, and like fixed land lines they have the tendency to be very slow. Weak mobile signals can sometimes be boosted locally within the MCPA.

Short wave HF radio – Suitable for email messages and the transfer of small files but not for large attached files or Internet browsing. Typically, the larger the file the longer the transfer time. This is particularly true in remote locations due to the long range of short wave, but signal quality can vary due to local conditions.

Broadband – A high-speed Internet connection through phone lines (ISDN and ADSL) with a special modem, via a wireless link in the VHF band, or with a direct satellite link.

Direct satellite link – Sometimes the only possibility in remote areas but expensive. If this is the only option, a once or twice daily up/download of data is recommended.

Sources of further information

Corfield, T. 1993. The Wilderness Guardian: A Practical Handbook. African Wildlife Foundation/The David Sheldrick Wildlife Trust. Longman, Kenya. 701pp.

Dagron, A. G. 2001. Making Waves: Stories of Participatory Communication for Social Change. A report to the Rockefeller Foundation, 420 Fifth Avenue, New York.

Davis, J. & Lambert, R. 1995. Engineering in Emergencies: A Practical Guide for Relief Workers (2nd Edition). London: RedR/IT Publications. 736 pp.

Gale, J.M. 1992. Marine SSB operation. Fernhurst Books, Brighton, UK. 96pp.

Lockwood, M. Worboys, G. & Kotari, A. 2006. Managing Protected Areas: A Global Guide. James and James Ltd / IUCN. 802pp.

Companies providing wireless and telecommunications services and relevant equipment:
www.inmarsat.com
www.icom.com
www.motorola.com
www.satsig.net/ivsat-asia
www.kenwood.com
www.globalstar.com
www.icom.com – commercial company giving information on creating websites and getting online.

KEY POINTS FOR THE MCPA

- **Establish a communications system that adequately covers the MCPA and beyond, and that incorporates the use of computers and relevant accessories.**
- **Provide training and opportunities for staff to obtain proficiency certificates (this is sometimes mandatory) in the use of radios.**
- **Establish a radio call procedure (e.g. limit usage to important exchanges of information only).**
- **Provide waterproof plastic cases for hand-held units used on boats, and try to purchase marine models.**
- **Keep a log to record signing in/out of VHF sets for asset tracking purposes and the daily checking of battery power.**

CASE STUDY

Use of Radios in Menai Bay Conservation Area, Zanzibar

As part of a WWF-supported project, the Zanzibar Department of Fisheries has established a network of radio posts in the Menai Bay Conservation Area linking 19 villages within the MCPA to the patrol base in Kizimkazi. The seven 'base' radios include several in villages, some powered by car batteries connected to solar panels, and others in a vehicle and a boat. These stations were initially operated by volunteers from village environment committees associated with the Conservation Area, and thus able to report potential violations of park regulations to Kizimkazi. Radio posts were strategically posted in villages with clear views of entry points to the MCPA and were installed by a technician. Six hand-held radios were also bought for use on the fishing and patrol boats, providing a critical link with the radio base in case of emergencies, need for reinforcements, or for reporting on the location of alleged offenders.

Some lessons learnt during the first phase of operations were:

- The radio network was appreciated by those villages involved, who actively reported illegal activities and were able to use the network in case of other community needs such as reporting on death or sickness of community members.
- A speedy response was required since violators could quickly move on, but the radio network did not adequately cover the large MCPA. Three additional patrol bases are therefore being established, and the hand-held units have helped.
- Compensation to radio operators made them more reliable and it is hoped that they will eventually receive a government salary.
- Although marine radios are better they have not been used, as the costs are higher and frequencies are not compatible with the terrestrial units that were purchased first.

Scuba and snorkelling equipment F8

Diving or snorkelling provide those working in or visiting MCPAs with the means to see underwater and, in the case of scuba diving, to breathe underwater, thereby providing a significant opportunity to experience the marine environment first hand. Snorkelling and scuba equipment needs careful maintenance and there are a number of safety issues to be aware of in their use. This sheet provides a brief overview of the key points.

MCPA staff, visitors and researchers may need to snorkel or dive for monitoring, research, recreation, underwater guiding and for a range of management activities such as installation and maintenance of mooring and boundary buoys, or even finding items that have been lost overboard.

Snorkelling, sometimes called skin diving, requires comparatively little skills and training, and just three main pieces of equipment: mask, fins and snorkel. Environmental awareness briefings prior to snorkel excursions can help to prevent damage to vulnerable shallow water habitats such as coral reefs, which are easily damaged by direct contact from fins and limbs.

Scuba diving requires specialised training so that the diver is fully aware of the dangers associated with this activity. Standard training courses include PADI (most common in the region), BSAC, CMAS, SSI and NAUI. The equipment includes mask, fins and snorkel as well as all the additional components to regulate buoyancy and allow breathing so that the diver can spend time underwater at depth. Most MCPA activities will only require shallow-water diving, that is dives of around 40 minutes to depths of up to about 20m using compressed air. Decompression dives, and even dives approaching this limit, should always be avoided in accordance with PADI certification guidelines, especially in MCPAs far from any decompression chamber, as is the case in most South Asian MCPAs. More advanced forms of diving, as practiced by commercial or salvage divers, involve different mixtures of gas, and depths and duration of dives are much longer. Recompression chambers in such diving may be essential.

EQUIPMENT

The main items required for diving are: mask, fins and snorkel; wetsuit and booties; cylinder; regulator, pressure gauge and octopus rig; weight belt and weights; buoyancy jacket; watch and depth gauge; dive computer, knife, decompression tables, compass; surface marker buoy (SMB) and safety sausage; torch and glow sticks.

A slate (plastic sheet), and pencil (attached) used to make notes underwater are useful for both snorkelling and diving, and are essential if data are being collected.

Prices of individual items vary throughout the region. Specialised diving equipment is not manufactured within the region. Currently, the best selection of retail diving equipment is available in Maldives, due to the presence of a major dive tourism industry. However, dive equipment may be purchased or imported through several retail distributors in other South Asian countries. The following are details of the more expensive and technical equipment.

Cylinders or bottles – There are two types: steel and aluminium, and they often come in sizes of 10 or 12 litres. Both have a steel or bronze pillar valve screwed into the top of the bottle, for attachment of the first stage of the regulator. The Test Date (TD) should be stamped into the metal around the upper curved sides as should the Working Pressure (WP), which is usually 200 bar, although in some countries 300 bar is common. Steel bottles are heavier, may rust internally as well as on the outer surface, but last for a long time if well cared for. Aluminium bottles are lighter (become positively buoyant underwater when almost empty), and do not rust, but the surface may corrode and become pitted.

Cylinders, valves and valve O-rings must be checked and serviced regularly, preferably every year, and tested under Test Pressure (TP). The maximum period between tests varies from country to country, but is usually 3-5 years. The minimum period is one year as it is important to avoid over-stressing the cylinder.

Regulators – There is now a vast range of regulator models, from more than 10 international companies. Most regulators are fitted with a console, which contains the depth gauge, pressure gauge, and compass. Two main systems of first stage valve/fitting are common (K-valve and DIN), and the appropriate model of first stage should be bought for the tanks in use. Regulators often have a spare second stage, called an octopus, and this is mandatory for divers using the PADI certification system. Ideally, regulators must be serviced every year by the manufacturer or a certified specialist. The first stage, in particular, is a delicate piece of equipment and dangerous malfunctions can arise from inappropriate handling. Certified dive centres or commercial dive operations with trained technicians may be used if specialists certified by the manufacturer are absent.

Compressor – The MCPA may have its own compressor for filling bottles, or may have to use the services of a local dive operator. In South Asia, where funding for MCPA management is limited, it is more practical to develop agreements with local dive operators for providing air fills and other diving assistance. Compressors range in size, weight and capacity, from those that are portable and fill a bottle in 20 minutes, to those that are fixed to the ground and fill five bottles in ten minutes. Power can be supplied by a petrol, diesel or electric engine. Proper installation and maintenance of the compressor is vital for safe scuba diving, particularly installation

U. Mistry

Diver using scuba equipment

of an up-wind air intake to avoid contamination of the air by the exhaust fumes of the engine, and changing the carbon filters as per user's manual.

Underwater camera and video – Digital cameras and underwater housings are rapidly becoming cheaper, and with a computer, images can be produced within minutes of leaving the water. These are not essential diving items, but are very useful for obtaining images that can be used for promoting the MCPA (e.g. for fund raising), use in education materials, and monitoring and research.

MAINTENANCE

Scuba and snorkelling equipment requires good maintenance for the following reasons:

- The lives of those using it may depend on it working effectively;
- The equipment is often expensive; and
- Repairs may require specialists and replacement of spare parts may be difficult.

Maintenance begins with the treatment of the equipment as soon as it leaves the water before being stored for future use. The first step for all equipment is a freshwater wash with a good soaking to remove salt, sand and oils. This must be followed by dry storage, preferably in an air-conditioned storeroom, which can be used to store boat equipment as well, e.g. outboard engines. However, most MCPAs do not have this luxury, so the storeroom should be kept clean and well-aerated. Following washing, O-rings may need careful greasing with silicone grease, or filters may need replacement. It is advisable to disinfect equipment regularly to prevent growth of mildew and bacteria, particularly regulator and snorkel mouthpieces, and booties. The special products for this purpose are not widely available in the region, but a mild chlorine solution can be used. However, check with an expert on appropriate dilutions as solutions that are too concentrated will damage the equipment severely.

In addition to regular maintenance by the users and MCPA personnel, scuba diving gear, especially regulators, diving cylinders, and compressors, requires periodic maintenance by a specialised facility. When purchasing scuba equipment, it is therefore important to consider the maintenance/repair facilities that are available to the MCPA or country. Although using official dealers for maintenance and repairs may appear expensive in the short term, it is more cost-effective in the long term, and it will help to ensure that lives are not put at risk through faulty equipment.

DIVING ACCIDENTS AND INSURANCE

All diving operations should have a procedure to treat diving accidents. Normally this would include evacuation to a qualified medical centre or re-compression facility (See D4, Safety and Emergency Procedures). The location of recompression facilities in the South Asian region, and worldwide, can be found at www.scuba-doc.com/listchmbr.htm

In all suspected decompression sickness cases, the victim should be given oxygen as soon as possible after the accident, ideally on site. Small oxygen bottles can be purchased from commercial diving centres or the Divers Alert Network (DAN), and should be a standard part of emergency kit in MCPAs where diving is carried out. There is an excellent alternative to storing oxygen on site called Emox that produces 99% oxygen. It is an affordable emergency powdered oxygen system that is portable, non-pressurised, non explosive, environmentally accepted, has no moving parts and is non corrosive; therefore no specialised services or maintenance is required (see www.emox.co.za).

Many insurance policies consider SCUBA diving as a 'dangerous' sport that is excluded from standard cover, so that special arrangements may need to be made. Alternatively, organisations such as DAN have specialist insurance for divers.

KEY POINTS FOR THE MCPA

- **Develop close cooperation with local dive operators who can provide technical support, maintenance facilities as well as help with training.**
- **Do not buy equipment without checking with experts for appropriate models and suppliers; local dive operators may be able to assist with this or even help to provide the equipment.**
- **Ensure proper maintenance of diving equipment, good basic training, additional training and regular refreshers for diving staff.**
- **Make sure the MCPA has a strict policy on diving practices, particularly safety and environmental aspects.**
- **Ensure that anyone who dives within the MCPA has sufficient training and approved diving certification.**
- **Provide comprehensive environmental briefings, and facilitate access to dive and snorkel areas, to avoid disturbance to vulnerable habitats within the MCPA.**
- **Ensure that any necessary insurance has been taken out.**
- **Make sure that all MCPA personnel are aware of first aid and emergency procedures that would be needed in a diving accident.**

Sources of further information

Great Barrier Reef Marine Park Authority – Responsible Reef Practices: www.gbrmpa.gov.au/onboard/home/high_standards/responsible_reef_practices

The NOAA diving manual is available in hard copy and CD-ROM from www.ndc.noaa.gov/rp_manual.html or www.ntis.gov/products/bestsellers/noaadive.asp?

CMAS, BSAC, SSI and PADI other manuals are available from dive shops and scuba training facilities, or online www.padi.com; www.cmas2000.org; www.bsac.org; www.divessi.com or www.ssiusa.com

Information on digital underwater camera equipment available at www.digideep.com/and www.wetpixel.com/

Manufacturers of scuba equipment include www.poseidon.se/; www.aqualung.com/; www.technisub.com/; www.diverite.com/; www.sherwoodscuba.com/; www.suunto.com/

Diving insurance details can be found at www.danasiapacific.org/

Moorings and buoys F9

Buoys are used for a variety of purposes in an MCPA, including mooring boats to prevent damage to the seabed from anchors. All buoys require careful installation and proper maintenance to ensure a long life. This sheet provides guidance, with particular emphasis on the Halas embedment mooring system that is recommended for MCPAs.

The main uses for buoys in an MCPA are for:

- Marking navigation channels, and the boundary and zones of the MCPA;
- Marking a specific location (e.g. a wreck);
- Mooring boats and thus eliminating the need to drop and haul anchors.

Colour is often used to indicate buoy purpose, and should conform to the International Association of Lighthouses (IALA) system. Colour and shape can also designate type of service, such as for short stays, day use only or overnight mooring, with spar or pole buoys to designate boundary marks or obstructions.

Moorings are particularly important in an MCPA to protect the seabed from anchor damage, especially in coral areas, and to reduce overcrowding (e.g. at popular dive sites where anchoring is prohibited and the number of buoys can be limited). Fishers may use the moorings as well as tourist boats, and competition over the buoys can be reduced by requiring different users to use different buoys or different times of day. The Great Barrier Reef Marine Park has both public and private moorings, the latter for regular and guaranteed access by users such as dive operators. Before installation, it is thus important to estimate expected frequency and type of use and to carry out a site survey (depth, seabed conditions, tidal range, currents, and wave and wind factors).

HALAS MOORING SYSTEM

Halas embedment moorings are strongly recommended for MCPAs, and were designed specifically to prevent environmental damage while providing robust and safe moorings (see www.reefmoorings.com).

Components

Floats or buoys – 46cm diameter, made from polypropylene plastic filled with polyurethane. Moulded medium density polyethylene floats with ultraviolet (UV) stabilisers can also be used; plastic containers are sometimes used, but UV damage significantly reduces their durability.

Pick-up line – A small, floating, polypropylene pick-up line (with an eye-splice at the end) should be attached to the main float. The line should be 3m long (rather than the standard 5m) to encourage users to pass their own mooring line through the eye and pay out sufficient scope.

Mooring line – The main anchor line should be 20% longer than the maximum high tide depth. Three- strand, 20mm, polypropylene line is ideal. Chain can be used but is not recommended for the Halas system. To minimise chafing, protective sheaths, thimbles, and shackles are used at all attachment points. The Halas design ensures that the mooring line is kept off the seabed by a float several meters above the anchor point, and away from the surface (to prevent entanglement by boats) by a weight several metres below the mooring float.

Anchor – Options include a single (or double for larger boats) stainless steel eyebolt cemented into cores drilled into bedrock, or a Manta Ray anchor forced into a cored hole in rubble or sand bottoms. An anchor cone of resistance, known as a helix mooring system, may also be used, screwed into the rubble or sand seabed. Anchors of cast concrete, engine blocks or scrap metal should be avoided as they may damage the seabed.

Maintenance

Specifications of each mooring should be recorded. All components require regular maintenance, including visual inspection (using scuba) and immediate replacement of worn parts, a pull test on the system and cleaning from fouling. A monitoring schedule might involve:

Monthly – Inspect all buoys and pick-up lines; clean pick-up lines of growth or replace if necessary; clean, wax and polish buoy, check for cracks and replace where needed; inspect and clean exposed portions of buoy through-line and replace as needed.

Three months – Inspect mooring line and protective sheaths for wear and replace as needed; inspect shackles and mooring, especially the contact area between the two.

Six months – Inspect anchor mountings and surrounding area, checking for signs of movement; replace buoy through-line and pick-up line if system is regularly used.

Twelve months – Replace pin in mooring line shackle.

Twenty-four months – Replace mooring line if needed.

COSTS

Depending on local materials, components for a single mooring might cost US$ 200-US$ 2000, with additional labour, boat use and fuel costs. Maintenance costs can also be expensive. In many developing countries, donors have funded installation costs, while some Caribbean MCPAs have set up 'Adopt a Mooring Buoy'

M. Nightingale

A concrete mooring site in the Philippines.

programmes to raise funds. Dive operations are also often willing to contribute financially or in kind, and improvised mooring buoys have been installed by dive operators in Sri Lanka. Ideally, the MCPA should also set aside an allocation from its budget for maintaining buoys.

LEGAL LIABILITY

Since mooring buoys are expected to provide a vessel with a safe anchorage, an accident may have legal repercussions against those who install and maintain them. Disclaimers in writing, with terms such as 'use at your own risk' and 'non-mandatory use' may reduce the risk of liability but are inappropriate in an MCPA that requires mooring buoy use. Insurance is possible but is usually dependent on the ability to show compliance with 'Best Practice'.

KEY POINTS FOR THE MCPA

- Provide information on positions of buoys (particularly MCPA boundary marker buoys). This can be done through a Notice to Mariners issued by the relevant charting institutions (e.g. Harbour Master); or by marking positions (determined using GPS) on charts, which can then be made widely available and lodged with local authorities (e.g. police, district administration, Fisheries Officer).
- Disseminate information on mooring buoys and boundary markers, and their purpose, widely to reduce conflict.
- Endeavour to install moorings even if it requires securing external funds.
- Provide written guidance and training (if required) on the use of mooring buoys for all boat operators, and ensure a proper maintenance schedule to reduce accidents and minimise repairs.
- Establish a monitoring programme to determine the use and impact of mooring buoys.
- Develop a fee system for use of any moorings that is harmonised with other MCPA user fees.
- Carefully examine insurance and legal liability issues for mooring buoy use; ensure that the MCPA can provide evidence of proper design and installation, inspection and maintenance, and provision of clear and detailed advice on use to boat operators, based on 'Best Practice'.

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CASE STUDY

Community Initiated Mooring Buoys in Sri Lanka

Mooring buoys were installed at popular snorkelling sites in Unawatuna, Sri Lanka in 2006. Shallow coral reefs in the area are popular with snorkellers and anchoring of boats was seen as having a major destructive impact on the reef. Therefore, the mooring buoy installation was initiated and carried out by a local NGO with the assistance of dive operators and volunteers.

Unfortunately, many of the buoys were subsequently damaged due to storms, and unavailability of funding to repair and re-install them has proven to be a major stumbling block towards the success of the project. However, it is encouraging that local stakeholders and community members have initiated and contributed towards such a programme, as currently there are no permanent moorings within MCPAs in South Asia. Dive operators in Bentota, Sri Lanka have also established improvised buoys at several dive sites. This indicates that dive operators and other stakeholders are willing to contribute, both financially and in kind, towards establishing and maintaining officially sanctioned mooring buoys within and outside MCPAs.

Currently, there are no mooring buoys within MCPAs in Sri Lanka, but marker buoys to designate MCPA boundaries and zones are currently being installed within the Hikkaduwa Marine Sanctuary and the Bar Reef Marine Sanctuary by the Coast Conservation Department. Opportunities for establishing mooring buoys within MCPA boundaries with the support of stakeholders may be explored in the future.

Monitoring and evaluation principles

G1

Monitoring and evaluation (M&E) is an essential component of any successful management activity. Managers need the information generated to improve their management, and donors and stakeholders need results to ensure accountability. This sheet provides an introduction to the topic.

The principal reasons for developing an M&E programme are to (1) assess the status of the key values (biodiversity and socioeconomic aspects) of the MCPA; and (2) determine whether management is having its intended impact and is effective (see sheet G9). M&E terminology, methods and approaches can be confusing, thus it is useful to distinguish the following terms.

Monitoring – A continuous systematic process of collecting and analysing information through the use of indicators. Ecosystem and biodiversity health (see sheet H5) and the well-being of local communities dependent on the MCPA should be monitored as well as the management process.

Evaluation or Assessment – A one-off activity (preferably repeated regularly, e.g. every 2-3 years) that assesses how well the objectives of the MCPA are being met. Individual projects may be evaluated, or the management effectiveness of the MCPA as a whole may be assessed (see sheet G9). The word 'assessment' also means a survey to establish a situation at any one point in time; for example, baseline assessments (see sheet C1) are essential when an MCPA is first established.

Common monitoring activities for MCPAs include the following:

- Review of management plans (see sheet C3);
- Regular tracking of implementation through planning and reporting schedules (see sheet C5);
- Long-term monitoring of environmental and socioeconomic parameters (see sheets G3, G4, H2, H3, H4, G5, G6, G7);
- Assessing management success (see sheet G9);
- Evaluations and reviews of donor-funded projects (see sheet G10).

Unfortunately, few MCPAs have integrated M&E programmes, and invest time and resources in collecting data that are never used. Monitoring of single environmental variables (e.g. coral reef health) or tracking of implementation through mechanisms such as annual reports, financial accounting and project reviews, are important but cannot alone show whether the MCPA objectives are being met. For this, a more analytical and integrated approach is needed, incorporating the data from all monitoring components.

DESIGNING M&E PROGRAMMES

The first step is to decide on the scope, recognising that all the activities described above may be necessary, but that the resources and capacity of the MCPA for M&E are likely to be limited. Specific M&E requirements (e.g. for donor-funded projects) will be priorities. Beyond these, a careful balance is needed between investing resources in management activities and in assessing their impact. Second, appropriate indicators (i.e. units of information that, when measured over time, will document change) must be selected, as it is not possible to monitor every species or process. A baseline assessment of ecological and socioeconomic characteristics and of the threats is thus essential. In many cases, unrealistic indicators are selected that are too difficult to measure regularly with available skills and capacity, or that are found later not to measure impact or success.

SELECTING INDICATORS

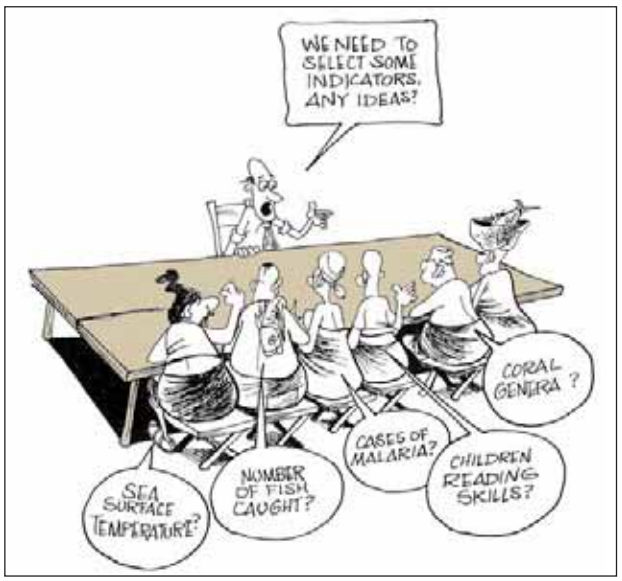
Selection must be based on:

- First, a careful analysis of the objectives and the types of changes wanted as well as how progress might be measured.
- Second, an analysis of available human, technical and financial resources.

A good indicator should closely track the objective that it is intended to measure. For example, abundance and diversity of coral species would be good indicators if the objective is to maintain healthy coral reefs. Selection should also be based on an understanding of threats. For example, if El Niño events are a potential threat, indicators should include sea surface temperature and coral bleaching. Two types of indicator are necessary: 'impact indicators' that measure changes in the system (e.g. coral abundance as a measure of coral health); and 'process indicators' that measure the degree to which activities are being implemented (e.g. number of patrols undertaken). Note that it may be difficult to attribute a change, or effect, to one particular cause. For example, an increase in nesting turtles could be due to good management of the beach or to a decline in harvesting of turtles outside the MCPA.

A good indicator should be precise and unambiguous so that different people can measure it and get similarly reliable results. Each indicator should concern just one type of data (e.g. numbers of nesting turtles rather than numbers of turtles in general). Quantitative measurements (i.e. numerical) are most useful, but often only qualitative data (i.e. based on individual judgments) are available, and this has its own value. Selecting indicators for visible objectives or activities (e.g. mooring buoys installed, reef survey undertaken) is easier than for objectives concerning behavioural changes (e.g. awareness raised, women's empowerment increased).

Indicators must reflect the human capacity available; e.g. genera diversity would be more appropriate for corals if there is no one



to identify at the species level. An indicator must also be present frequently enough for meaningful data to be gathered; e.g. very rare species or events are generally not good indicators as there will be many 'zero' observations and trends will be difficult to determine. A few good indicators may therefore be better than many weak ones, even if this means, for example, that it is not possible to monitor overall biodiversity health. WCPA-Marine has provided generic biophysical (physical conditions, species and ecosystems), socioeconomic and governance indicators that can be used to help develop monitoring programmes in MCPAs (see Pomeroy *et al.* 2004).

IMPLEMENTING M&E PROGRAMMES

Given the complexity of M&E, a general plan should be developed for the MCPA comprising:

- A timetable for the main activities and components;
- Indicators and data collection methods;
- Responsibilities for each component;
- Reporting requirements (i.e. formats, frequency) for the protected area agency, donor and other authorities;
- Budget (note that funding for different components may come from different sources).

Since monitoring often appears less immediately important than day-to-day management issues, M&E responsibilities must be clearly specified in the TOR of relevant staff, and adequate time made available for analysis and interpretation. Compliance with the tasks specified in the M&E plan should be monitored and adjustments made as appropriate. Separate plans may be required for particular components (e.g. coral reef monitoring, which will involve specific methods, schedules and personnel). However, the various sectoral components must be integrated into the overall M&E plan.

Monitoring is best carried out by, or with the full involvement of, MCPA personnel and relevant stakeholders. It may be necessary, and is often beneficial, to use external researchers (and in the case of evaluations, external consultants); but in such cases it is essential that results are passed back to the MCPA and used for management decisions. Involvement of stakeholders such as local communities and tourism operators can raise awareness about the MCPA, provide useful information and feedback, and increase general capacity.

The frequency of data gathering (e.g. annually, monthly, daily) depends on the parameter monitored. For example, annual monitoring of tree growth may be adequate, but monitoring of sediment levels in an estuary might need to be done weekly. Simple methods are often the best.

KEY POINTS FOR THE MCPA

- **Where budgets allow, appoint someone to oversee all components of the M&E plan.**
- **Monitoring activities should be set up as soon as an MCPA is established, following the initial baseline surveys and assessment.**
- **Develop an overall M&E plan that covers all components – ensure that monitoring programmes are in place for all the MCPA objectives.**
- **Involve stakeholders in all components of M&E whenever possible.**
- **Ensure that data from all monitoring programmes and tracking tools are collated, analysed, interpreted and made available.**

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Compliance and enforcement G2

An MCPA is only effective if stakeholders and users comply with the legislation that has been put in place to support management. The MCPA management authority and relevant government agencies play a primary role in enforcing legislation, but compliance is greatly improved if the stakeholders also actively take part. This sheet focuses on patrolling, which is a key activity undertaken by an MCPA to ensure that the regulations are being respected.

Patrolling or surveillance refers to physical observation of the MCPA area to see who is using it and how, and in particular to check that:

- Regulations on zoning, fishing, and mangrove and forestry legislation are known, understood and are being respected;
- User fees (where appropriate) are being appropriately collected and tickets issued;
- Mooring buoys are being used;
- Tourism operators are appropriately licensed and tourists are using beaches, dive sites and other popular areas according to regulations;
- Other activities in or adjacent to the MCPA, that might have an adverse impact on it, are monitored;
- Visitors and users are made aware of the importance, purpose and value of the MCPA and the resources it is established to protect.

Patrolling to check on compliance involves ensuring that regulations are understood, discussing infractions with offenders, issuing a warning where required, and ultimately arrest and prosecution if compliance cannot be achieved in any other way. The process should be laid out in the MCPA management plan and regulations.

MCPAs may operate as a partnership between national and local government authorities, local communities, the private sector (e.g. fisheries co-operatives and tourist associations), and local NGOs. To promote voluntary compliance, MCPA users must be consulted when the regulations and by-laws are prepared, and education and public awareness-raising should be made part of the enforcement programme. Incorporation of a coast-watch (such as a coastal radar system or using local volunteers) or reef-watch component (monitoring the impact of management activities on the reef) may be possible, but individuals participating in such schemes should not usually undertake any direct enforcement action. Where local people are participating in compliance activities, it is essential that their role is clearly defined and mandated by official enforcement agencies, and responsibilities are fully understood.

Some MCPA legislation comes under the mandate of other government agencies, not of the MCPA itself. For example, the management of most MCPAs in India is the responsibility of the Forest Department, while the responsibilities for fisheries management within these areas continue to be vested in the Fisheries Department. The situation may vary between MCPA sites within a country, and cooperation and coordination between the various agencies and departments is essential to effective management.

The MCPA personnel responsible for compliance must therefore fully understand the wider national legal framework, and consult with police, coastguard, navy, and other agencies (e.g. Tourism Department which issues licenses to tourism operators) as appropriate. Information obtained during surveillance of an MCPA may be useful to other management agencies, and the latter may be able to provide information valuable to the MCPA.

Monitoring, control and surveillance (often known as MCS) of fisheries legislation and management systems is well developed in many countries and may provide guidance for an MCPA. There may already be national standards for surveillance activities, and for training in surveillance techniques, and other MCPAs in the country may have established programmes. Coordination with such groups can help to improve overall standards and efficiency.

RESPONSIBLE PERSONNEL

Most MCPAs have rangers or enforcement officers who are responsible for daily patrols, on foot or by boat. These are often salaried MCPA personnel but sometimes staff from other agencies are seconded for this purpose. In other places, community representatives provide their services voluntarily, for an honorarium, or are paid by the MCPA.

Involving local stakeholders in patrolling and surveillance has many advantages. It promotes sharing of responsibility for compliance, which reduces costs and encourages a sense of local ownership of management activities. There are also disadvantages. In some situations MCS can provoke violence, and so local participants, as well as the MCPA staff involved, must be appropriately selected and trained. The personal risk to those involved in surveillance activities must be minimised. It is crucial for surveillance to be carried out efficiently, honestly and accurately; problems may arise if locally recruited rangers cast a blind eye over illegal activities by their own communities, and if equipment is misused.

R. Torres

Enforcement personnel are trained in CSI techniques in the Dominican Republic (see case study)

Training of those responsible for MCS is essential and should cover verbal communication skills, radio communications, navigation, boarding and inspection techniques, chain of evidence, and preparation of legal staff and witnesses for court proceedings. It is important for enforcement staff to receive advice on how to use effective, non aggressive approaches in their daily tasks, and to receive adequate support at the agency and institutional levels to process and advance cases of non-compliance to resolution (in many areas, the probability of detection of illegal activity and the penalties are not sufficiently high to act as a disincentive). To maximise the impact, and retain the benefits of personnel training, national agencies should consider how best to ensure continuity in personnel within the MCPA sector.

EQUIPMENT

The appropriate equipment for surveillance will be determined by the physical characteristics of the MCPA (e.g. shape, size, habitat types and location of villages). Some surveillance is best done by foot, although much will be done by boat. A basic equipment list would include:

- Binoculars;
- Radios;
- Formal identification (ID card, uniform);
- Handheld GPS;
- Standardised report forms, notebook and pens, underwater slates (where appropriate);
- Fibreglass tape measure;
- Digital camera with underwater housing;
- A base station for communications and support.

For surveillance operations at sea, the patrol vessel must be marked, and contain the necessary safety equipment including a radio and/or telecommunications system. In Senegal a small coastal radar system is being used, which allows a 'no-force' approach. When an intruder is detected by the radar system, officials request a local fisher to go alongside the intruder, take a picture, record its position with a handheld GPS, record identifying markings on the vessel and return to the beach. The information is then passed to the local law enforcement personnel who take appropriate action to apprehend the vessel. Coastal radars are also being tested in Indonesia in two MCPAs to provide early warning against intruders and permit MCS enforcement staff to intercept the vessels.

KEY POINTS FOR THE MCPA

Given that safety, security and legality are so important, 'Standard Operating Procedures 'must be developed. These should cover:

- **Aim of the patrol – What is the purpose of the mission, and what resources are required?**
- **Operational profile – What does the patrol have to do? How where, when and for how long? What other factors might affect the effectiveness of the patrol (e.g. weather, tides, staffing)?**
- **Equipment and logistics – Is the correct equipment available and functioning? What extra equipment might be required according to seasonal patterns of activities taking place at MCPA? Is this viable and budgeted for? Are fuel, water and other consumables available?**
- **Personnel – Are correctly qualified personnel available? Is their personal safety equipment available and functioning correctly? Is there support staff at the operations base?**
- **Telecommunications – Are the telecommunications functioning properly?**
- **Dual-tasking – Are there any other functions that the surveillance team can perform during the patrol, such as research (data logging)? Can costs be shared with another agency?**
- **Establish a rigorous 'chain of evidence' protocol, with advice from appropriate legal authorities, so that the prosecution is not hampered by legal technicalities that might allow alleged offenders to escape the charge (see case study).**
- **Develop a supportive institutional framework – Are detection levels and penalties sufficiently high (and applied) to act as a disincentive to illegal activities?**

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CASE STUDY

Coral Reef Enforcement and Investigation

Traditionally in MCPA management, challenges exist to effectively enforce regulations, and to obtain the timely and robust evidence needed to prosecute or deter violators. In many areas, the probability of detection of prohibited activity and the penalties are not sufficiently high to act as a disincentive. Lessons learned from MCPA sites across the globe have demonstrated that the ability to prosecute along with a supporting infrastructure is integral to effectively enforcing the system.

While legal systems and resource management strategies vary from country to country, successful investigation strategies related to human impact events on natural resources are relatively limited, and as yet unstandardised. Few countries currently have trained field investigators or well-developed natural resource programmes to properly assess and respond to the wide variety of regulation infringements (e.g. destructive fishing, coastal pollution, vessel groundings) occurring both within and outside of MCPAs. In response, an international effort is underway to promote capacity development in marine enforcement and natural resource investigation on coral reefs, led by the International Coral Reef Initiative (ICRI) Coral Reef Enforcement and Natural Resource Investigation Committee.

Experts from across the globe have worked together to produce and collate critical information and tools into a comprehensive coral reef Crime Scene Investigation (CSI) Toolkit to guide practitioners. A unique field training programme, which draws upon the toolkit, gives participants an opportunity to practice techniques and equipment use in a series of impact scenarios, while developing an understanding of the common shortfalls of natural resource evidence collection and presentation processes through role play and legal preparation.

The workshops gather participants from a wide field of expertise including academics, resource managers, litigators, enforcement officers and others, promoting multi agency cooperation around enforcement and investigation issues. Workshops have been successfully conducted in Mexico, the Dominican Republic and Jamaica; with many more planned globally. They have catalysed interagency consultations for the establishment of regional and/or national rapid coral reef CSI response teams in support of effective enforcement and investigation in those countries.

For more information on the coral reef CSI programme please visit www.icran.org

Monitoring coral reefs G3

A vast literature exists on coral reef monitoring, often making selection of an appropriate method for use in an MCPA a daunting task. This sheet provides some guidance on the most commonly used methods, and outlines some of the issues to consider when selecting the one to be used.

Most coral reef monitoring programmes involve periodic surveys of the bottom (or benthos) and of mobile invertebrates and fish, in order to measure trends in population size, area cover of species present or species diversity. More detailed methods involve measuring ecological processes, such as coral recruitment, or fish herbivory and predation, and physical oceanographic parameters.

MONITORING METHODS

Rapid surveys – The simplest and quickest way to obtain a broad qualitative picture of large areas of reef is the manta tow method, if water clarity is suitable (10m at least). An observer is towed behind a boat which stops at regular intervals so that observations can be made of overall reef condition or populations of visible species (e.g. crown of thorns starfish, sharks and turtles). Swimming surveys can be used for smaller distances. Reef Check (www.reefcheck.org) is another method, specifically designed for use by non-professionals, trained and led by marine scientists. It involves counting key indicator species along transects. Normally undertaken annually, it can be done by snorkelling or scuba-diving and learnt in one day.

Detailed benthic monitoring – Line transects or quadrats are most commonly used, and require more time in the water and more complex subsequent analysis than the rapid surveys. The line intercept transect (LIT) allows estimations to be made of percentage cover of different substrate types. A transect line (or tape measure) is laid out, following the depth contour, and the amount of each substrate type encountered under it is recorded (i.e. the length of each life form or benthic category is recorded). Transects must be laid systematically and objectively, generally parallel to the reef edge, or stratified according to local habitat features. Transects are usually randomly placed within a site (the use of permanently placed transects is discouraged). Several replicate transects (> 5 recommended of 20m length) should be laid at each site so that average percentage cover can be calculated. Replicate transects should not overlap and each 20m transect should be completed by a single observer. Quadrats can be used to estimate percentage cover of each species or other reef components, and obtain information about density, abundance, diversity and colony size. Quadrats, however, provide data on a horizontal surface and are problematic on irregular or highly three-dimensional surfaces.

Underwater photography and video can be used for data collection, although subsequent analysis can be time consuming, and quality of the imagery may vary depending on the ambient conditions and the experience of the photographer. However, currently available photo equipment and software such as Coral Point Count are increasingly making this approach more useful and efficient. Digital photos taken from a height of approximately 0.6-0.75m above the substrate are grouped into 'transects' of four, and benthic cover under 25 randomly located points in each photo is recorded. Not less than six, and preferably 10 'transects' should be scored for each site, i.e. 24 to 40 images should be analysed. Specific measurement of coral condition and colour will be necessary if bleaching is occurring (see sheet H7).

Reef fish diversity and abundance – This is usually monitored using underwater visual census (UVC) techniques, including, belt transect or stationary counts (biomass, species abundance and frequency of occurrence), and random swim techniques (species richness). Belt transects are usually 50m long, with divers recording the fish observed at a set distance on either side of the transect line (often 5m, but dependent on visibility). Stationary point counts are equally effective, and are particularly useful for very heterogeneous environments or where there are isolated structures (e.g. large coral heads), and more suitable for some species whose behaviour is altered by the moving diver in a belt transect. The observer records fish in a 'cylinder' of a given diameter around him/herself for a given period of time, e.g. 5 minutes, with 10 repeat counts per site. Random swim techniques are conducted during replicate, timed intervals and provide good information on species, relative abundance and richness. Other methods are more invasive and involve traps, baited lines and set nets, and application of poisons, but these should not be used for regular monitoring or in an MCPA.

Invertebrate diversity and abundance – Mobile invertebrates, such as octopi, lobsters and many echinoderms, can be monitored using transects, although in the case of lobsters and octopi roving surveys and timed swims might be more appropriate. If the same transects are used as for fish, invertebrate monitoring should be done after the fish counts to avoid affecting fish behaviour.

DEVELOPING A MONITORING PROGRAMME

The programme must be designed to suit the resources, personnel available and objectives of the MCPA. Professional guidance should be sought, particularly for sampling design (e.g. location and number of replicate samples), as this must be correct if the results are to be valid and statistically robust to draw conclusions from. An MCPA may wish to set up an independent programme, but it is best to collaborate with local and/or national scientific organisations. MCPAs may also have their own programmes but they need to share data at the national level. International entities and projects such as GCRMN, CORDIO and ICRAN have facilitated monitoring training, networking and reporting of results on a regional level (see, for example, GCRMN Status of Coral Reefs of the World and CORDIO Status Reports), including socioeconomic monitoring in South Asia (see sheet G6 for further details on socioeconomic monitoring).

J. Tamelander

Scuba diver using an underwater camera for coral reef research

The Indian Coral Reef Monitoring Network (ICRMN) is a notable national effort in the South Asian region, which is coordinated and funded by the Ministry of Environment and Forests (MoEF), Government of India. The project was initiated early in 1999 with funding approved for a preliminary three year period. The objective of the ICRMN is to provide a framework for monitoring of coral reefs in the four main coral reef areas of India: Andaman and Nicobar, Lakshadweep, Gulf of Mannar and Gulf of Kachchh. As such, ICRMN provides a national level programme in India for participation in the GCRMN.

KEY POINTS FOR THE MCPA

- **Seek professional advice in setting up a programme to ensure the sampling design is correct, and that simple and suitable methods are selected and used consistently; this will help to ensure that monitoring is maintained over time and that long-term comparisons can be made.**
- **Involve local fishers and communities where possible; contact local and national scientific institutions for information on techniques in common use, and involve them in the programme on a regular basis where possible.**
- **Ensure that data collectors, particularly non-professionals, are adequately trained, and undertake regular calibration to ensure consistency and quality of data collection.**
- **Use recommended methods to select and mark monitoring sites to facilitate relocation.**

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Coastal Ocean Research and Development in the Indian Ocean (CORDIO) - www.cordio.org

Coral Health and Monitoring Programme (CHAMP): lists a variety of resources for reef monitoring – www.coral.noaa.gov/methods.shtml

Global Coral Reef Monitoring Network (GCRMN) – www.gcrmn.org

Indian Coral Reef Monitoring Network (ICRMN) – www.reefindia.org

Reef Check methods and instruction manual – www.reefcheck.org

Socioeconomic monitoring and tools – www.reefbase.org/socmon/

CASE STUDY

Coral Reef Monitoring in the Gulf of Mannar, South-eastern India

The Suganthi Devadason Marine Research Institute (SDMRI) Reef Research Team conducts a coral reef monitoring programme in the Gulf of Mannar. Over a two and a half year period (January 2003 to October 2005) all reef areas around the 21 uninhabited islands in the study area were surveyed to establish a baseline on coral status, diversity, abundance and distribution. The survey started with mapping of patch reefs and island reef communities using the manta tow technique. The survey then continued with an assessment of selected sites using 20m line intersect transects at two depths at each site (1 and 6m). Depending on the size of the reefs, 11 to 25 transects were recorded per site. In total 374 transects were completed. The percentage cover of each life form category was calculated.

Since then, SDMRI has regularly conducted coral reef monitoring at permanent sites in the Gulf of Mannar Marine National Park, with support from CORDIO and Gulf of Mannar Biosphere Reserve Trust (GOMBRT). The monitoring programme covers:

- Physical parameters (i.e. temperature; salinity; pH; nutrients; turbidity; total suspended solids and sedimentation rate using sediment traps);
- Biological parameters (i.e. percentage cover of corals; species composition and size structure of coral communities; coral recruitment, coral growth and size class groups; coral diseases and bleaching; numbers, species composition, size and structure of fish populations and; macro-algal assemblages); and
- A component on coral bleaching, which is recorded in permanent quadrats at each island.

From the results of the 2003-2007 survey, an increase in mean live coral cover, from 37% to 41%, was observed, possibly due to a reduction in human disturbances in the area, in particular a complete halt to coral mining. Coral recruitment rates were also high, dominated by *Montipora* sp followed by *Acropora* sp. Overall recruits representing 6 families and 10 genera were recorded.

The regular monitoring that is being undertaken by SDMRI provides a continuous assessment of the status of the Gulf of Mannar coral reefs and allows for any changes, due to human and natural impacts, to be assessed and monitored over time. The coral reef monitoring programme has proved to be a useful tool for conservation and management measures undertaken by the MCPA authority.

Source:

Patterson Edward, J.K., Mathews, G., Patterson, J., Wilhelmsson, D., Tamelander, J. & Linden, O. 2007. Coral Reefs of the Gulf of Mannar, Southeastern India – Distribution, Diversity and Status. SDMRI Special Research Publication No.12, 113 pp. Available from: www.sdmri.org/public.htm

Monitoring mangroves and seagrasses

G4

Mangroves and seagrass beds are important habitats in many MCPAs in South Asia, and it is important that their health is monitored. This sheet introduces available techniques and encourages MCPA managers to develop monitoring programmes.

Many mangrove management and restoration programmes are underway in South Asia (see sheet H9), but there is little monitoring of mangroves or seagrasses. MCPAs have the opportunity to set examples by developing monitoring programmes for these habitats. Simple techniques are now available that enable communities and non-professionals to assist, preferably under the guidance of experts. As with all monitoring, physical data (e.g. weather, state of the tide, water quality) should be collected at the same time (see sheet G5) and baseline maps and assessments are essential (see sheet C1).

MANGROVES

Nearly 30 species are easily recognisable in South Asia. Monitoring methods are described in English *et al.* (1997), but a comprehensive programme may be beyond the scope of many MCPAs. Priority parameters should therefore be selected, and collaboration sought with local forest departments for personnel and equipment. The main parameters for monitoring mangroves are described below.

Community structure and biomass – The Transect Line Plot (TLP) is the basic approach and involves at least three transect lines perpendicular to the shore, in two sites at each location. Along each transect, three randomly located plots (usually 10 x 10m) are staked out, and their positions recorded with GPS. The species, position, height (using a tool called a hypsometer) and girth of each tree (including stumps) in each plot are recorded and the trees are tagged. This takes time, but need only be repeated every 2-3 years. A simpler method, that can involve local communities, uses a greater number of 5 x 5m plots over a wider area, recording samples of trees in each plot.

Primary productivity – Leaf area is correlated with total photosynthesis and thus primary productivity and mangrove 'health'. The 'leaf area index 'is measured using a portable light meter with an underwater quantum sensor (for protection from corrosion) and a clinometer to measure solar zenith angle. The method is quick and reliable.

Leaf litter production – This is sensitive to many environmental factors, and can be measured using suspended net traps to catch falling leaves that are dried and weighed.

Soil characteristics – The productivity and structure of forests are influenced by the soil. Monitoring soil changes requires collecting 5-10 samples from each location with a D-section corer, and measuring:

- Redox potential (Eh) (extent to which soils are conducive to microbial decomposition and thus nutrient production) and acidity/alkalinity (pH) (influences chemical transformation of nutrients), with a pH/Milli-voltmeter, preferably on site;
- Soil salinity (determines growth and zonation) with a refractometer;
- Temperature at a depth of 10cm;
- Grain size (proportions of gravel, sand and mud determine soil permeability) using the time consuming particle size fractionation method or the simpler hydrometer method.

Area coverage – Aerial or satellite images (e.g. LANDSAT MSS, SPOT-XS) can be useful for monitoring changes, but ground-truthing using TLP methods, is essential to determining mangrove health and other information needed for management (see case study).

SEAGRASSES

There are around 12 seagrass species in South Asia. They respond very differently to changes in water temperature, turbidity, nutrient levels and human disturbance, and some species undergo annual die-back. Distribution, composition and density of seagrass beds may thus vary over time and seasonally, which must be considered in a monitoring programme. There are two global monitoring programmes that provide advice: SeagrassNet is primarily for managers and professionals, and involves quarterly data collection; and Seagrass Watch is for communities and volunteers. SeagrassNet monitoring has been carried out in the Andaman Islands, India. The following parameters are usually monitored for seagrass.

Community structure – The standard method requires three transects for each location, perpendicular to the shore, 50-100m apart, extending to the outer limit of the seagrass bed or reef edge. At regular intervals, <5m for heterogenous communities or up to 20m for homogeneous meadows, quadrats (ideally 50 x 50cm, divided into 25 sectors) are used to calculate percentage cover for each species through visual estimation. Sometimes a scale (e.g. 0 for 'absent' to 5 for 'over half cover') is used to estimate cover. SeagrassNet provides a guide on how to standardise this to give percentage cover. Individual shoots can also be counted for each quadrat, and photographs taken of each quadrat or a video recording made of the entire transect, either on foot or using scuba-diving.

Biomass – Digging up seagrass from within each quadrat to calculate biomass from wet and dried samples can be time consuming, requires laboratory equipment and damages habitat. Alternatively, a small biomass core sample may be taken to one side of the transect. A simpler, less destructive visual technique exists for above ground biomass, but good observer standardisation is important.

G. Sriskanthan

Measuring out strip quadrats for mangrove monitoring in Huraa Mangrove Nature Reserve, Maldives

Area coverage – Can be calculated from satellite images, or by measuring and mapping seagrass beds at low tide.

MONITORING FISH IN MANGROVES AND SEAGRASS BEDS

Visual methods are not reliable due to low visibility, and samples must be collected. Beam trawl nets are generally used in seagrass beds but are not recommended for regular monitoring in MCPAs because of seabed damage. For mangroves, gill nets and encircling nets (the latter for intertidal areas only) can be used. To avoid damaging the fish, they can be caught in traps or on hook-and-line and then released. Monitoring should be done at different times of day and night and at different times of year to cover seasonal variation due to migration and breeding.

KEY POINTS FOR THE MCPA

- **MCPAs should develop monitoring programmes for mangroves and seagrass beds, choosing methods that reflect the needs of the MCPA, the time constraints, the personnel available and the budget.**
- **Collaboration with appropriate scientists, local government agencies (particularly forestry for mangroves) and NGOs is recommended.**
- **Where possible, involve local people in monitoring.**

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GLOMIS – Global Mangrove Database and Information System: contains a global mangrove bibliography - www.glomis.com

World Seagrass Association – a Global Network of scientists and coastal managers committed to research, protection and management of seagrasses - www.worldseagrass.org

SeagrassNet – a global programme to monitor and document the status of seagrasses – www.seagrassnet.org

CRC Reef Research Centre: information on monitoring including SeagrassWatch (community-based programme) –www.reef.crc.org.au

CASE STUDY

Mangrove Monitoring in India: (1) Monitoring Restoration Activities Using Field-level Techniques in Maharashtra, and (2) Remote Sensing Monitoring of the Mangroves of the Godavari Estuary

Systematic, on the ground, field-level mangrove monitoring is perhaps the most commonly used approach in South Asia. The Indian Oil and Natural Gas Company in collaboration with Bombay Natural History Society (BNHS) are undertaking mangrove afforestation activities in Gujarat and Maharashtra. Two mangrove nurseries have been developed in Gujarat, and plantation activities were carried out during 2007 and 2008 in the Gandhar region of Gujarat. A restoration site has also been identified in Konkan region of Maharashtra, with a nursery of about 15,000 propagules being developed. A team of researchers is undertaking an extensive mapping exercise to document and monitor the mangrove community structure in four major creek basins in Maharashtra. Twenty-five fixed width transects (100m x 5m) are being laid in each basin to document vegetation profile, canopy, biomass production, seeding profile and regeneration. Data will be collected for three seasons over five years to establish mangrove community profile in these river basins. Besides these mapping activities, the research unit is also undertaking genetic mapping of various species of mangrove in the study area to assess the genetic variations within species and within basins. The project has linked up with local partners from the coastal area of Maharashtra, allowing it to reach a large number of people in the area. Volunteers have been trained to assist the research unit to document threats to mangroves as well as carry out monitoring and restoration work.

With increasing access to remote sensing technology, researchers are able to use remote sensing images as useful sources of information for coastal and marine ecosystem monitoring. Through reviewing periodic remote sensing data, physical changes in coastal and marine areas over time can be analysed for trends in ecosystem change, and management actions recommended accordingly. The mangroves of the Godavari estuary, Andhra Pradesh, India were assessed to understand the changes in the extent of mangroves through remote sensing, namely, accreted mangroves, erosion due to wave action and river water flow during floods, and changes in vegetation density due to restoration activities undertaken between 1986 and 2001. Analysis of the remote sensing images between 1986 and 2001 revealed that the mangroves outside of forest boundaries had been converted to aquaculture. A mangrove area of about 3,498 ha was formed due to restoration activities and natural regeneration from 1986 to 2001. During the same period, 3,130 ha of mangroves were lost due to aquaculture, erosion and other causes. The study noted that the expansion of agriculture and aquaculture farms in these coastal areas has led to the conversion of mangroves in the recent past. The extent of mangroves has changed due to coastal erosion, and accretion near river mouths has led to the formation of new mangrove areas. Changes in the vegetation cover due to forest restoration and natural regeneration were found to be appreciable, while the changes due to erosion and accretion were seen to be more or less equal.

Source:

Ramasubramanian, R., Gnanapazham, L., Ravishankar, T & Navamunniyammal, M. 2006. Mangroves of Godavari – Analysis through remote sensing approach. Wetlands Ecology and Management 14: 29-37.

Monitoring physical conditions G5

Physical conditions of the marine environment have a major impact on species and ecosystems. A good monitoring programme is therefore essential in an MCPA to evaluate ecological changes that may relate to changes in weather, water quality or other aspects of the physical environment. This sheet outlines some of the main parameters to consider.

Physical conditions may change on a daily basis or over much longer time periods, and may have natural (e.g. weather) or human causes (e.g. sedimentation from coastal construction or deforestation). There may be several sources (e.g. nutrient increases could be due to sewage discharge or fertiliser run-off) and care must therefore be taken in interpretation.

Simple methods for monitoring are available that can be used by MCPA personnel and/or local stakeholders with appropriate training. Depending on the parameter, data collection will need to be on a weekly, monthly or annual basis, and, as seasonal changes can have a major impact, sampling should be consistent throughout the year.

Monitoring of the physical environment should be linked with ecological monitoring (see sheets G3 and G4), with a focus on sites:

- That represent particular communities or habitats;
- Where other monitoring activities (e.g. of coral reef health) are carried out;
- Adjacent to locations where human activities may affect the MCPA (e.g. construction work, vegetation clearing or dredging).

Water parameters that can be measured include temperature, sedimentation rate, turbidity or visibility, salinity, dissolved oxygen, pH, nutrient loading, and levels of pollutants (e.g. industrial and domestic pollutants). Some parameters require the collection of samples whereas others can be measured directly from a boat or while in the water. Weather parameters include air temperature, relative humidity, wind strength and direction, cloud cover, rainfall and air pressure. A small weather station can be installed, but it may be preferably to partner with a local airport or technical institution that is collecting more comprehensive data. Similarly, where specialised equipment is needed (e.g. for monitoring heavy metals), collaboration with a research institute or government agency that has the necessary skills, expertise and equipment, is usually best.

WATER TEMPERATURE

A marine-rated mercury thermometer in a protective casing should be used and recordings taken just below the surface (30cm) and at other depths depending on other data collection programmes and the presence of a thermocline or stratification. Retrievable temperature loggers are very useful for obtaining long-term data sets and can automatically record data at set intervals (e.g. from 30 minute intervals to yearly intervals); however the data is only retrievable once the logger has been removed from the site.

SALINITY

Water samples should be taken 30cm below the surface and at specific depths as required. Salinity is measured with a refractometer, which is a relatively inexpensive piece of equipment. Near freshwater discharges, such as river mouths, a series of readings may be needed to determine the gradient, bearing in mind that the state of the tide will affect salinity, as does rainfall and evaporation rate.

LIGHT CONDITIONS, TURBIDITY AND VISIBILITY

Suspended particles influence water clarity (turbidity) and light penetration, parameters that are particularly important in processes such as coral bleaching. A Secchi disc is used to measure water clarity. It is lowered over the side of a boat or jetty to the depth at which it is no longer visible and then pulled slowly back until it is just visible, the depth being recorded from graduations on the rope. A light meter may be more accurate when the water is shallow or very clear. Measurements should be taken on clear days, around midday when the sun is high. Relative differences in light condition at different depths can be estimated using a photometer, or by pairs of divers making underwater horizontal Secchi disk readings. Cloud cover is important to record (it can be recorded in 'oktas', or the number of eighths of sky that are covered by cloud).

SEDIMENTATION

The settlement of suspended particles onto the seabed, called sedimentation, can have a major impact on benthic filter feeders and species dependent on light for photosynthesis. Sedimentation rates are measured using 'traps': a series of pipes, closed at one end that are attached vertically to the substrate and are collected after a fixed period. The sediments that accumulate in the pipes are washed out, dried and weighed.

CHEMICAL AND BIOTIC PARAMETERS

Measuring chemical and pollution levels is important if land-based activities may be influencing the MCPA, but this is often complex and advice from specialists should be sought. Oxygen levels, pH, and some nutrients (e.g. nitrates) can be measured with electrical probes, sensors or chemical test kits, but are difficult to monitor accurately. Water samples can be screened for pathogens (faecal bacteria and viruses), hydrocarbons, heavy metals, pesticides and other toxins. Samples must be clearly labelled and stored in refrigerated containers for rapid transfer to a qualified laboratory

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Using a Nansen seawater collection bottle for oceanic monitoring in India

or test facility. Measurement of chlorophyll level gives an estimate of plankton quantities, which is an indicator of water quality; phytoplankton can be collected by towing a special net.

WATER MOTION

Tidal regime influences mangrove species distribution, abundance and growth, and simple methods are available to measure their inundation. Currents and waves influence the extent to which bleaching occurs and the speed of recovery. Plaster of Paris 'clod cards' can provide some information, as well as drifting current buoys and dye flow determination. Sea conditions can be determined according to the 'Beaufort Winds Scale and Sea Disturbance Table'.

KEY POINTS FOR THE MCPA

- **It may not be essential to monitor all physical parameters, and priorities should be set according to the needs and capacity of the MCPA; water temperature, visibility and salinity are among the more important.**
- **Assign specific MCPA personnel to collect routine data, with a clearly defined schedule; provide training in the use and maintenance of any equipment involved.**
- **Involve local partners where possible and develop partnerships with national monitoring programmes.**
- **If the MCPA has regular access to the Internet, follow global sea surface temperature monitoring programmes as it may be possible to get advance warning of a warming event (refer to sites such as the NOAA HotSpots database – see Sources of further information).**
- **Ensure that data are logged promptly and accurately, and are analysed quickly so that if there are changes that may affect the MCPA, expert advice can be sought quickly.**

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NOAA HotSpots database: shows ocean areas with high surface temperature - www.osdpd.noaa.gov/PSB/EPS/SST/climohot.html

Information on data loggers from:

Onset Computer Corporation – www.onsetcomp.com

International SeaKeepers Society – www.seakeepers.org

Other suppliers: The Kiwi Group or ACR Systems, USA.

CASE STUDY

Coastal Ocean Monitoring and Prediction System (COMAPS) in India

A programme on Coastal Ocean Monitoring and Prediction System (COMAPS) has been operated since 1991 by the Department of Ocean Development, in close cooperation with the Ministry of Environment and Forests, India. The main objective of the programme is to constantly assess the health of India's marine environment and indicate areas that need immediate and long-term remedial action. Data on nearly 25 environmental parameters are being collected at about 70 locations with the help of 121 research and development institutions in the 0-25km sector of the coastline of the country.

The main objectives of the programme are:

- To establish a knowledgebase in the field of biogeochemical parameters in estuaries and in coastal, shelf and open seas.
- To operate an appropriately structured information system for ready dissemination of various data sets to users in government, industry, research and social institutions.
- To provide advisory and technical services to government, industry and public institutions, aimed at evolving pollution containment measures.
- To detect radical changes in the biogeochemical regimes of the marine system, and to alert government, public and social institutions of their implications.
- To set standards for the measurement of various pollution parameters, and to ensure compatibility between the data acquired and processed by various monitoring agencies.

Parameters being monitored include: temperature, salinity, dissolved oxygen, pH, suspended solids, BOD (biochemical oxygen demand), inorganic phosphate, nitrate, nitrite, ammonia, total phosphorous, total nitrite, total organic carbon, petroleum hydrocarbons, pathogenic Vibro, pathogenic Enterobacteriaceae (E. Coli, Salmonella, Shigella), heavy metals (such as cadmium, lead, mercury) and pesticide residues (Dichloro-Diphenyl-Trichloroethane - DDT, benzene hexachloride – BHC, and Endosulfan).

The data collected will be disseminated to the concerned Pollution Control Boards for legal/remedial action. MCPA managers can use the information from this initiative to understand potential risks to priority sites that they manage through applying set standards to any monitoring programme adopted by the MCPA as well as to respond to appropriately to pollution outbreaks that may affect their sites in response to warnings issued by COMAPS.

For further information: http://dod.nic.in/comaps.htm

Socioeconomic monitoring G6

Few MCPAs have monitoring programmes to record trends in social and economic issues that affect, or are affected by its presence, although some do collect data on fisheries or visitor use. However, socioeconomic monitoring is essential to demonstrate the value of an MCPA and provide information for management. This sheet outlines the main principles involved.

The monitoring of MCPAs as well as people's knowledge, attitude and practices is important because it allows us to improve management practices in response to any detected changes in either socioeconomic or biophysical conditions and status. Through socioeconomic monitoring we can better understand what human induced factors are affecting MCPAs, whether people are benefiting from the current levels of management and how they perceive the MCPA. In response to this knowledge we can adjust management practices to better achieve socioeconomic management goals.

It is becoming widely recognised that protected area goals have to reflect the needs and aspirations of communities that are ultimately affected by conservation activities. Most MCPAs in South Asia have objectives that relate to social, cultural and economic issues, particularly in terms of improving livelihoods of local communities and providing economic benefits nationally. In order to incorporate social and economic development concerns into the management goals of protected areas, socioeconomic and 'performance' factors need to be monitored so that managers can ensure that all these goals are being met. Without a socioeconomic monitoring programme, it is difficult to demonstrate whether these objectives are being achieved. Socioeconomic monitoring also provides information that:

- Helps managers understand how people interact with the MCPA and its resources;
- Can be used to predict conflicts over resource use and potential changes in pressure on a particular resource;
- Helps to identify and/or measure changes in the motivations of resource users;
- Assists economic valuations (see sheet E6).

INTEGRATING SOCIOECONOMIC AND ECOLOGICAL MONITORING

Traditional approaches to protected area management have focused on ecological monitoring: on understanding the biological, chemical and physical issues affecting an ecosystem, and implementing physical and policy level management interventions to ensure ecological management goals are satisfied.

Linking ecological and socioeconomic aspects of monitoring is also necessary because sustainable, effective and equitable approaches to protected area management require a thorough understanding of the inter-linkages between socioeconomic and biophysical status, influences and threats. As conservation values, threats and impacts all encompass biological, ecological, economic and livelihood aspects, so protected area management responses must simultaneously address and react to each of these factors.

This means that a thorough understanding of both socioeconomic and ecological issues — and of the inter-linkages and interconnectivity between them — is required. In order to integrate ecological monitoring with socioeconomic monitoring, there is thus a need to develop a holistic monitoring plan that: relates the findings from one discipline to the other; and looks at how we can effectively track (and achieve) goals related to both sound ecological management, and improved community and economic development. For example, monitoring of fish populations underwater should be linked to fishery data collection and the contribution of fish resources to local livelihoods; this will help determine the causes of changes in catch size or composition as well as provide some understanding as to how this will affect local communities.

SOCIOECONOMIC INDICATORS

Finding reliable and realistic indicators for socioeconomic issues is difficult. First, the main 'parameters', or areas of interest, must be identified. The 10 most commonly used are listed below (Bunce et al., 2003). Note that not all of these are relevant to every MCPA, and they should be carefully selected to reflect MCPA objectives.

Resource use patterns – e.g. activities on which people depend for food and income (particularly those associated with marine resources) and their location, timing and seasonality, and use rights.

Stakeholder characteristics – e.g. household characteristics (such as age, gender, education level, religion, literacy, food consumption, incomes).

Gender issues (see sheet B3).

Stakeholder perceptions – e.g. perceptions and level of understanding of MCPA management, and of their impact on the environment, perceptions of other stakeholders, cultural and religious beliefs, willingness to cooperate.

Organisation and resource governance – e.g. property rights, management efforts, administrative and political arrangements at community and governmental levels.

Traditional knowledge (see sheet B4).

Community services and facilities – e.g. medical, education, transport, communications, public utilities.

V. Hoon

ACRMN team discusses the status of fishing sites with local fishers (see case study)

Market attributes for extractive uses – e.g. supply, demand, prices and market structure, such as fishing or mangrove harvest.

Market attributes for non-extractive uses – as above, for activities such as tourism or aquaculture.

Non-market and non-use values – e.g. storm protection and provision of fish habitats.

The parameters allow the selection of indicators. For example, the indicator 'stakeholder characteristics' is likely to be relevant to many MCPAs, and appropriate indicators to monitor might include numbers of inhabitants and households, ethnic and religious groups, age group composition, number of men and women, and so on. In MCPAs where fishing is a major activity or impact, 'market attributes for extractive uses' would be an important parameter, and suitable indicators might include species harvested, amounts, values, and numbers of fishers and traders.

The most important feature of an indicator is that it must very clearly reflect or 'indicate' some aspect of the status or condition of what we want to measure, whether it is the status of a particular species of mangroves, or the economic condition of the adjacent community. Indicators should be sufficiently simple for monitoring at regular intervals on a permanent basis. Detailed guidance on indicator selection is available in Bunce et al. (2000) and Pomeroy *et al.* (2004).

DESIGNING A PROGRAMME

As with all monitoring programmes, clear objectives are needed, while who will use the data and for what purpose must be known as well as the methods, frequency of data collection and personnel needed. A baseline survey should be carried out, and data then collected at regular intervals in a standardised format. Data should be entered into a database or other storage system accurately and promptly, analysed and interpreted, and the results fed back to the managers. Sources of data include:

Primary – Interviewing key informants with specialised knowledge, household interviews, direct observation, mail, phone or in-person surveys; focus and discussion groups (see sheet B1); public meetings; MCPA personnel, ranger and visitor log books, ticket stubs, permits and licences.

Secondary – National census data (usually needs to be ground-truthed in the field); local government and council records; historical sources, reports, literature; cost-benefit analysis, modelling.

Some socioeconomic parameters are difficult to measure as people may be reluctant to give accurate information. It is often not possible to collect data directly on income, and so another indicator will be needed to show trends in the economic status (relative wealth or poverty) of households, such as diet, or their assets. It is also important to recognise that socioeconomic monitoring may be viewed as 'policing' by certain communities, especially if relationships with authorities are not smooth and if a monitoring initiative is seen to be coming from a formal authority. As MCPAs can place many restrictions on people's activities through prohibiting activities they carried out in the past (e.g. fishing in no-take zones), any socioeconomic programme should take into account local sentiments and try to understand the prevailing situation. The potential for creating community ownership and participation, perhaps even through the use of a neutral facilitator, can be considered in some instances (see case study). As outlined above, a socioeconomic monitoring programme should ideally be carried out jointly with ecological and biophysical monitoring, and the programme should make provisions for integration during the data collection and analysis stages.

The Global SocMon programme run by the National Oceanic and Atmospheric Agency of the USA (NOAA) provides a global resource for socioeconomic monitoring for coastal communities, and a SocMon Manual for South Asia is currently being developed (see Sources of further information).

KEY POINTS FOR THE MCPA

- **Obtain expert advice when developing a socioeconomic monitoring programme and ensure that it is sufficiently simple and cost effective to maintain over the long term.**
- **Ensure that the indicators selected will provide the information that is needed for the MCPA.**
- **Ensure that those responsible for data collection are aware of their responsibilities and adequately trained; if possible, give one person responsibility for oversight of the programme.**
- **Try to integrate socioeconomic monitoring with ecological and biophysical monitoring regimes as much as possible.**
- **Where possible, use stakeholders, including local communities as well as local and national government representatives, in data collection activities.**

Sources of further information

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CORDIO/GCRMN Socio Economic Monitoring Programme (SEMP) – Brochure training sheets manual and review of monitoring issues available from cordio@cordio.info

www.reefbase.org/socmon/ – SocMon Global Socioeconomic Monitoring Initiative for Coastal Management

www.mpa.gov – National social science strategy for MPAs in the USA: Details priorities for social science research in relation to planning, management and evaluation of MPAs.

CASE STUDY

Community Based Socioeconomic Monitoring in Agatti Island, Lakshadweep Islands, India

The Agatti Coral Reef Monitoring Network (ACRMN) is a locally based network that has been carrying out socioeconomic monitoring on Agatti Island since 2001. The community based reef related monitoring programme that they are implementing was developed with the facilitation of the Centre for Action Research on Environment, Science and Society (CARESS) with financial support from GCRMN and CORDIO, on the understanding that the long-term sustainability of coral reef management and monitoring initiatives could be better achieved with local community participation and ownership. The programme was seen to have the dual aims of building capacity and awareness in local communities through direct involvement in monitoring activities as well as providing data to support management strategies and decisions.

During initial training in 2001, participants were provided with guidelines on how to conduct socioeconomic assessments of coral reef uses, and had the opportunity to field test methods as a follow up activity. During a six month period after the training, participants were tasked with data validation and creating a socioeconomic baseline of Agatti Island. A steering group created during the training period was made responsible for selecting and training field enumerators for data collection, with an emphasis on ensuring a gender balance in the field teams.

Initial assessments culminated in detailed information on local community livelihoods, fishing methods, resource governance patterns, indigenous knowledge, site use and resource perceptions. Results highlighted the vital importance of reef resources to the human well being and livelihoods of the islanders. Based on these assessments, ACRMN decided on a total of the 20 most significant reef related activities that would form the focus of their socioeconomic monitoring programme during 2001-2002. These same 20 activities were also monitored in the second phase of monitoring (2003-2004), with the addition of two more activities based on new developments on the island.

Through these activities, ACRMN developed a comprehensive mapping of reef related activities for Agatti Island that allowed them to understand (a) the influence of culture and thereby the nature of traditional fishing and resource extraction methods; (b) the frequency of fishing effort and catch size; (c) conflicts/ cooperation in the use of reef space; and (d) anthropogenic stress on the reef. This information has been given to the Lakshadweep Administration and various concerned departments to make use of for management planning. Being a citizen's initiative, an area for further development will be to make the initiative more visible locally through disseminating key learning to the Lakshadweep public, using the local media.

Source:

Hoon, V., Moosa, O.G., Cheriuyakoya, M.I., Shamsuddin, V.M., Ayoob, A.E., Hussain, S., Moosakaya, B., Hajara, A. & Tajunnissa, N.M. 2005. Community based monitoring of coral reef related activity of Agatti Island – UT of Lakshadweep. Centre for Action Research on Environment, Science and Society, Chennai.

Fisheries monitoring G7

Monitoring of fisheries in and adjacent to an MCPA is essential to determine the impact of fishing on the biodiversity within the MCPA, and whether it is having an impact on fishery yields and thus on the livelihoods of coastal communities. This sheet describes key issues to bear in mind when developing a fishery monitoring programme.

Fishing both affects and is affected by the establishment of an MCPA. Increased catches (or fishery yields), as a result of spill-over from no-take zones and areas of reduced fishing pressure, can lead to improved coastal livelihoods. Collecting information on fishing from within and adjacent to an MCPA is thus essential to:

- Determining the extent to which fishing is having an impact on stocks (or populations), species, and biodiversity within the MCPA;
- Detecting changes (trends) in the fishery and their causes;
- Estimating the contribution of fish to food security and the economy, and how the MCPA plays a role in poverty alleviation, which is useful for influencing national and local policy makers, planners and donors.

DATA TO COLLECT

Before starting any fisheries monitoring, a profile (or frame survey) of the fisheries operating in and near the MCPA should be undertaken. This identifies the number and types of vessels, gears, fishers (including migratory fishers and their seasonal movement) and locations of landing sites/home ports. Frame surveys tend to be costly but are not needed often, as artisanal fishing fleets do not change much between years. Note that the data may be available from Fisheries Departments.

Basic elements of a fisheries monitoring programme are:

Catch (weight) and catch composition (species and/or families harvested). Lengths are essential for standard species-specific fisheries stock assessments;

Fishing effort includes type, duration and location of fishing operations; e.g. number of boat-days, man-hours or gear-hours per month or year;

Costs and revenues, which are mainly those of fish prices, fuel, gear costs and wages.

Information on both catch and effort is needed for estimating catch rate, or Catch per Unit of Effort (CPUE). It is generally assumed that a continuing decline in CPUE reflects over-fishing, whereas increased CPUE may reflect recovery of a fish stock or effective management. However, the relationship between CPUE and stock abundance is not simple, as it is confounded by changes in gear efficiency, changes in fishers' behaviour, and by schooling or seasonal movements of fish. Interpretation of CPUE trends should thus be cautious; however, if both CPUE data and independent survey data on fishery populations are used, it should be possible to assess the impacts of the MCPA on a fishery.

To determine whether an MCPA is contributing to food security and poverty alleviation, a 'food balance sheet' can be created. This is developed from estimates of total fish catch and information on seasonality, marketing and distribution of the catch (both inside and outside the MCPA), and the number of people using MCPA resources regularly. The price of fish, ideally at all marketing stages, and the gross value of the catch should be recorded. Analysis of these data, with information on labour, effort and opportunity cost, allows assessment of a fleet's economic performance.

DESIGNING A MONITORING PROGRAMME

Since there are often many types of fishing gear and vessels, usually with quite different catch-rates, and even catch composition, it is necessary to sub-divide, or stratify, the 'fishery' into groups that have similar characteristics (e.g. same gear, same vessel-type, commercial, or subsistence). If dugout canoes are grouped with larger sailing or motorised vessels the sampling is not stratified and the average catch, or income, will not be accurate. Ideally, all strata should be sampled, but the cost of and manpower for this is usually prohibitive, because enough samples must be taken to ensure accuracy (see below). For a long term programme, monitoring just the dominant strata may be sufficient.

Accuracy and precision are two key factors in monitoring design. Data accuracy indicates how close the estimation (e.g. average catch per day) is to the actual or true parameter (i.e. if every fishing trip is measured) and depends on how well the sampling has been designed. For example, measuring catch and effort of a handline fishery in one season will not be an accurate reflection of the total fishery if most fish are taken by traps in a different season.

Effort is harder than catch to measure accurately, and FAO guidelines recommend that three times more fishers should be asked about their fishing effort compared with their catch. Data precision (measured as the Coefficient of Variation, CoV) relates to the variability of the samples. An estimate based on a small number of unrepresentative samples tends to show a high variability and thus gives low precision. Precision improves with increasing numbers of samples or measurements, but if these are not representative, the data will be inaccurate.

Annual estimates of catch and effort can be improved using fleet and boat activity surveys. Fleet activity surveys show the number of days fished each month for each vessel/gear combination. This

V. Hoon

Fisheries monitoring can benefit from the involvement the local community

information can be obtained by asking a sample of fishers how many boats went fishing in the previous month, and how many days were missed due to bad weather, illness or holidays. Since such events affect the whole fleet, the sample does not have to be large. A boat activity (BAC) survey records the number of days fishers fished in a month, which may vary between individuals depending on their other commitments.

Since fish caught within the MCPA may be landed some distance away, and since fishing outside the MCPA may have an impact on stocks within its boundaries, the monitoring programme will need to incorporate data collection at fishing grounds and landing sites outside the MCPA.

GATHERING THE DATA

Fishery catch and effort monitoring is generally done in one of the following three ways (in decreasing order of accuracy and cost):

- Onboard vessels, recording catch/effort during fishing;
- At landing sites, when fishers land catches; or
- Through interviews with fishers after trips, and personal records.

Although data are likely to be collected by local fisheries departments, this may not be sufficiently detailed for MCPA purposes. However, any separate monitoring programme should be closely linked with existing government programmes, preferably involving local staff. Fishers can also be involved in data collection, as long as training is provided, methods are well understood and there is regular checking and calibration.

Standardised classifications for vessels, gear and species being fished should be used, but also local names where appropriate. Use of both scientific and local names allows scientists, managers and others to understand the data and results of analyses. Since fish catches are often very diverse and species are difficult to identify, it may be necessary to use a family-level or more generic nomenclature.

Data on illegal fishing activities should be obtained where possible, to monitor compliance with regulations. It can be obtained from various sources including direct observations, particularly during patrols and interviews with key informants.

KEY POINTS FOR THE MCPA

- **In developing a fishery monitoring programme, build on existing tried and tested protocols, and tailor to suit local needs (e.g. sampling effort, terminology, target species, gears). Consult or involve specialists as much as possible.**
- **Ensure adequate training of those involved; aim to cover as many exploited species as possible, but set the priorities according to the MCPA objectives.**
- **Use local fishers to help collect data where appropriate (for example, a logbook system has been used in Sri Lanka and Maldives for ornamental and some commercial fisheries).**
- **Establish a good relationship with the local Fisheries Department and involve it and local communities in designing and implementing the programme.**
- **It may be useful to work closely with research institutions that may also conduct fisheries monitoring, and such institutions may be able to undertake detailed monitoring on behalf of the MCPA (see chapter on research).**
- **If the MCPA is closed to fishing (see sheet I1), information on the adjacent fisheries may still be important to determine any spill over benefits from the MCPA.**

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Information management G8

Large quantities of data are generated in an MCPA, from records of visitor numbers and patrols, to the results of monitoring and research. It is essential that this is organised, stored, analysed and made available appropriately to provide the information that is needed for management. This sheet provides advice on how this can be achieved, including basic principles for setting up databases.

The data collected within an MCPA are a vital source of information by which the effectiveness of the MCPA can be assessed and the best management decisions made. Data entry, storage, analysis and write up takes as much time as data collection, and this is often overlooked in work plans. As a result, data are often never used and monitoring programmes fail to be useful because data are lost or never analysed. A good information management system can help to overcome this problem. Types of data may include:

- Textual or qualitative – e.g. words, sentences;
- Graphical – e.g. map, photo;
- Numerical or quantitative – e.g. areas, units, a ranking score.

An information management system may involve electronic and/or hard copy files. Software for electronic systems include Excel-type spreadsheets or database programmes such as MS Access. Spreadsheets are simple to set up and view, and analysis is easy on a one-off basis, but the regular analysis and reporting required in most MCPAs generally requires a more rigid system. Furthermore, as the quantity of data increases, so do the limitations of spreadsheets, and they are less secure as automated tasks and values in cells can be changed by any user.

Electronic, packaged databases are preferable because they can record changes over time more easily, take up less space and can be duplicated, and allow for efficient, accurate data entry and retrieval, safe storage and greater accessibility. Relational database programmes such as Microsoft SQL Server, or Microsoft Access for PC users, or FileMaker Pro for MAC users, are particularly efficient and powerful. These store data by dividing the information up into tables containing different fields. Queries can be set up to do analytical tasks in a consistent way, and standardised reports generated. For example, a query can be written to ask how many people visited the MCPA over a specific period and the results can be printed out as a report in a format designed by the user.

Databases must be kept up-to-date which requires good maintenance, especially as software is regularly revised, and it is best if someone is made responsible for this. The procedures involved in management of electronic data are detailed below:

DATA COLLECTION

Agree on the terms, format and abbreviations before data are collected (i.e. create a data dictionary), and use them consistently; always indicate measurement units; and be clear about how dates are to be recorded. Maintain a logbook for data collection and entry as a back up. Fill in all fields on data sheets to show that no data are missing and note any problems or irregularities. Transcribe data on to clean datasheets after returning from the field if necessary, and make photocopies so that the originals can be stored. Regularly back up all data, databases and associated files that are stored on the computer.

DESIGNING THE DATABASE

This should be done jointly by the staff responsible for the monitoring, research or management programmes, and those responsible for information technology. An external advisor or consultant in database design is invariably necessary. Close links, either in-house or with partners, should be developed between the database programmer, scientists with experience in analysis and managers who know the questions to be answered.

A management-oriented database must have data entry, verification and analysis pages designed for easy use by non-specialist staff. Focus on what is relevant or essential for the analysis so that the required outputs are obtained. Numerical data fields are preferable for analysis; comments can be added in text fields.

Other people or institutions may need access to summarised data, and the database may need to be compatible (i.e. have inter-operability) or harmonised with international or regional databases, such as CORDIO, South Asia Marine and Coastal Protected Area Portal, ReefBase, FishBase, the GCRMN Coral Reef Monitoring Data Management System (CoReMo) and the World Database on Protected Areas. CORDIO has developed databases for coral reef, fisheries catch and socioeconomic monitoring data which, as open-source databases in MS Access, can be continually upgraded and improved.

A database may need to include a security protocol, and this is already available in most good software packages. While it is

advisable to allow only certain individuals to enter or make changes to the data and structure, some form of access is essential for those responsible for analysis and preparing reports.

Relevant MCPA information should be made available, where possible, to support national, regional and global knowledge exchange. Useful ways of doing this include sharing data with recognised regional and international programmes and status reports, such as the global GCRMN reef status report, which is produced every four years.

DATABASE DOCUMENTATION

This is best done by creating word-processing files that describe how and why the data were collected (including any known problems or data gaps) and the data given within each table, and any analyses performed.

DATA ENTRY

A key aspect of data entry is quality control. The following procedures are recommended:

- Enter data as soon as possible after collection; it is best if the data collector does this or at least is available for consultation;
- Enter raw data. These can be aggregated later to produce summaries (e.g. daily averages, site totals), but it is generally impossible to extract raw data from a summary;
- Be consistent, as abbreviations, misspellings and data entered in a different format will not be recognised and risk being lost.

Customised data-entry forms assist by:

- Allowing (or requiring) users to select entries from a list (e.g. species, fishing gears) which makes data entry quicker and ensures that the same terms are used every time;
- Standardising formats (e.g. the user has to enter dates as dd-mm-yy) and preventing entry of text into numerical fields;
- Automatically filling in data fields from entries made in other fields, which speeds up data entry and provides additional checks.

Where data entry is done by someone who may not know whether the data are correct or not, validation rules can be set up that indicate values that are unusually low or high and need checking, and that certain fields are filled before the user can move on.

DATA VERIFICATION

Summary analyses of data should be carried out regularly to check that the data being collected are what is required, and that data entry is accurate and complete. The queries tool can be used for this by, for example:

- Counting the records to check that there are enough for statistical validity;
- Looking for data entry errors, e.g. unusually high or low values;
- Counting the records to see if they match the number of data sheets.

DATA ARCHIVING

Data must be archived for future users, and backed up in case of damage or loss. Back-ups are short-term copies of current work. An archive remains in storage as a record of a database at a particular time, and should be conducted regularly, but perhaps only monthly or six monthly. A backup is done much more frequently (e.g. weekly) and the new back-up is written over the old one. An archive should include the final version of all database files and data document files in a clearly labelled folder, saved on a CD-R (non-rewriteable) or DVD and stored in a central office, with the original raw datasheets and the printout of the data tables. The version on the computer, as well as photocopies of the data sheets are back-ups, and should be labelled accordingly and stored separately.

KEY POINTS FOR THE MCPA

- **If possible, appoint a data manager and provide appropriate training. Alternatively, ensure that all personnel are trained in data collection, management and analysis for the areas for which they are responsible.**
- **Make sure that data management and the equipment needs are factored into the budget for the MCPA.**
- **Ensure that information on visitor numbers, ticket revenues, sightings of rare or endemic species, breaches of MCPA regulations and other management or occasional events is collected and stored, together with data from monitoring programmes and research.**
- **Maintain close contact with other programmes in the region to exchange experiences, and help in the development and maintenance of a database, especially if funds and staff capacity are low.**

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ReefBase – www.reefbase.org

World Database on Protected Areas – www.wdpa.org

CoReMo – www.gcrmn.org/

Assessing management success

G9

Managers need to know how successful or 'effective' their MCPA is, and stakeholders and donors want information on whether the objectives are being met. An assessment of management success or effectiveness can help to provide this information and identify where improvements are needed. This sheet describes the principles involved and introduces some of the methods available.

Assessing or evaluating management effectiveness means measuring the degree to which a protected area is achieving its objectives, and how successfully it is designed, planned and managed. An assessment can also help to identify threats and needs, improve planning, and raise awareness about the MCPAs objectives and performance. It establishes accountability to government agencies, donors and the public, and helps meet national and international reporting requirements. It also identifies issues that are within the control of the manager and those that go beyond it, provides lessons learnt and allows for comparison between MCPAs, and helps when setting priorities and developing funding proposals.

Where assessments have been undertaken, managers have gained valuable insights into what works well in addition to any shortcomings. The Convention on Biological Diversity has recommended that countries should assess management effectiveness of at least 30% of their protected areas by 2010.

GENERAL PRINCIPLES

IUCN/WCPA has developed a 'framework methodology' comprising six components (see diagram) related to the three key elements of the protected area management cycle. The key elements are:

Design – What is the *context* in which the MCPA exists, and what is its vision? How appropriate is the *planning*?

Management systems and processes – What *inputs* are needed? What is the management *process*?

Delivery of objectives – What are the *outputs*/products? What are the *outcomes*/impacts?

Principles of assessment as identified by IUCN/WCPA are:

- To improve management and generate positive change, not compete with other MCPAs;
- The guidelines should be adapted to the site – there is no single 'right' method;
- Assessments should ideally be participatory and involve all stakeholders, and include biophysical, socioeconomic, cultural, and management issues;
- The type of assessment should be chosen according to available resources and capacity;
- Results and recommendations from the assessment must be followed up.

Assessments should preferably be repeated every 2-3 years (e.g. when reviewing the management plan) and mainstreamed into the MCPA's monitoring and reporting system (see sheet C3), thus developing an adaptive management approach.

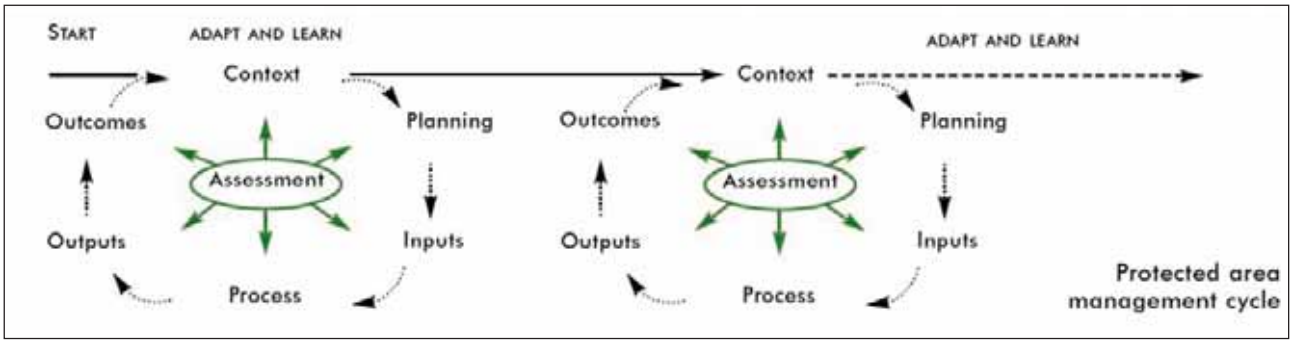
ASSESSMENT METHODS

There are several methods and common steps include:

- Developing a plan for the assessment;
- Analysing the biophysical and socioeconomic characteristics of the site (if not already available) to define clearly the values (i.e. why it was established) and management objectives (see sheet A2);
- Identifying indicators for measuring effectiveness (indicators for existing monitoring activities can be reviewed for their suitability – see sheet G1);
- Analysing status and trends in biodiversity, socioeconomic issues, threats and governance, using qualitative and numerical rating systems if appropriate;
- Reviewing and revising preliminary assessment results with stakeholders, through workshops or discussions;
- Preparing a report with recommendations to improve management; this should be simple and clear so that both the management authority and key stakeholders will read it. A summary is useful for the general public;
- Adjust management as necessary.

The first assessment of an MCPA tends to be incomplete whatever method is used, but is invaluable for discovering where monitoring, other data gathering exercises, and information management systems need improvement. The methods described below are based on the IUCN framework methodology.

Outcome/output assessment – IUCN/WCPA-Marine, WWF and NOAA have developed a method focusing on outputs and outcomes (or impact) of MCPAs (Pomeroy et al. 2004). This has been piloted at 17 sites worldwide, including a number of sites in the Philippines. For this method, the MCPA ideally needs clear objectives, a management plan, baseline data from when it was established,



and to have been in operation for at least two years. Indicators are selected with the help of predetermined generic indicators. This method helps to provide new information and emphasises the importance of quantitative monitoring programmes, but is time-consuming.

Comprehensive assessment – This method was developed through a UNESCO/IUCN project, *Enhancing our Heritage*, aimed at testing the IUCN framework in World Heritage Sites. It uses work-sheets that can be adapted to individual protected areas to assess each component of the management cycle. These have been adapted by IUCN-EARO for shorter assessments of MCPAs in the Western Indian Ocean, and piloted in eight sites. A small 'implementation team', comprising MCPA personnel, key stakeholders, and sometimes consultants, leads the assessment. The completed worksheets are reviewed by staff and stakeholders in consultative workshops, and a report and recommendations are produced. This method is relatively cost-effective and quick but requires subjective self-assessment, which can be difficult.

Scorecard – Developed by the World Bank for use in GEF projects related to MCPAs (see case study sheet G10), this provides a simpler method, focusing on the Process component of the management cycle. If repeated at intervals, it will help to track progress. It is viewed as a level one assessment, requiring little or no additional data collection. Issues are broadly covered but the depth of analysis is generally low. Its authors recommend that it is used in combination with the IUCN Guidebook, which provides a more detailed assessment tool for evaluating outcomes and achievement of objectives. The scorecard is completed by MCPA staff, and makes use of immediately available information and staff knowledge, and should take a maximum of half a day to complete. The potential shortcomings of this method is that items scored can receive equal weight, even though they may not be equally important to achieving conservation success, and the fact that ranking is subjective; for instance, an attribute can be classified as good by one person and fair by another.

The Marine Protected Areas Evaluation Model (MPAEM) is a multidisciplinary appraisal technique to evaluate MCPA management effectiveness based on a number of easy-to-score attributes. An ordination of a set of attributes using multidimensional scaling (MDS) is performed. The attributes are defined by MCPA management goals, and the results expressing the relative management effectiveness in each evaluation field are reported on a scale from zero to 100%.

Six evaluation fields used in MPAEM are:

1. Living resources;
2. Non-living resources;
3. Economic;
4. Social;
5. Ecosystem functions;
6. Management.

The model is based on the Rapid Appraisal of Fisheries approach used for the evaluation of the sustainability of fisheries.

KEY POINTS FOR THE MCPA

- **Carry out an assessment of management effectiveness; if financial and human capacity is limited, one of the simple methods can be tried. Engage the expertise from outside the core staff if needed (e.g. engage a consultant).**
- **In order to conduct a meaningful evaluation process, the exercise will need MCPA management plans as a starting point, and to be repeated on a regular basis to build up a database that can be examined to determine status and trends.**
- **Seek funding for more in-depth assessments (many donors are interested in this topic).**
- **Use the results when reviewing management and other plans and to encourage adaptive management.**
- **Share effective methodologies, techniques and experiences between MCPA sites to encourage greater uptake.**

Sources of further information

(See also sheet G1)

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IUCN/WCPA Management Effectiveness Task Force – www.wcpa.iucn.org

Conservation Measures Partnership – a consortium including WWF and IUCN that is developing standards for conservation practices – www.conservationmeasures.org/CMP/

UNESCO/IUCN Enhancing our Heritage project – assessing World Heritage Sites www.enhancingheritage.net

OSPAR guidance:

Self assessment methodology to assess the effectiveness of MPA management – www.ospar.org/documents/dbase/decrecs/agreements/07-05e_Guidance%20assessing%20MPA%20managmnt%20effectiveness.doc

Assessment checklists for the design of networks of MPAs – www.ospar.org/documents/dbase/decrecs/agreements/07-06e_Guidance%20MPA%20ecocoh%20self%20assessmt%20chcklist.doc

CASE STUDY

Assessing Management Effectiveness, Aldabra Atoll, Seychelles

Aldabra World Heritage Area and Special Reserve, managed by the Seychelles Islands Foundation (SIF), is one of the pilot sites in the UNESCO Enhancing Our Heritage project. Using the project methodology, an implementation plan was prepared. Given the limited personnel, the work was led by a team of SIF staff with local consultants, who were independent but had prior knowledge of Aldabra, which proved useful. Team members took responsibility for compiling the worksheets for different components, which accelerated the process. Biases may have arisen as a result of limited interest from some stakeholders; others found the process intimidating, particularly when issues related to their role were raised, which highlighted the importance of stressing the positive aspects of an assessment.

The assessment was considered very useful by all SIF staff, the local Management Committee and the Board of Trustees as it clarified issues and prioritised future actions, and it gave staff the opportunity to review their own work. The involvement of upper management helped to ensure that recommendations can be followed up, including:

- Lack of awareness of the values of the World Heritage Site and management plan and operations manual which were not being used effectively.
- Inadequate monitoring programmes for terrestrial vegetation, marine ecosystems and the impacts of introduced animals (e.g. rats), although others were good or adequate (e.g. giant tortoises, birds).
- The need to create opportunities to involve other stakeholders, particularly NGOs and civil society.
- The need to improve annual work plans, the system for reviewing and monitoring the management plan and the financial management system.

Source:

Seychelles Island Foundation 2002. Initial Assessment: Report of initial management effectiveness evaluation. Aldabra Atoll, Seychelles, Enhancing our Heritage project, IUCN/WCPA. 117pp.

Evaluations and reviews G10

Evaluations and reviews are invariably a condition of donor funding. They should be carried out periodically in any MCPA to determine whether the objectives are being met. This sheet provides guidance on carrying them out appropriately so that they contribute to improved management of the MCPA.

The terms 'evaluation' and 'review' are often used in similar ways. However, a review generally means an assessment of a piece of work at one point in time in order to check that it is going in the right direction. Donors often require a mid-term review part way through a project. An evaluation is generally an assessment of the impact of a piece of work and of the extent to which stated objectives are being met. Evaluations are thus often required at the end of projects or defined phases within a project. As with assessments of the management success of MCPAs, evaluations and reviews should be seen as a learning process, aimed at increasing project or programme effectiveness.

TERMS OF REFERENCE (TOR)

Donors often have specific TOR (see case study sheet D2 for an example of TOR) for evaluations and reviews, but may request assistance in preparing them or ask for comments and approval. Preferably all partners should see the TOR and be allowed to comment before they are finalised. The TOR are often couched in terms of questions, along the following lines:

Effectiveness, efficiency and timeliness

What outputs were achieved and were the activities in accordance with the Project Document and work plans? To what extent did the outputs contribute to the overall objectives? Were technical and financial resources, skills, institutional arrangements, organisation and strategies available and adequate? Were the resources used optimally, and funds spent in accordance with work plans and using correct procedures? Were any unforeseen problems dealt with appropriately? Were the capacities of the project partners adequate and did they all work well together? Was there a process for self-monitoring and assessment, e.g. through team meetings, reporting and reflection?

Impact

This section is primarily for evaluations. Were the intended impacts realised, and were there any unintended positive or negative impacts? Did the project bring about desired changes in the behaviour of people and institutions? Have these changes resulted in an improvement in the lives of people and a more efficient use of resources upon which they depend? What might have been the likely situation without the project? Note that evaluation of the impact of the project may be difficult if the objectives are neither clear nor measurable and if there are no monitoring programmes.

Relevance in relation to the needs of the stakeholders and environment

What was the context within which the project was designed and did it address most pertinent issues? Did the project address identified needs, issues and challenges facing people and the environment? What have been the roles of the donor, project partners and project staff, and were they appropriate?

Long term sustainability

Were all key stakeholders sufficiently involved? Were their expectations met and were they satisfied with their level of participation? Do partners have the capacity to continue to implement all initiated activities, and can they raise adequate material and financial resources? To what extent were external factors that influence sustainability (e.g. political support, availability of funding, technical capacity, economic development activities) addressed? What else is required to ensure continued sustainability and positive impact?

Identification of lessons learnt

What lessons were learnt about project structure, including management (e.g. human resources, financial), decision making, monitoring, reporting and assessment? What lessons were learnt regarding the strategic approach of the project, e.g. stakeholder involvement, partnerships and operational strategies used in implementation? What lessons were learnt regarding the initial assumptions and hypothesis made during project design?

The TOR should specify: the information that the consultants need to gather and how they may obtain it; how the results should be presented; arrangements for feedback and consultation with project partners; and logistical arrangements with a time scale. Sometimes the evaluation or review team are asked to develop the methodology themselves.

CARRYING OUT AN EVALUATION

The timing of evaluations and reviews is generally laid out in project documents. Evaluations and reviews are usually carried out by a team (minimum of two people) that includes individuals external to the programme. Such people often provide useful insights to on-site staff who may be too close to problems, reluctant to acknowledge them, or too pre-occupied with day-to-day issues and activities. External teams can also bring in experience from other areas to provide fresh perspectives on how to overcome obstacles. Teams should, however, also include someone very familiar with the project or programme, and certainly a member who is national to the country involved. The composition of the evaluation team should be such that it reflects a balance of views, and in its work it must consider the views of all the stakeholders.

Preferably a participatory approach is used, with widespread consultation among partners, stakeholders and project beneficiaries (see sheet B1). Most evaluations and reviews will involve:

- A review of the Project Document, work plans and progress reports, and other relevant documentation;
- Consultation with project partners and staff;
- A field or site visit;
- Presentation of preliminary results to all those involved, often to the Advisory Committee or Board.

KEY POINTS FOR THE MCPA

- **Ensure that all MCPA staff are aware of the requirements for the evaluations and reviews that may have to be undertaken for projects and donors that are supporting the MCPA.**
- **Try and encourage MCPA staff to see these events as a learning opportunity rather than a job threat.**
- **Start preparations for evaluations and reviews in good time, and ensure that all those involved are aware of what is involved and are available; sometimes self-assessments with different stakeholder groups, in advance of the visit from the external team, can be very useful.**
- **Ensure that the team has all the relevant documentation and information; make sure the results of monitoring programmes are accessible and in a usable format.**
- **Make sure that recommendations from reviews and evaluations are followed up, and use the lessons learnt to improve MCPA management in general.**

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Guidelines for managing evaluations in IUCN. Monitoring and Evaluation Initiative, IUCN, Gland, Switzerland. www.iucn.org/themes/eval/index.html

CASE STUDY

Lessons Learnt from a Review of the Marine and Coastal Protected Areas of Sri Lanka

A paper based review on the MCPAs of Sri Lanka that included an assessment based on the scorecard approach by Staub and Hatziolos (2004), indicated that despite the popularity of MCPAs as a management tool, many fail to achieve their conservation objectives. Over the years, Sri Lanka has declared a total of six MCPAs, most of which are not managed adequately and are still suffering from unsustainable resource extraction and habitat degradation. While existing protected areas go ungoverned, new legislation and protected areas are declared. This review highlighted the need for identifying and declaring MCPAs based on sound ecological principles, socioeconomic realities and long-term management sustainability. Poor coordination and a lack of serious political will have also hindered successful resource management. Due to the large dependence of coastal communities on marine resources for subsistence, the issues are complicated and it is unfeasible to exclude such resource users. Ultimately, the review highlighted the urgent need for a more integrated approach where decisions are based on the analysis of all relevant criteria combined with a concerted and genuine effort towards implementing strategies and achieving predetermined targets, in an attempt to achieve effective management of MCPAs and the sustainable use of marine resources in Sri Lanka.

Source:

Perera, N. & de Vos, A. 2007. Marine Protected Areas in Sri Lanka: A Review. Environmental Management. 40: 727-737.

Appropriate research on both biological and socioeconomic issues is essential for long-term effective management of an MCPA, and many MCPAs in the region have the promotion of science or research as one of their objectives. This sheet provides guidance on how an MCPA can develop good relationships with researchers, build up their own research programmes and benefit in general from research activities taking place within their boundaries.

The natural sciences are vital to understanding ecosystem function and change, and the social sciences are essential to identifying the sources of human-induced problems. Successful MCPAs typically involve collaboration between managers, staff and scientists at all stages: formulating management policy and interventions; designing the MCPA; identifying sources of human-induced impacts and conflicts; and evaluating and adapting the approaches used and their impact.

RESEARCH PARTNERSHIPS

It is rare for a management agency to be able to fund all the necessary studies, and outside assistance will be required. This may come from a range of sources – local universities and research institutes, overseas researchers, students working on projects or further degrees, or consultants and volunteers. The MCPA or its management authority may need to contract out research to external agencies. Developing a good partnership with academic institutions and universities is vitally important. Depending upon its location and scientific interest, an MCPA may well be a potentially attractive 'field laboratory' for scientific or other research. Having research teams in the MCPA, including PhD students, can put it on the scientific map, bring publicity, expose MCPA staff to wider experience and knowledge and bring in modest amounts of income to support running costs. MCPA managers should attempt to work together with researchers to answer specific management related questions. Identifying research gaps and sharing them with potential research partners would also increase the usefulness of research for managers, and promote more management related research efforts by institutes, independent scientists and students.

Once researchers start working in an area, they may opt to continue to do so, thus establishing a long-term relationship that can be useful for monitoring and studies of long duration. It can result in additional useful research being carried out for the MCPA at no cost. Scientists are also often willing to help train MCPA staff in particular research or monitoring techniques. A memorandum of understanding (MoU) or formal agreement with an academic institution is a good way to formalise links and ensure that each party understands the expectations and potential of the other.

RESEARCH WITHIN THE MCPA

Some MCPA management bodies are large enough to have a designated Research or Science Officer to oversee, coordinate and prioritise research activities. In other cases, scientific task forces or working groups can be set up, with staff members and perhaps individuals from local institutions. In South Asia, MCPA management bodies are often understaffed or poorly trained, and such research committees are generally part of the overall management authority. In such cases, it may be useful to encourage MCPA managers to periodically provide updates on ongoing research and future needs to the research committee. In addition to promoting research, this would also encourage managers to become more actively involved with overall management of the MCPA rather than functioning merely as an enforcement authority.

It may be appropriate to develop field station facilities with a national university or research station, or to develop collaborative arrangements with researchers from further a field. Depending on the agreed research and management goals of the MCPA, investing in basic facilities for research may be advisable. The MCPA can often charge a fee to cover the use of basic facilities, but in exchange should also be willing to assist and facilitate the research work, for example, helping to obtain the necessary visas and research permits, assisting with transport and accommodation, and providing logistical support where appropriate.

Several MCPAs in South Asia such as the Gulf of Mannar Biosphere Reserve and Mahatma Gandhi Marine National Park in India, and the Hikkaduwa National Park and the Bar Reef Marine Sanctuary in Sri Lanka, have had numerous research studies spanning many years. Unfortunately, the results of many of these studies may not have been adequately used towards improving management due to a variety of reasons. In addition, recommendations arising from past research are sometimes completely ignored when undertaking new management programmes and a number of studies have been duplicated. MCPA management authorities need to develop mechanisms to retrieve, store and use all relevant information, as past data may provide valuable indicators and guidance for future management needs. In doing so, the MCPA should ensure that it is involved in research activities and should maintain a record of studies undertaken, and ensure that copies of all research reports and publications are provided by the scientists. The value of any research undertaken should be assessed periodically to ensure that it is contributing to the management of the MCPA. This will help to avoid duplication of studies, ensure that new research builds on the results of previous research, and help to ensure that the results of research are fed into the MCPA decision-making, planning and management process. The managers will need to understand the limitations of the research results; this can be achieved through regular discussions and feedback sessions with the scientists.

C.Raghunathan

A plankton collection net being used in research off the coast of south India

KEY POINTS FOR THE MCPA

- Establish partnerships with appropriate research institutions, with an MoU or agreement, concerning areas of collaboration such as joint authorship of publications, ownership of specimens, and develop a research plan that lays out the roles of the MCPA personnel and the external agencies.
- If funding is available, appoint a Research or Science Officer to the MCPA personnel. Prepare a research strategy or plan, identifying key needs and priorities that can then be made available to potential researchers or students who ask to work in the MCPA.
- Develop a code of conduct for researchers so that they fully understand how they are expected to behave in an MCPA and what the regulations are.
- Ensure that visiting researchers and students work closely with the MCPA staff; if possible, assign certain staff members to the projects or research studies so that they can learn from the work being carried out.
- Ensure that regular feedback on research underway in the MCPA is provided to staff and other interested stakeholders, e.g. through informal talks or seminars.
- Compile and keep up-to-date a bibliography of research work carried out in the MCPA, preferably stored electronically and perhaps made available on the MCPA's website (if it has one), and establish a library to host information relevant to the MCPA.
- To the extent possible, provide basic research facilities, such as a field laboratory, information about the area (a standard site description is useful), simple accommodation, assistance with transportation on site, and guides, translators and other assistants. Establish clear charge rates for the use of the facilities where appropriate.

Sources of further information

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CASE STUDY

Coral Reef Research in the Bar Reef Marine Sanctuary, Sri Lanka

The Bar Reef Marine Sanctuary (BRMS) includes a 307.6 sq. km area comprising extensive coral and sandstone reefs, deepwater coral communities and seagrass habitats in north-western Sri Lanka. It was declared a sanctuary in 1992 based on research carried out by the National Aquatic Resources Research and Development Agency (NARA). Research within the BRMS was greatly assisted by a Sri Lankan and Swedish research collaboration under the SIDA-SAREC Marine Science Programme, which resulted in numerous studies on the coral reef biology and ecology as well as hydrology and oceanography in the area. As a result, the BRMS is one of the best studied reef areas in South Asia.

NARA maintains a field research station adjacent to the sanctuary and this has facilitated long term research and monitoring by scientists from NARA and other institutions. The research station comprises of laboratories, storage facilities, accommodation and a boat used for research purposes. The establishment of several long term coral reef monitoring sites has assisted with studies on the impacts of coral bleaching in 1998 and subsequent coral recovery. Monitoring of fishing effort and landings, together with the impacts of fishing on coral reefs, has provided detailed information on the impacts of increased fishing pressure and the use of several destructive fishing practices.

Research conducted by NARA has been used for the development of a management plan for the Bar Reef, including a proposed zoning plan under a 'Special Area Management' project initiated by the Coast Conservation Department of Sri Lanka. However, a major factor affecting the management of the sanctuary has been the non enforcement of regulations and the inadequacy of staffing with regards to the management authority. Some of the research data have not been used when developing management plans and recommendations have been overlooked. As one of the best studied reef areas in Sri Lanka and South Asia, the BRMS offers an opportunity for MCPA managers to work together with researchers to establish a collaborative partnership to enable more efficient management of the MCPA, with decision making based on sound scientific research. In addition, collaboration with international institutes and scientists can promote and improve research as was exemplified by the SIDA-SAREC Marine Science Programme. This is particularly beneficial for MCPAs in South Asia where local funding and capacity for research is often very limited.

Resilience G12

The concept of resilience-based management is becoming increasingly popular in MCPAs, especially in response to the observed impacts of extreme events and global warming. This sheet explains some basic resilience concepts and how MCPA management schemes can incorporate them.

Ecological resilience can be defined as the extent to which ecosystems can recover from natural and human disturbances without losing their functions or shifting into alternate states – for example, the speed of recovery of a coral reef after a mass bleaching event or the ability of a mangrove forest to survive rising sea-levels. A resilient ecosystem continues to deliver goods and services that are essential for human livelihoods and the development of coastal societies, so a more resilient ecosystem often improves the resilience of human populations dependent on it. Social resilience is the capability of these societies to withstand and recover from disasters (for example, hurricanes or flooding) while retaining essential structures and processes. Social-ecological resilience encompasses the ecosystems and the societies that depend on them.

According to resilience theory, ecosystems can exist in multiple 'stable states' and shift from one to the other ('phase shifts') when certain tolerance thresholds are crossed. Thresholds causing phase shifts could, for example, include the loss of keystone species or increases in temperature or pollution levels. Often, it may be several factors acting together that cause a phase shift. A classic example of a phase shift is that of a coral reef that is heavily affected by a bleaching event and is overgrown by algae to become an algal-dominated reef with a consequent change in species diversity (see sheet H7). It is possible, although difficult, for the algal-dominated reef to return to a coral reef state, and this may depend on, for example, fishing or pollution levels. An ecosystem's resilience thus reflects the magnitude of disturbance that it can absorb before undergoing a phase shift.

Resilience-based management represents a shift from traditional perspectives. Whereas previously we often attempted to control and stop changes in natural systems, and separate natural and human systems, today we increasingly attempt to enhance the capacity of ecosystems and human systems to adapt together and be resilient to changes and disturbances. MCPAs can be a key tool in achieving this end.

RESILIENCE FACTORS

Coastal social-ecological systems are highly complex, and a myriad of environmental, ecological, oceanographic and social factors affect their resilience. In each system, the main resilience factors vary and local knowledge as well as resilience monitoring are important in enabling a manager to pick out which factors are most applicable to his/her MCPA. The following provides a quick overview of the main resilience factors affecting MCPAs, with a focus on coral reefs and mangroves.

PROTECTION

Local environmental conditions can protect certain localised areas from undergoing the stress that causes disturbance. This allows them to survive and thus to 're-seed' adjacent areas that have been affected. For example, during mass bleaching events certain coral reefs have survived because of local upwelling that cools seawater, or because of cloud cover or turbidity that shades them from excessive UV radiation. It is important for a manager to identify areas that are consistently protected from stressful conditions (for example, by consistent local upwelling) as potentially resilient areas.

TOLERANCE

Some species or ecosystems are naturally more tolerant to certain stresses than others. This allows them to survive the disturbance and to form the basis for recovery. For example, massive corals are generally more tolerant to temperature stress than branching corals, and there are certain types of zooxanthellae that have a higher thermal tolerance than others. In mangrove ecosystems, sediment-rich macrotidal environments and the availability of freshwater to compensate for increased salinity increases their tolerance to sea-level rise. Again, managers should identify species and ecosystems in their MCPA that are potentially more tolerant or susceptible to specific disturbances.

ACCLIMATISATION

Species and ecosystems often have the capacity to acclimatise or adapt to stress. Areas that are consistently or regularly exposed to stress are often more tolerant to high-level stress events where adjacent areas are damaged. These acclimatised areas can then help 're-seed' the damaged areas. For example, corals in environments with highly fluctuating temperature regimes are often more tolerant to bleaching events as they are acclimatised to temperature stress. MCPA managers should identify areas where acclimatisation is taking place.

U. Mistry

Diverse, healthy ecosystems are likely to be more resilient

CONNECTIVITY AND RECRUITMENT

For ecosystems to recover from disturbance it is essential that they are well connected to sources of recruits and that they provide a suitable environment for the recruits to settle and grow. Without recruitment, there is no recovery. In mangrove ecosystems, unencumbered tidal creeks and areas with a large tidal range tend to enhance propagule dispersal. In coral reefs, some reefs can act as sources of larvae that are transferred to 'sink' reefs via ocean currents. It is important for MCPA managers to identify recruit connectivity corridors between systems and to protect the corridors from disturbance.

HERBIVORY

Corals compete for space on the reef with other animals and with algae, and can be easily outgrown by algae if these are not cropped by herbivores. Thus herbivores are an extremely important functional group for coral reefs as they keep algal growth in check and allow coral recruits to settle and grow. There are many different types of herbivores – some that crop algae fronds, others that rip them out at the base, and others that scrape the rock while feeding – all these have a different role, and a balance is required to adequately control algae populations. Removing herbivores from the reef reduces resilience to disturbance by making coral recruitment and regrowth more difficult.

BIODIVERSITY AND FUNCTIONAL DIVERSITY

The more diverse an ecosystem is, the more resilient it tends to be. Biodiversity enhances resilience by allowing a decline in one species or functional group to be compensated by an increase in another. A balanced ecological community with abundant species interactions and robust functional groups is essential for recovering from disturbance. For example, the role of diversity of herbivore groups was powerfully demonstrated in Jamaica where overfishing led to the depletion of herbivorous fish. The black-spined sea urchin *Diadema antillarum* was the main herbivore remaining, however when they were decimated by disease, macro-algae began out-competing corals and reefs suffered a phase shift from a coral-dominated to an algal-dominated state with a subsequent loss of biodiversity. It is important for MCPA managers to maintain good biodiversity and functional diversity in their ecosystems through effective protection from anthropogenic disturbances.

SOCIAL RESILIENCE

Societies with strong institutions for collective action, robust governance systems and a diversity of livelihood choices tend to be more resilient to natural disasters and to show higher capacity for social reorganisation. Coastal communities that include experienced, prepared and responsive institutions are more likely to prevent natural disasters becoming long-term social disasters. MCPA managers should work closely and build partnerships with coastal communities and social institutions dependent on their MCPAs, in order to raise local community awareness and to bolster social-ecological resilience through, for example, alternative livelihoods that do not depend on resource extraction (see sheet B6).

RESILIENCE-BASED MANAGEMENT

It is possible for MCPA managers to promote ecological resilience through certain actions and strategies:

1. Spread the risk of ecosystem loss by identifying and protecting representative and replicate species and habitats;
2. Identify and protect resilient refuges that can provide the basis of recovery for adjacent areas;
3. Reduce anthropogenic stresses on protected areas by effective management and enforcement;
4. Maintain connectivity between areas and systems to allow an adequate flow of recruits;
5. Maintain suitable habitats for recruits to settle and grow;
6. Establish a resilience monitoring plan. For example, the IUCN Climate Change and Coral Reefs Working Group has developed a methodology that assesses coral reef resilience to climate change. To obtain more information on the methodology and how to implement it in your MCPA, please see www.iucn.org/themes/marine/coral_reefs/cccr/cccr_home.html or get in touch with Dr David Obura (dobura@cordioea.org) or Mr Gabriel Grimsditch (ggrimsditch@iucnus.org);
7. Develop adaptive management strategies to ensure sustainable management of MCPAs. Strategies should be flexible and responsive to new information;
8. Develop sustainable and alternative livelihoods for local communities to avoid excessive extractive usage of ecosystems;
9. Build constituency and partnerships at local, regional and global scales to share knowledge and help alleviate financial burdens;
10. Restoration of degraded ecosystems is possible, but this should be carried out under expert guidance and only when natural regeneration is no longer possible.

KEY POINTS FOR THE MCPA

- **Develop a resilience monitoring plan for the MCPA to identify potentially resilient refuges.**
- **Identify and protect corridors of connectivity that are crucial to recruitment and recovery. Identify sources and sinks of recruits. Make sure that conditions for recruit settlement and growth are as optimal as possible.**
- **Effectively manage direct anthropogenic stresses that you can control – for example over-fishing, destructive fishing, pollution, sedimentation, anchor damage, diver damage, land-based nutrients etc.**
- **Identify and protect representative and replicate habitats and species to spread the risk of ecological losses. Integrate the management of adjacent ecosystems (for example, coral reefs, seagrass beds and mangroves).**

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CASE STUDY

Assessing Coral Reef Resilience to Climate Change in Kenya

The Kenyan coast is slightly more than 500 km long, stretching from Tanzania in the south to Somalia in the north. Coral reefs are the dominant ecosystem along the majority of the coast, creating habitats for seagrass and mangroves in the lagoons and creeks protected by the reef crests. There are five marine parks and reserves (Kisite, Mombasa, Watamu, Malindi and Kiunga) in Kenya. However Kenya's coral reefs have been badly affected by bleaching, with a 50-80% loss of corals recorded in shallow reefs during the 1998 ENSO event. Some reefs have shown good recovery since then, but bleaching events regularly continue to affect the area and some reefs have not recovered at all.

The variable response to bleaching of Kenyan reefs has prompted an assessment of the resilience of coral reefs to climate change by the IUCN Climate Change and Coral Reefs Working Group. Working in collaboration with the Kenya Wildlife Service (KWS) and the World Wide Fund for Nature (WWF), CORDIO and IUCN scientists have assessed the resilience to climate change of all marine parks along the Kenyan coast using an IUCN 'rapid coral reef resilience assessment methodology'. This method allows a small team of scientists to use a low-tech approach to collect relatively simple data that is then analysed to compare the resilience potential of sites. Data collected describe coral community structure, coral recruitment, coral condition, herbivorous fish populations and a range of specific environmental, ecological and oceanographic resilience factors.

Using multivariate statistics, the data are then analysed to determine the resilience of each site. This information is useful for the MCPA management authority to predict which sites will be more or less affected by climate change, and can thus advise it where to focus management and monitoring efforts.

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Threatened marine species H1

Biodiversity protection is a primary objective of MCPAs and where this includes threatened species, these will need to be made a specific target and focus for management. This sheet explains the IUCN Red List of globally threatened species, and provides an introduction to the more detailed theme sheets that follow on particular groups of species that require special management attention.

Marine species were once thought to be so widespread and abundant that they would be unlikely to go extinct. New information is showing that many are now seriously threatened, undergoing more rapid declines in population size as a result of exploitation, and recovering much more slowly than previously understood. Furthermore, research is showing that many have more restricted distributions and are endemic to smaller areas than previously thought. MCPAs are playing a crucial role in maintaining and restoring populations of many globally threatened species.

Information on distributions and abundance of marine species in the South Asian region is limited. Species lists for major phyla exist but often the conservation status is not known, even for large species such as many marine mammals.

Large marine animals, such as whales and some dolphins, turtles, dugong and seabirds are particularly at risk. Turtles, dugong and whales are vulnerable to human capture as they have to surface to breathe, making them easy targets at such times (see sheets H2, H4). Turtles and seabirds both nest on land, so their eggs and young are also highly vulnerable to predation, both by humans and other species.

Little information is available on the status of marine fish and invertebrates. However, the monitoring programmes in the South Asian region, such as those supported by GCRMN and CORDIO, and other research studies, have revealed dramatic declines in large parrotfish, humphead wrasse and groupers. Groupers are particularly easy to catch and their spawning aggregations make them very vulnerable to over fishing; they have been fished out of most shallow reefs worldwide. Humphead wrasse are distinctive coral reef fish that can grow to more than two metres in length and are naturally rare and extremely vulnerable to overexploitation. Demand for this species is already high and on an upward trend with an uncontrolled illegal trade. There is evidence of targeted fishing of spawning aggregations, increasing the already high level of threat to these species. Spiny lobsters have also declined dramatically on coral reefs all over the world (see sheet I6).

THE IUCN RED LIST

Every year, IUCN publishes the global Red List of threatened species on-line. Species are classified into the eight categories listed below, defined by criteria that cover trends in population size, extent of occurrence and extinction risk.

Extinct (EX) – A taxon is Extinct when there is no reasonable doubt that the last individual has died.

Extinct in the Wild (EW) – A taxon known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside its past range.

Critically Endangered (CR) – A taxon facing an extremely high risk of extinction in the wild in the immediate future as defined by the criteria. Certain shark species in the South Asia region (e.g. Pondicherry Shark and the Dumb Gulper Shark) are listed under this category, as well as a number of sawfish species and the Leatherback and Hawksbill turtles.

Endangered (EN) – A taxon that is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future as defined by the criteria. South Asian examples are Loggerhead, Green and Olive Ridley turtles, humphead wrasse and the blue whale.

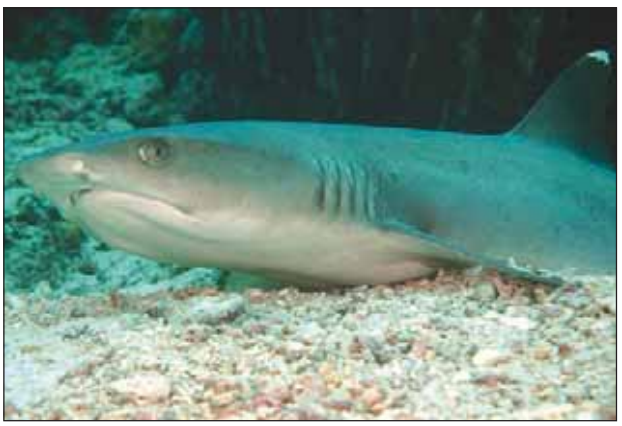
Vulnerable (VU) – A taxon that is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future as defined by the criteria. South Asian examples are dugong, Whale shark, and several other shark species.

Lower Risk (LR) – A taxon that has been evaluated but does not satisfy the criteria for any of the above categories. Such taxa are divided into the sub-categories Near Threatened and Least Concern. South Asian examples include many shark and whale species.

Data Deficient (DD) – A taxon for which there is insufficient recent information for assessing threat or uncertainty about data for widespread but declining species. South Asian examples are species of whales, dolphins and fish, including seahorses and sharks.

Not Evaluated (NE) – A taxon that has not yet been assessed against the criteria.

Marine species are poorly represented on the IUCN Red List, largely because of the lack of information about them. The status of most of the larger species (marine mammals, seabirds and turtles) has been assessed and many are considered globally threatened. Threatened marine fish are currently being assessed and many have been or are being added to the Red List, including swordfish, sawfish, all tuna species (except Skipjack), sharks, groupers, seahorses and manta rays. Very few marine invertebrates are on the IUCN Red List, with the exception of seven species of clam.



U. Mistry

Shark species are heavily overexploited in the region and many species have experienced alarming population declines

There is a dearth of information and general lack of awareness of the vulnerability of the many marine species found throughout the world's waters.

The Red List is used to help establish conservation priorities at the international, regional and national levels, and provides the basis for listing species under environmental conventions. However, the listings under such conventions, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), do not necessarily equate directly to the IUCN Red List, as conventions are developed to address specific threats (international trade in the case of CITES; the protection of migratory animals in the case of the Convention on Migratory Species; and the Indian Ocean-South East Asian (IOSEA) Turtle Memorandum of Understanding).

Some countries have their own national Red Lists of threatened species, but few if any include marine species other than the larger species such as turtles. Additionally, few of the categories differentiate between the terrestrial and marine species, but rather, include them in a single category.

Marine species on the 2007 IUCN Red List

	Global	South Asian Region
Whales dolphins	65	29
Marine otters	7	0
Seals	4	0
Manatees/dugong	4	1
Seabirds	155	No definitive numbers
Marine turtles	7	5
Marine fish	375	105
Molluscs	93	7
Coelenterates (corals, sea fans, anemones)	3	No definitive numbers

KEY POINTS FOR THE MCPA

- It is essential to know whether there are any nationally or globally threatened species within the MCPA, so check species lists against the Red List and any national lists that exist.
- MCPA staff should be aware of the occurrence of threatened and protected species both inside and outside their MCPA.
- All threatened species in an MCPA should be monitored; manuals on specific methods are available and regional/global monitoring programmes have been developed for many species; MCPA staff should find out about these programmes and participate.
- Some species may need special techniques for their study and management; in this case, outside appropriate expertise should be obtained if possible, and MCPA personnel should receive relevant training.
- There are often global or regional networks and working groups on threatened species (such as Species Survival Commission groups), and MCPA staff should check their websites, subscribe to newsletters and email groups, and participate in monitoring programmes.
- Protection of breeding, nesting, feeding and resting sites of threatened species (e.g. turtles and certain seabirds) that occur within an MCPA will be essential.
- Many of the larger threatened marine species (e.g. whales, turtles) are tourist attractions; organised visits, carried out so that they do not affect the animals themselves or their surroundings, can bring income to the park through visitor fees.
- Initiate, or participate in, media campaigns to increase public understanding of marine threatened species.

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IUCN/SSC Groupers and Wrasse Specialist Group, IUCN/SSC Coral Reef Specialist Group, IUCN/SSC Mollusca Specialist Group – www.iucn.org/themes/ssc; www.iucn.org/themes/marine (Note: websites for IUCN Specialist Groups for sharks, turtles and marine mammals are listed under the relevant theme sheet)

Oceanographic Biogeographical Information Service (OBIS) – www.iobis.org

Marine Species Conservation Factpack, 2001. Marine Conservation Society, Ross-on-Wye, UK

Shatter the Myth – www.iucn.org/themes/ssc

Marine Turtles H2

Many MCPAs in the region have nesting or feeding marine turtle populations, which are often a particular focus for management. This sheet provides guidance to the extensive literature and sources of information on these species.

Five of the seven species of marine turtle found in the world are found in the waters of South Asia. All are on the IUCN Red List: the Hawksbill (*Eretmochelys imbricata*) and the Leatherback (*Dermochelys coriacea*) are both categorised as Critically Endangered; the Green (*Chelonia mydas*), Olive Ridley (*Lepidochelys olivacea*), and Loggerhead (*Caretta caretta*) are listed as Endangered. They are also on Appendix 1 of CITES which means that international trade in live specimens or their products, such as carapaces and oil, is prohibited.

The life cycle of marine turtles involves a variety of habitats. Eggs are laid and incubate in sandy beaches. The hatchlings and young juveniles are pelagic and inhabit the surface waters of convergence zones and major gyre systems (circular currents) throughout tropical and temperate oceans. The feeding grounds of most adults include seagrass beds, coral reefs, sand and mud flats, and mangrove ecosystems, although the pelagic leatherback feeds in deep waters.

STATUS

With the notable exceptions of the Olive Ridleys of Orissa, India, there is a paucity of good data on marine turtles in South Asia. In India, the Andaman and Nicobar Islands have important feeding and nesting areas for four species (Green, Hawksbill, Leatherback and Olive Ridley). The Gulf of Mannar is another major feeding ground and developmental habitat for Olive Ridleys and Green turtles. Tamil Nadu is the only State in India where all the five species are still seen both breeding and foraging. Olive Ridleys nest at mass nesting sites all along the Orissa coast (see case study). The Lakshadweep Islands has populations of four species (Olive Ridley, Hawksbill, Green and Leatherback).

Five species are found in Sri Lanka, although populations have been significantly reduced. Most of the nesting sites have been identified in the south, south-west and east of the country, while no information exists from the North coast due to the ongoing civil conflict. Tagging records show that Olive Ridleys of Orissa forage off the coast of Sri Lanka. Marine turtle hatcheries are a common phenomenon on the south coast, established purely for commercial purposes as tourist attractions. On the whole, these tend to be poorly run and serve little, if any, conservation value, and many are actually illegal under the Fauna and Flora Protection Ordinance.

Only a limited number of Olive Ridley and Green turtles nest at present in Bangladesh. Trade (meat, egg and stuffed curios) continues openly. Green and Olive Ridley turtles are known to nest in Pakistan, and the Sindh Wildlife Department has had a hatchery and tagging programme in place since 1979. Tagged green turtles have been recovered from Gujarat in India and as far as Eritrea. Threats to turtles differ in the country's two coastal provinces, with accelerating urban development in Karachi damaging populations in Sindh, and direct exploitation threatening their survival in Balochistan.

In Maldives, Hawksbill and Green turtles are the most common of the five species found within the country's national waters. The other species present are the Loggerhead, Olive Ridley and Leatherback turtles, although the latter are very rarely encountered. A 10 year moratorium prohibiting the catching or killing of any marine turtle species, and the sale, import and export of their products was put in place in 1995, but did not tackle the issue of marine turtle egg harvesting. This moratorium was renewed after the expiration of the first moratorium in 2004, and expanded to ban egg harvesting on 11 islands.

THREATS

The major threats to marine turtles in the South Asia are:

- Loss and degradation of nesting beaches and foraging habitat (seagrass beds) as a result of poorly planned coastal development (tourism, commercial, urban, residential and housing developments, seasonal fisher camps);
- Exploitation for meat, eggs, shells, oil and other products (traditional medicines, cooking fat);
- Disturbance of nesting turtles by beach lighting, boats and watersports offshore, dogs, other predators and people on the beach;
- Incidental capture and drowning in shrimp trawls, gillnets and other fishing gears.

CONSERVATION MEASURES

Key measures for marine turtle conservation include the protection of breeding, feeding and nesting sites as well as controlling the harvesting of individuals. Many protection and monitoring programmes (e.g. monitoring of nesting sites; monitoring of adults through tagging initiatives) have been initiated worldwide. Examples regionally include Pakistan, India and Sri Lanka. A number of MCPAs in South Asia have been demarcated precisely because of their importance to breeding and nesting populations (e.g. Gahirmatha Marine Sanctuary, India – see case study; and Rekawa and Gowaya Beach, Sri Lanka). Sri Lanka has also produced a national strategy for the conservation of marine turtles.

The loss of individuals through incidental catch, or bycatch, fatalities remains a challenge. Fishing restrictions, which can be implemented

N. Perera

A turtle frequenting a reef habitat

through zoning measures and in conjunction with MCPAs (see case study), can be an effective way of dealing with this problem. In addition, there are innovative ways of reducing marine turtle mortality through incidental capture. Turtle Excluder Devices (TEDs) used by shrimp trawlers are now commonly used to prevent the incidental capture of turtles in trawl nets. A TED is essentially a grid of bars with an opening either at the top or the bottom of the trawl net. Small animals such as shrimp pass through the bars and are caught in the bag end of the trawl, while larger animals, such as marine turtles and sharks are ejected through the opening. TEDs have been used in some parts of the region but there has not been a concerted effort for the promotion of this tool, even in areas where TEDs are supported in policy. For example, in Orissa it is mandatory for shrimp trawlers to use TEDs, but enforcement and uptake of TED use has been weak.

International agreements requiring parties to carry out conservation and management actions for turtles apply to the region. The Convention on the Conservation of Migratory Species of Wild Animals (CMS) includes a regional agreement, the Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South East Asia (IOSEA), which has been signed by Bangladesh, India, Sri Lanka and Pakistan. Most countries in South Asia have national legislation protecting turtles. MCPAs play a vitally important role as they include many of the key nesting beaches and feeding areas, although not all.

TOURISM AND VOLUNTEERS

There is a lot of public interest in marine turtles as 'charismatic' animals, and in many parts of the world they can act as a tourist attraction. Marine turtle based tourism can be quite lucrative, but many initiatives have few conservation benefits and can actually negatively impact on individuals and populations. 'Turtle watching', or the observation of egg laying females, is one popular activity that can result in individuals being subjected to stress and cause disruption to the nesting process. However, if carried out according to approved guidelines (see Sources of further information), this can be used as an awareness raising and income generating activity for an MCPA. Marine turtle hatcheries, where hatchlings are kept and released after a brief period, are often used as a tourist attraction, but many have poor standards and dubious conservation value (e.g. Sri Lanka – see above).

Many marine turtle conservation initiatives have been very successful at building volunteer programmes into their activities, using volunteers to carry out basic research and monitoring as well as generating income through attracting paying volunteers. This kind of activity can be very useful for MCPA management and revenue generation (sheet D3 has more information on this as well as a case study on the use of volunteers in marine turtle conservation). It is important that conservation guidelines are closely observed when considering any kind of tourist or volunteer activities within or near an MCPA.

KEY POINTS FOR THE MCPA

Identify turtle species, nesting beaches, feeding areas, and seasons involved, within the MCPA.

- **Use zoning schemes to distinguish 'critical' nesting habitat (where all building construction, offshore water sports, and presence of vehicles, humans, and dogs on the beach would be prohibited) from 'sensitive' nesting habitats (where such activities would be reduced, or eliminated just during the nesting season) as well as to identify key near shore breeding areas that could be protected.**
- **Ensure that all stakeholders are consulted prior to the implementation of any restrictive conservation measures. Ensuring the full cooperation and participation of local stakeholders is essential for the long term success of conservation activities.**
- **Monitor populations, using standardised methods, including patrolling nesting beaches, counting nests and eggs, and recording tags, sightings and mortalities, and activities in the water (e.g. foraging and mating). Involve MCPA rangers, guides, volunteers, community representatives and government officers, and provide training as needed.**
- **Initiate a tagging programme, but do not start without consulting an expert. If a tag is recovered, return it to the address on the back.**
- **Collaborate with Fisheries and Wildlife Departments, national turtle working groups and local conservation groups involved in turtle protection.**
- **Promote the use of Turtle Excluder Devices (TEDs); discourage the use of gillnets where these result in accidental capture of turtles.**
- **Raise awareness about turtles in MCPA publicity and educational materials and, if appropriate, set up an ecotourism programme for tourists to view turtle nesting, ensuring that there is a code of conduct.**
- **If planning a hatchery or nest translocation programme, seek expert advice, as interfering in the way hatchlings reach the sea can have negative effects and reduce their chance of returning to the same beach once they are adult. National-level hatchery standards have been developed in some countries (e.g. Sri Lanka), so support the adoption and enforcement of these as a priority.**
- **Fence in nests at risk from predators, but be sure to check them daily during the hatching period.**
- **If planning a compensation scheme (e.g. for turtles released from nets, or reporting of nests), seek expert advice as this can be expensive and unsustainable, and may promote intense reporting or even capture.**
- **Never harass, catch, feed or ride turtles; when encountering turtles underwater, keep your distance and avoid disturbing them.**

The techniques needed to implement most of these activities are described in a comprehensive manual produced by the IUCN/SSC Marine Turtle Specialist Group (MTSG).

CASE STUDY

Protected Nesting Sites for Olive Ridley Turtles in Gahirmatha Marine Sanctuary, India

The single most important breeding area for Olive Ridleys in the Indian Ocean region is Orissa, India. 'Arribadas', or mass nesting events, occur at many sites in Orissa, of which Gahirmatha is considered the most important.

Marine turtles are protected in Orissa under national law, as well as the Orissa Marine Fisheries Act. In 1994, the Government of Orissa issued biennial orders under the Orissa Marine Fisheries Act, prohibiting all fishing in the waters close to the Gahirmatha beach off the Bhitarkanika National Park year-round. Following this, the Gahirmatha Marine Sanctuary (GMS) was declared in 1997, featuring 725.50 sq km core area and a 709.50 sq km buffer zone. In addition, a seasonal prohibition on fishing by trawlers within a specific 20km seaward radius of the Orissa coast was put in place in 1998. However, it is well known that turtle mortality off the Orissa coast is high, with figures averaging 10,000–15,000 every year since 1999. It is generally recognised that shrimp trawlers, gillnets and trawl nets are implicated in these high mortality rates.

There is currently some contention between the various categories of fisherfolk, conservationists, the Forest Department and the Fisheries Department over the conservation measures in place in GMS. There is a lack of consensus over which fishing operations and gear are responsible for entanglement and drowning of turtles as well as over the turtle protection strategies currently in place, and the process of selecting and enforcing conservation practices. Until 2003, most fisherfolk and local fisher leaders were unaware of the orders for GMS as well as those permitting restricted fishing in the buffer zone, and it seems that these orders were drafted with no clear consultation with local stakeholders. Researchers who have been studying the offshore turtle congregations indicate that in order to bring down mortality rates it is important to focus efforts on protecting geographical areas that are key for reproduction. Congregation zones are confined to only certain parts of the sanctuary and some of the currently demarcated core zones fall outside these important areas, indicating that current zonations, and restriction pertaining to these zones, could be revised.

The demarcation of GMS, and subsequent orders to curtail damaging fishery activities in important breeding areas of the sanctuary, are a clear step in the right direction in protecting key nesting populations in Orissa. However, the lack of participation and involvement of local fishing communities in the process may be counterproductive for conservation in the long term, and it is possible that present zoning plans may be out of step with current research. This example indicates that MCPA management for species conservation needs to adapt and respond to the needs of stakeholders and current science, in order to remain relevant and best serve the interests of both important turtle populations and local communities.

Source:

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The Turtle Conservation Project, Sri Lanka – www.tcpsrilanka.org/

IUCN/SSC Marine Turtle Specialist Group – www.iucn-mtsg.org

www.seaturtle.org – includes online access to Marine Turtle Newsletter which is also available by e-mail: mtn@seaturtle.org

www.seaturtle.org/tagging/ - information on tagging.

To subscribe to the Sea Turtle (CTURTLE) electronic mailing list, email listserv@lists.ufl.edu.

Turtle watching guidelines fact sheet produced by the Coral Reef Alliance (CORAL) – www.coral.org

TED overview from Queensland Government, Australia – www2.dpi.qld.gov.au/fishweb/10559.html

Wider Caribbean Sea Turtle Conservation Network (WIDECAST) – www.widecast.org

Indian Ocean – South-East Asian Marine Turtle Memorandum of Understanding (IOSEA MoU) – www.ioseaturtles.org/

Seabirds and shorebirds H3

Many MCPAs in South Asia protect important populations of both seabirds and shorebirds, but their management is often overlooked. Birdwatchers frequently visit MCPAs and they may become regular visitors and be willing to help with monitoring. This sheet provides some background information on birds relevant to MCPA management as well as guidance to best practices.

SEABIRDS

There are nearly 200 species of true seabirds (i.e. species that spend a large part of their lives at sea). The main groups of seabirds are albatrosses, petrels, shearwaters, tropic birds, boobies, frigate birds, gulls and terns, all of which often breed in large colonies on small islands. Many of these species of seabird breed on small islands found across South Asia, and an additional number are also known from the mainland coastline. Apart from these breeding residents, several other species visit this region as winter visitors and/or summer loiterers from the northern regions.

SHOREBIRDS

A second group of birds that are important in MCPAs are coastal resident or migratory waterbirds. These species include: small and medium sized wading birds such as herons, egrets, spoonbills, plovers, and sandpipers; larger waders such as storks, ibises, and flamingos; swimming birds such as ducks, teals, cormorants and pelicans; and others such as gulls, terns and raptors. They tend to congregate in estuaries, creeks, salt pans, mangroves and beaches, particularly along the mainland coast as these areas provide good feeding grounds. Some species use these areas as wintering grounds; for others, they are essential stopovers on journeys from northern areas, but there is very little information on their migratory patterns.

THREATS

The main threat to both resident and migrant birds in South Asia is habitat degradation and poaching. Other threats are disturbance by fishers and tourists, accidental entanglement in fishing nets, egg collecting, and predators such as rats, cats, dogs and, potentially, oil spills (see sheet K3). Invasive species can also pose a threat to certain bird species. For example, the feeding habitats of coastal waders in southern Sri Lanka are affected by the spread of invasive alien plant species such as Mesquite (*Prosopis juliflora*) and cattail (*Typha angustifolia*). Few species are globally threatened (i.e. on the IUCN Red List, see sheet H1) because most coastal waders and seabirds have very wide distributions.

CONSERVATION MEASURES

Some of the large nesting seabird colonies and key roosting and feeding sites for coastal migrants lie within MCPAs. For example, South Asia has a particularly large number of important bird sites which are now protected, either at the national and/or international level e.g. Bundala National Park/Ramsar site, Maduganga Mangrove Estuary Ramsar site and Annaiwilundawa Sanctuary/Ramsar site in Sri Lanka. Designation of Ramsar sites under the Convention on Wetlands of International Importance (Ramsar Convention) is a mechanism that affords protection of bird populations. For designation, a site must meet one of two criteria of importance to waterbirds: Criterion 5 for sites that regularly support at least 20,000 waterbirds; and Criterion 6 for sites that regularly support 1% or more of a waterbird species' biogeographic population. Many of the key sites for bird species are now recognised internationally as Important Bird Areas (IBAs), under a scheme initiated by BirdLife International, which aims to identify, monitor and protect a global network of sites for the conservation of the world's birds and other biodiversity. Several of these are included either within or overlap with MCPAs. Those that occur in South Asia are listed below.

Country Important Bird Areas

Some key marine and coastal sites for birds, as classified under the IBA list compiled by Birdlife International, are given below by country.

Bangladesh: Patenga Beach, Sunderbans (East, South, and West Wildlife Sanctuaries).

India: Car Nicobar, Charakla Salt Works, Coringa Wildlife Sanctuary and Godavari estuary, Great Nicobar, Little Nicobar, Gulf of Mannar Marine National Park, Jarawa Reserve (Middle Andaman and South Andaman), Little Andaman, Mahatma Gandhi Marine National Park (Wandoor National Park), Marine National Park and Wildlife Sanctuary (Jamnagar), Narcondam Island Wildlife Sanctuary, North and South Sentinel, North Reef Island Wildlife Sanctuary, Pitti Island, Rani Jhansi Marine National Park, Saltpans of Bhavnagar, Sundarbans Biosphere Reserve (National Park).

Maldives: Haa Alifu Atoll.

Pakistan: Hingol National Park, Indus Dolphin Reserve and Kandhkot wetlands, Indus Waterfowl Refuge, Jiwani Beaches and Dasht Kaur, Jubo Ramsar site, Keti Bundar North Wildlife Sanctuary, Outer Indus delta, Rann of Kutch Wildlife Sanctuary.

Sri Lanka: Amaipaddukkai, Ampara, Annaiwilundawa tank complex, Araly South-Punalai, Bellanwila-Attidiya, Bundala lagoon complex, Jaffna Lagoon, Kayts Island-Mandathive, Mundel Lake, Muturajawela marsh, Periyakadawela, Periyakalapuwa mouth, Seguwantive mudflats, Wirawila Tank, Welihena, Yala wetland and forest complex.

U. Mistry

Sea birds on the open water in India

(TST)

KEY POINTS FOR THE MCPA

- Determine if the MCPA has important bird populations and is an IBA; if so, ensure management plans and MCPA operations address their protection.
- Establish a monitoring programme, documenting populations of the most important birds; when and which part of the MCPA is being used; specific short, medium and long term threats. For seabirds (see case study), priorities are annual censuses (to determine long-term trends) and monitoring of breeding performance (survival of eggs and chicks, chick growth and fledgling size), diets and feeding rates.
- Understand bird migratory practices - if recorded. Wintering grounds for many important bird species are in South and South East Asia. Local migration also needs to be documented as some do also use terrestrial habitats along the coast and often close to human habitation.
- Protect nesting, roosting and – if possible – feeding sites, noting that breeding seasons of many seabirds do not follow a 12-month cycle. The most important feeding zones may be difficult to determine if outside the MCPA. Littoral feeders follow tidal cycles coming into conflict with people on an irregular basis. During the highest tides, critically important roosts will contain the bulk of the population and, if roosting occurs during daylight, these birds are at risk from disturbance and predation.
- If introduced species are a threat, seek expert advice.
- Establish viewing hides or platforms to reduce general disturbance. An MCPA should be able to welcome both casual birdwatchers and the real enthusiasts. Careful thought is needed in the siting of hides. The best places for the viewer are at roosts but these change with seasons and tide levels.
- Since nesting areas and other key sites are easily disturbed, people should be directed away from sensitive areas using trails; if essential, erect screens/fences to keep people out of sight of birds.
- For terrestrial coastal birds, allow (or encourage) appropriate natural vegetation to develop and ensure that no alien species are introduced.
- Create awareness among local populations as well as involving them and learning from their potential experiences and perceptions.
- Support the enforcement of legal provisions against the poaching of birds and eggs.

CASE STUDY

The Use of (a) Species and Habitat Checklists, Andaman and Nicobar Island, India, and (b) Bird Censuses in Sri Lanka

(a) Species and habitat checklists

A variety of coastal ecosystems are found on South Asia's coastal landscapes, ranging from beaches, rocky coasts, cliffs, mangroves, mudflats, tidal pools, lagoons and reef flats exposed at low tide. Many shorebirds use these habitats to forage, nest and roost. Although bird checklists are often made for spatially defined areas, especially protected areas, it is useful to create a database of ecological niches with information on specific species that occupy these habitats. In monitoring the biological diversity of MCPAs, habitat-level data sheets can be prepared by managers, with the help of ornithologists and naturalists. By encouraging the public to use these checklists, the monitoring process could be used for creating awareness among visitors to MCPAs and to encourage volunteers and local people in valuing and monitoring biodiversity. Such habitat level checklists are being used in shorebird surveys that are being carried out in the Andaman and Nicobar Islands in India, and could be applied to other coastal areas and MCPAs in the region.

(b) Bird censuses

The Ceylon Bird Club (CBC) of Sri Lanka conducts an annual census of waterbirds in inland and coastal wetlands across the country, and maintains population records of native and migratory waterbirds in a methodical manner. The results are published in the CBC notes and local journals. The data is also shared with Wetlands International, which compiles information on numbers and distribution of waterbirds every 4-5 years. Such data has also been used in the designation of Bundala and Annaiwilundawa Ramsar sites, and also for the designation of several other national protected areas over the past three decades.

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Convention on Wetlands – www.ramsar.org

IBA site for Sri Lanka – www.ibasrilanka.net/Index.html

Marine Mammals H4

The Central Indian Ocean has a diverse marine mammal population and several species are found in, or migrate through MCPAs. Few of the existing MCPAs undertake specific management of marine mammals, however dolphins and whales are increasingly becoming tourist attractions, and could provide important revenue for MCPAs if tourism is properly managed. This sheet outlines some of the management issues that need to be considered for these species.

About 43 species of marine mammals (whales, dolphins and the dugong) inhabit the Indian Ocean. Several species are on the IUCN Red List, but are often listed as 'Data Deficient' (see sheet H1) because there is insufficient information to determine the risk of extinction. The main threats to marine mammals such as fishing-net entanglement, chemical pollution and noise pollution occur frequently within South Asian waters and as such affect the day-to-day survival of these species. Critical areas for cetaceans include habitat used for feeding, hunting, breeding, socialising, raising young, communication and migration, and need to be protected and managed. The Indian Ocean Whale Sanctuary was established in 1979 and extends to 55°S latitude with a western boundary of 20°E longitude by Africa and an eastern boundary of 130°E longitude by Australia. To the south it borders the Southern Ocean Whale Sanctuary and thus encompasses the entire region of relevance to this document. The rationale behind its creation includes the protection of whales from commercial whaling and to stimulate cetacean research and conservation while allowing these species to recover from the past century of overexploitation.

In view of the life history, range and, in some cases, migration of marine mammals, conventional MCPAs alone are not a suitable tool for the protection and management of these species. While it is important that all habitats critical to the survival of marine mammals are under sufficient protection, critical habitats are often less spatially fixed than, for example, those for terrestrial species, particularly hunting and feeding areas that are dependent on upwelling and other dynamic oceanographic conditions. Thus critical habitats for cetaceans cannot be protected using a system of traditional MCPAs with fixed boundaries, and require rules and regimes that have the necessary flexibility. It has been recommended that large areas are designated that include flexible, highly protected core areas with boundaries that are adjusted as needed from year-to-year or even within seasons. This will ensure that marine mammal hotspots as well as areas believed to support their survival are protected. As such adjustments would have to be adaptive, constantly reviewed and sensitive to signals from the wider environment. Regional research programmes also need to be designed to ensure the success of such protected areas. While devising such a scheme is beyond the scope for most MCPA managers it is important to note that, in many cases, protection of key habitats for marine mammals (e.g. nursery, feeding) is among the objectives of many MCPAs, and MCPAs thus fill an important function in such a system.

DUGONGS

Dugongs, whose historic range is known to coincide with that of seagrasses, were once widespread throughout the Indian Ocean. However, populations and range have decreased significantly in the last century, largely due to hunting. According to the IUCN Red List of Threatened Species, the Dugong is vulnerable to extinction throughout its range. In South Asia, dugong populations are found in Bangladesh, India and Sri Lanka. While the necessary legislation is in place for the protection of this species it is still hunted for its highly valued meat in India and Sri Lanka. Other significant threats include by-catch from fisheries, particularly gill netting as well as loss of sea grass habitats due to agricultural pollution, destructive fishing methods, and the expansion of human settlements. As a result, the population of dugongs in the Gulf of Mannar is very small and in critical need of conservation action to avoid their local extinction.

The Dugong is found within several protected areas in the region, including the Gulf of Kutch Marine National Park, Gulf of Mannar Marine National Park and the Gulf of Mannar Biosphere Reserve in India, in the Gulf of Mannar and Palk Bay waters between southeast India and north west Sri Lanka, and in the Bar Reef Marine Sanctuary in Sri Lanka. However, designation of these MCPAs does not appear to have led to an increase in dugong populations in this region, and many threats remain or have increased in recent years.

DOLPHINS AND WHALES

South Asia is home to a diverse number of whale and dolphin species, some resident and some migratory. Some areas within the Central Indian Ocean, such as the Gulf of Mannar Biosphere Reserve, have been identified as feeding and breeding grounds for many of these species. Large populations of dolphins and whales have also been recorded in other MCPAs such as the Bar Reef Marine Sanctuary in Sri Lanka.

Dolphins are often fished for bait for shark fishing and for their meat, but there is little information on their status in the region. A large number of dolphins are also killed each year as a result of entanglement in fishing nets, particularly in large monofilament gill nets and drift nets. Although commercial whaling never occurred in South Asia, whale populations were reduced drastically through this activity in other parts of the globe. In addition to national legislation, the declaration of the Indian Ocean Whale Sanctuary further protects whales from exploitation in this region.

U. Mistry

Dolphins in the Andaman Islands, India

Whale and dolphin watching is a popular tourist attraction in some areas including MCPAs. There has been an increasing interest in dolphin watching within the Bar Reef Marine Sanctuary, and whale watching operations have begun in several places throughout South Asia. Whale and dolphin watching can be a commercially important activity and if properly managed, provide revenue to an MCPA along with economic incentives for conservation.

KEY POINTS FOR THE MCPA

- Keep records of sightings of all marine mammals. They can be counted on timed boat or aerial surveys over defined areas (appropriate survey times do not always coincide with favourable weather periods). Document specific behaviours, such as breaching, and tail flapping, and where possible identify individuals through colour, scars on the skin, and shape of flukes. Obtain appropriate field guides and ensure that MCPA personnel are trained in identification.
- Strandings - A live stranded whale should be kept wet with sea water, and gently pushed back into deeper water, avoiding pulling or pushing on the flippers as these can easily be damaged. A large team of people will be needed, so call on visitors, local communities and other willing supporters.
- Whale and dolphin watching - New research is showing that marine mammals suffer high levels of stress when being watched by tourists. It is therefore vitally important that whale and dolphin watching is carefully managed. Obtain and/or develop codes of conduct and adhere to them. For example, when in a boat near whales and dolphins: maintain a full-time lookout person; never approach head-on or from behind; allow the animal to approach the boat rather than vice versa; keep engines running and do not approach animals under sail alone; maintain no-wake speed of 2 knots (no sudden changes in speed or direction); only reverse in emergency; maintain a parallel course with the animals; do not cut them off from open water; show extreme caution within 300-400m of the animal and never approach within 50m (100m is a good distance for viewing feeding, but further away if animals are socialising); do not go between a calf and adults. Involve local communities/fishers/boat operators in whale watching programmes.
- Where marine mammals occur within or adjacent to an MCPA, ensure that information is made available to visitors, local communities and key government officials about the status of, threats to and biology of the particular marine mammals. Obtain information on relevant marine mammal conservation programmes elsewhere and partner with relevant agencies.
- Dugong - Raise awareness amongs local communities about the status of and threats to dugongs. Encourage fishers to report live or dead dugongs caught in nets and to use alternative gears where these exist. Avoid using an incentive system if possible as this may encourage the capture of healthy dugongs and is likely to be difficult to maintain.

CASE STUDY

Protection of the Dugong in Bazaruto Archipelago National Park, Mozambique

There is a lack of good examples of targeted programmes to protect marine mammals in South Asia, but the following draws from the experiences of the East African side of the Indian Ocean. The dugongs in the Bazaruto Archipelago are probably the last viable population on the East African coast but may only number about 100 individuals. The population is monitored through regular aerial surveys carried out by a joint team of researchers from Natural History Museum in Maputo and Texas A&M University Institute of Marine Life Sciences, and appears to be fairly stable. The National Park plays a major role in their protection as well as protecting seagrass beds and other key habitats, guided by the management plan, which is updated every five years.

The main threats are incidental capture by gillnets set by local fishers and an illegal commercial shark fishery. Gillnets are banned within the National Park, but are still used illegally because of the difficulty in patrolling the large area (1,400 sq km). Incidental capture is being addressed by awareness-raising through the local fishers' associations, and the fish landing sites on the islands and mainland are patrolled to check for dugong carcasses and meat. If meat is found, it is confiscated and destroyed, and dead specimens are collected for the museum. Those responsible are fined and may be taken to court for additional legal measures as appropriate. There are plans to implement a gear exchange programme to replace gill-nets with others, and to train some of the fishers in other professional skills, to reduce their dependence on fishing. The rapid development of tourism in the area provides one livelihood opportunity.

Tackling the shark fishery is more difficult as this involves illegal Chinese boats. The establishment of a small navy base in the area and the provision of two powerful motorised boats to the park have helped. The park also provides education and awareness programmes about the need for dugong conservation to tourist operators and local communities.

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International Fund for Animal Welfare - www.ifaw.org

International Whaling Commission (IWC) - www.doc.govt.nz/Conservation/Marine-and- Coastal/International-Whaling-Commission/index.asp

IUCN/SSC Cetacean Specialist Group and IUCN/SSC Sirenia Specialist Group website - www.iucn.org/themes/ssc

To subscribe to the Sirenian mailing list, email: SIRENIAN@listserv.tamu.edu.

Ocean Blue Foundation: Developing an International Whale Watching Charter - www.responsiblewhalewatching.org

Whale and Dolphin Conservation Society - www.wdcs.org

Biodiversity and Ecosystem Health H5

Most MCPAs have a primary, if not openly stated, goal of biodiversity protection and maintenance of whole and functioning ecosystems. The terminology involved is not always easy to understand although the underlying concepts are important. This sheet explains some of the more common terms and describes how the concepts relate to management.

The term biodiversity, coined as recently as 1986, is short for biological diversity, which means the variability among and between living organisms and the ecosystems of which they are a part. It includes plants and animals at the gene and species level, the habitats and ecosystems that they form or are part of, and the ecological processes that support them. Biodiversity includes common and alien species, as well as threatened, endemic and rare species (see sheet H1). One can talk about the 'biodiversity' of a location, a country, a continent or the world.

Global, regional and national assessments show that biodiversity is declining dramatically. The World Summit on Sustainable Development in 2002 adopted the goal of securing, by 2010, a 'significant reduction' in the rate of biodiversity loss. Protected areas are a vital mechanism for achieving this. Placing them in areas of high biodiversity makes conservation more efficient as many species and ecosystems can be managed at one time.

SPECIES

A species is the fundamental unit of biological organisation. Individuals in the same species are genetically similar, look the same, and normally reproduce viably only with each other. Fewer species have been discovered from the ocean so far, with about 250,000 known marine species compared with 1.5 million terrestrial species. However, marine diversity is much greater than terrestrial diversity at higher taxonomic levels (phyla and classes), with 36 of the 37 animal phyla found in the sea, 18 of which are entirely marine. As time goes on we are developing better technology that is uncovering a wealth of information. The Census of Marine Life is a 10-year scientific initiative to assess and explain the diversity, distribution, and abundance of life in the oceans. This initiative engages a global network of researchers in more than 80 nations, and will provide the world's first comprehensive census of marine life - past, present, and future, to be released in 2010. The South Asian region generally has high marine and coastal biodiversity, found to be rich in scleractinian coral species and containing the largest single block of tidal mangrove forest in the world, the Sundarbans of Bangladesh and West Bengal, India.

ECOSYSTEMS

An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the non-living environment interacting as a functional unit (UNEP 2006). Ecosystems can be defined by certain features and characteristics and consist of many species, including humans, all playing different roles. A habitat specifically refers to the area occupied by a particular species or group of species. The terms 'habitat' and 'ecosystem' are often used interchangeably, for example, a mangrove forest, a coral reef, and a seagrass bed are all habitats for the characteristic species found within them. Equally, they are ecosystems as they function as a whole. At larger scales, an area comprising linked mangroves, seagrass beds and coral reefs could also be considered an 'ecosystem' as each component is integrated with the next through a web of ecological processes (e.g. fish movement, nutrient exchange).

Other important concepts are:

Ecosystem services – The services provided by ecosystems that are of value to humans, e.g. food, water, shore protection, cultural values, regulation of climate.

Ecosystem functions – Ecological processes e.g. nutrient retention, succession, productivity, decomposition.

Ecosystem health – An ecosystem is considered healthy if it is stable, resilient to stress and continuously provides a particular set of services.

Ecological or ecosystem integrity – The ability of an ecosystem to support and maintain a viable community over the long-term, with species composition, diversity and functional organisation appropriate for its location, and the full range of native species and supporting processes.

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Illustration courtesy of the SEA Trust

Biodiversity pie chart, showing approximate proportions of the larger, shallow water marine life

Ecosystem resilience – The capacity of an ecosystem to cope with disturbances, without shifting into a qualitatively different state. A resilient ecosystem has the ability to withstand sudden shocks and if damaged, repair itself without loss of function and services (see Sheet G12).

The main coastal and marine habitats and ecosystems found in South Asia are coral reefs, mangroves, seagrass beds, estuaries, lagoons and other coastal wetlands, small islands, beaches and coastal dunes, rocky shores, and the offshore pelagic and deep sea ocean. Globally, coral reefs tend to attract most attention, but all ecosystems in an MCPA must be managed, including the less appealing ones such as muddy bays!

MANAGING BIODIVERSITY

Protection and management of individual biological elements (e.g. threatened species, sensitive habitats, and target fishery species) has not been very successful in ensuring biodiversity conservation and maintaining productivity. Although small changes in the species that make up an ecosystem may only slightly alter how well it functions and the services it provides, some species – called keystone species – play unique roles, and their loss can have catastrophic repercussions. As more species are lost, there is greater risk of an ecosystem's functions and services being damaged or lost. Ecosystems, even more so in the oceans than on land, are linked through a complex web of direct and indirect interactions, including nutrient exchange, migration, and predator-prey interactions. Disruption of any of these processes in one ecosystem can have a negative impact on others.

The 'ecosystem approach' can help to address this. Defined as 'the integrated management of land, water and living resources to promote conservation and sustainable use of biodiversity in an equitable way', it is endorsed by many international agreements including the Convention on Biological Diversity and the FAO Code of Conduct for Responsible Fisheries. It recognises that humans are an integral part of biodiversity and that without effective management of ecosystems, sustainable development will not be possible.

Ecosystem-based management of fisheries recognises the interdependence of species and their habitats, the importance of healthy ecosystems for healthy fisheries, and the impact of fishing not only on target species but also on the habitats on which they depend. It thus recognises the need to halt damaging fishing methods and overfishing of predators and keystone species in order to prevent habitat damage and alterations to community structure.

PRIORITISATION OF HABITATS AND ECOSYSTEMS

By focusing strategically on key habitats and ecosystems, MCPA management can improve the effectiveness and relevance of conservation measures. The Convention on Biological Diversity (CBD) during the ninth Conference of Parties (COP 9) in 2008, made recommendations under Decision IX/20: Marine and Coastal Biodiversity, endorsing the application of scientific criteria and guidance to identify ecologically or biologically significant and/or vulnerable marine areas in need of protection. These give guidelines on how to categorise marine areas with respect to a range of criteria, namely: Uniqueness or rarity; Special importance for life history stages of species; Importance for threatened, endangered or declining species and/or habitats; Vulnerability, fragility, sensitivity, or slow recovery; Biological productivity; Biological diversity; and Naturalness. The same CBD decision also calls for the use of networks of marine protected areas, which present organised collections of individual sites, designed to link individual areas, and to comprehensively represent the region's spectrum of marine life characteristics. International commitments to marine protected area networks recognise that they fulfil ecological and social aims that a single marine protected area alone cannot.

The World Commission on Protected Areas - Marine, the world's premier network of MCPA expertise, seeks to support nations in putting in place effective and lasting MCPA networks in order to meet national and global commitments on biodiversity conservation as well as sustainable development and use of marine and coastal resources.

Given the commitment of many South Asian countries to the CBD, MCPA managers may increasingly be asked to apply and use such criteria in their work. The CBD COP 9 website provides more information, including prioritisation and protected area network guidelines and criteria (see Sources of further information).

KEY POINTS FOR THE MCPA

- **Carry out baseline assessments of all the main species and ecosystems of an MCPA and ensure that the basic principles for their management are understood.**
- **Choose indicators for monitoring programmes that represent the broader concepts of biodiversity and ecosystem health (see sheet G1).**
- **Work towards managing the MCPA from an Ecosystems Based Approach. Identify linked habitats or ecosystems (e.g. a coral reef ecosystem next to a mangrove/lagoon system) and involve communities and managers of adjacent ecosystems in the management of the MCPA.**
- **Understand national level commitments under the CBD, and seek national and regional level support to implement decisions regarding habitat and ecosystem prioritisation and the development of protected area networks using established guidelines and criteria.**
- **Promote the concepts of biodiversity health and ecosystem integrity using simple, clear language and minimal jargon.**
- **Understand the ecological linkages with other MCPAs, including in adjacent countries, and encourage the management of MCPAs as a 'system'.**

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The Convention on Biodiversity (CBD) - www.cbd.int/

The CBD COP 9 website with prioritisation guidelines – www.cbd.int/decisions/cop9/?m=COP-09&id=11663&lg=0.

OSPAR Criteria for the Identification of Species and Habitats in need of Protection and their Method of Application - www.ospar.org/documents/dbase/decrecs/agreements/03-13e_Texel_Faial%20criteria.doc

The World Summit on Sustainable Development - www.un.org/events/wssd/

World Commission on Protected Areas - www.iucn.org/themes/wcpa/biome/marine/marineprogramme.html

Coral Reef Rehabilitation H6

Coral reef rehabilitation can be an expensive and labour-intensive activity, but can in some cases be feasible for MCPAs if planned and designed properly. This sheet provides general guidance on when it is appropriate, and explains suitable methods.

Many rehabilitation techniques have been proposed to repair coral reefs damaged by various natural and anthropogenic stresses, including: constructing artificial reefs, e.g. using designed modules made of cement; 'electric' reefs constructed of metal and including an electric power source; consolidation of reef areas using e.g. cement or other binding materials; and transplantation using living corals from other areas.

Coral reef rehabilitation can be used to aid recovery of damaged reefs by enhancing natural processes. It is however a controversial issue globally for three main reasons. Firstly, depending on the method used it can be very expensive. Secondly, the activity may cause damage if large amount of coral colonies or fragments for transplantation are taken from healthy reefs, and finally, it has not yet proved effective on a large scale.

Some success has been noted on smaller scales. In the Gulf of Mannar, India, an area of over 1 sq km area has been rehabilitated using a combination of coral transplantation and reef modules with more than 85% survival rate observed among transplants, and enhanced natural recruitment. However, it should be noted that artificial reefs cannot replace natural reefs and do not function as effectively as a living coral reef. Coral reefs can usually repair themselves relatively quickly if environmental conditions are suitable, and chronic disturbances are removed or reduced. Investments in coral reef conservation and preservation should therefore focus on removing the causes of coral reef decline and facilitating natural and long-term recovery.

Before applying reef rehabilitation methods, a number of issues need to be considered (adapted from the International Coral Reef Initiative Resolution on Artificial Coral Reef Restoration and Rehabilitation, www.icriforum.org):

- Have the causative stresses that led to reef damage been addressed/removed?
- What are the chances for natural recovery of the reef? For example: are there available natural sources of coral larvae; are there stable habitats for settlement; and are environmental conditions favourable for reef growth?
- What is preventing natural recolonisation or recovery, e.g. high mortality due to local stress?
- What is the area of damaged reef that is targeted for rehabilitation? Is rehabilitation feasible?
- What is the cost of rehabilitation to achieve a viable, functioning reef? Would this be more cost-efficient than other management approaches?
- What is the likelihood of success, e.g. survival to normal growth and reproduction of transplanted colonies?

A brief study should precede attempts to rehabilitate by replanting or other methods. The study should assess whether certain species of corals have survived or have recruited showing good growth. If certain species are already showing signs of recolonisation, rehabilitation by introducing species from other sites may be unnecessary. If rehabilitation does indeed seem like a useful and realistic option, a number of further considerations can increase the potential for success.

SELECTION OF SITES

Only sites where rehabilitation is needed, and is a better option than other approaches, should be chosen. If coral transplantation is to be used the site should be near to donor sites, and sedimentation levels should be within the acceptable limits. The area should have minimal disturbance particularly from fishing activity. When selecting sites for rehabilitation, the importance of the site (e.g. high tourism importance) and purpose of rehabilitation (e.g. repairing reefs damaged due to ship grounding), should be considered.

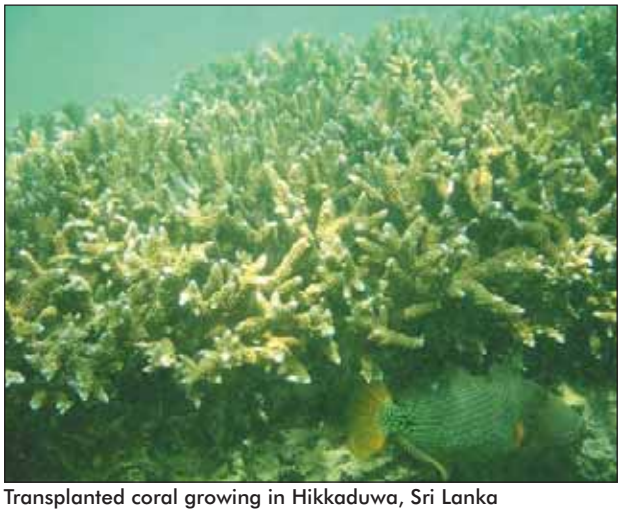
SELECTION OF METHODS

The rehabilitation method needs to be carefully chosen depending on the damage that is to be repaired and the desired end result. For example, areas damaged from dynamite fishing might be better rehabilitated through substrate stabilisation than transplantation. A combination of the two might be suitable to create a reef for tourism purposes.

On a degraded reef, the availability of suitable substrate for larval settlement can rapidly decrease due to algal or soft coral overgrowth, and sedimentation. Minimising land based sources of nutrient enrichment and maintaining algae-eating fish populations will help to reduce algae. Techniques for actively increasing suitable substrate, if essential, include:

Artificial surfaces for larval settlement – These include concrete blocks, wrecks or other purpose-designed structures. Such artificial reefs may have an additional benefit for fisheries management (see sheet J7) but the cost may be prohibitive for large areas.

Encouraging natural surfaces – This can be done by reducing disturbances on the dead reefs, stabilising or removing loose substrate material (such as coral fragments) and removing algae and other organisms that might inhibit larval settlement or damage young recruits.



N. Perera

Transplanted coral growing in Hikkaduwa, Sri Lanka

TRANSPLANTING CORALS

Coral fragments can be removed from a healthy reef and transplanted to natural substrate on a damaged reef, or to artificial substrates such as concrete blocks (provided these are secured to the seabed). Transplantation should in general be undertaken only if recovery through natural recruitment is unlikely or if there are no remaining corals that can repopulate the area.

Many species survive transplantation provided environmental factors are favourable; however certain species are more amenable than others to transplantation and significant loss of transplants can be expected in higher energy areas regardless of the attachment method used. The source of corals for transplantation must also be chosen with care and obtained with high precision, to avoid damage, and consideration should be given to the use of fragments or whole colonies as this can influence survival. Experiences have shown that transplantation is of greatest value in shallow, accessible sites that are important for eco tourism. It should be recognised that corals taken from sites that do not have the same environmental conditions as the transplantation site may not survive well. This was seen in the case of the HIkkaduwa National Park in Sri Lanka. After the 1998 bleaching event, coral transplants were brought from reefs located 15km from a site that had suffered bleaching. Modest growth was observed in these corals after their initial settlement, but a few years later they appeared stunted compared to corals growing in the donor site. It is important to note that transplants are subject to the same stresses as any other corals, so stress reduction is key.

FARMING CORALS

Attempts have been made to farm corals, mainly in South East Asia. Coral fragments are transplanted to a protected site and 'grown out' to a certain size before being used for rehabilitation and for creating new fragments. The source of fragments must be chosen with care, to avoid damage to other reefs. Coral farms potentially have an additional benefit as an attraction for snorkellers. Such concepts have not yet been tested widely across South Asia.

KEY POINTS FOR THE MCPA

Rehabilitation should not be considered as large scale solution in the damaged areas, but it can in some cases be a supporting tool to enhance the natural recovery process. Managers must evaluate the potential success rates, cost-effectiveness and long-term viability of the appropriate method, and:

- **Identify the objectives of rehabilitation (e.g. biodiversity conservation, tourism, fishing, protection from coastal erosion).**
- **Determine whether the factors causing reef damage have been arrested prior to pursuing a rehabilitation programme.**
- **Determine the scale i.e. whether the area needing rehabilitation is small (e.g. anchor or boat grounding damage, dynamite crater), or large.**
- **Determine the technical, logistical and personnel costs in relation to available funding.**
- **Identify whether technical expertise and sufficient labour is readily available.**
- **Decide whether it is the most appropriate and effective means to meet the objectives.**
- **Conduct an assessment to determine the most suitable species for rehabilitation in view of the existing conditions at the site.**
- **Conduct an assessment to determine the impacts on the donor sites.**
- **Encourage active participation of those whose livelihoods depend on the reef.**
- **Develop strategic partnerships with local scientific institutions and agencies to enhance capacity and advance rehabilitation programmes.**

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CASE STUDY

Reef Rehabilitation Initiatives in the Gulf of Mannar, India

The Gulf of Mannar (GoM), India, was declared a Marine National Park in 1986 and a Marine Biosphere Reserve in 1989. Despite this the reef ecosystem is presently highly disturbed by human impacts such as destructive fishing practices, mining, and pollution etc.

To facilitate the recovery and natural colonisation process in degraded areas, a reef rehabilitation study was conducted in four sites around the Tuticorin coast of the GoM (outside the park area). The study, the first of its kind in the country, investigated the survival rates of transplanted corals, looking at the responses of different native species and growth forms, while also raising the awareness of coral reef dependant communities in the area through participatory monitoring and transplantation.

Branching and massive coral fragments of over 8cm were collected from a site with high coral cover (taking <2-3% of any source colony) and carefully transported to the rehabilitation sites. The coral fragments were then attached to artificial substrates (concrete frames and low cost 'fish houses' made from cement and limestone) with nylon rope. The fragments were monitored every month to study survivorship, growth, and associated flora and fauna.

Results obtained between 2002 and 2006 indicate 85-90% annual survival of coral fragments and good growth rates in several coral species (e.g. 12.1cm per year in *Acropora intermedia*). Approximately 1 sq km area of degraded reef on the Tuticorin coast has been successfully rehabilitated with a variety of coral species using an estimated 500 concerete frames, 1,000 'fish houses' and 7,500 concrete slabs to provide sufficient artificial substrate. Observations indicate an increase in fin fishes (9.5%) and molluscs (11.5%), as well as modest increases in crustaceans and echinoderms (3.2%) at the transplantation sites when compared with control sites, with a total biomass increase of 30%.

Source:

Patterson Edward, J.K., Patterson, J. Mathews, G., & Wilhelmsson, D. 2005. Awareness raising and feasibility of reef restoration through coral transplantation in Tuticorin, Gulf of Mannar, India. CORDIO Status Report, 2005, 243-251

Coral bleaching H7

Coral bleaching is a particularly difficult issue for an MCPA manager as its cause cannot be 'controlled'. This sheet summarises recent information on bleaching and outlines the various ways that an MCPA may be able to assist in mitigation, promotion of the best conditions for recovery, and protection of reefs that are resilient to bleaching.

Coral bleaching is the whitening or paling of coral tissues due to the loss of microscopic symbiotic algae (zooxanthellae) and/or reduction of their photosynthetic pigment concentrations. The zooxanthellae live in the tissues of the host coral and provide it with most of its colour and energy. Bleaching occurs as a result of various harsh environmental conditions including high sea temperatures, abnormal salinity, and bacteriological or viral infection. In most reported incidences, high sea temperature (1-2^{0}C above normal maximum) appears to be the main stress. Low wind speed may also be important, as this apparently favours localised heating and a greater penetration of solar (UV) radiation. Prolonged bleaching conditions (for over c. 10 weeks) eventually kill coral polyps and ultimately the colony, but in many cases colonies recover after a certain time.

Research and monitoring data reveal changes in sea surface temperatures (SST) as the primary cause of recent coral bleaching. High SST associated with El Niño and probably climate change have already caused extensive coral bleaching and coral death, particularly in 1998, when the most geographically extensive bleaching event ever recorded took place. The Indian Ocean was the worst affected region, with a SST increase of over 5^{0}C for over a month in some places of South Asia. By April 1998, many reefs had experienced some mortality, and this worsened in May before the onset of the Southwest Monsoon resulted in a drop in SST. Shallow reefs (less than 10m depth) in Lakshadweep, Maldives, and Sri Lanka were the worst affected with nearly 100% mortality in some places (e.g. Bar Reef Marine Sanctuary, Sri Lanka).

Recovery has been variable with some reefs having nearly 100% live hard coral cover while others have shown very little coral recruitment or growth. Another major impact of bleaching is its socioeconomic impact. Populations of many fish species may be reduced, while dead reefs with little fish life would be less attractive for tourists. South Asian reefs provide livelihoods for many coastal communities through fisheries and tourism (see sheet B5), and coral bleaching could have serious long term implications on the income of such communities.

The Intergovernmental Panel on Climate Change (IPCC) has predicted an increase of 1-2^{0}C in SST over the next 100 years and coral bleaching may become a more regular event. This could pose serious demands on MCPA managers trying maintain the ecological integrity of coral reefs, and rapid response mechanisms for observing, understanding and mitigating long term impacts of coral bleaching will become a major responsibility of MCPA staff.

RESISTANCE AND RESILIENCE

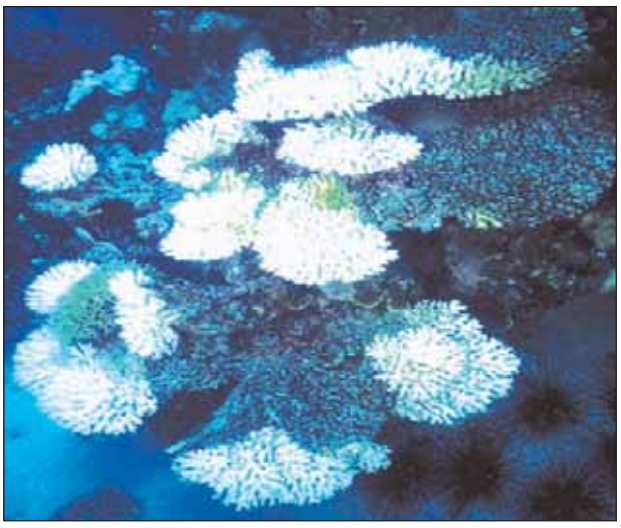
Even with mass bleaching and severe mortality there is never a total loss of all reef-building corals, and scattered colonies, localised communities or whole reef sections will survive. Some reefs can return to their previous state of diversity and abundance more quickly than others through growth and reproduction of surviving colonies and recruitment of new corals.

Some corals seem to be more resistant (i.e. colonies do not bleach or do not die if they bleach) to bleaching than others. Certain coral species showed very little bleaching even on severely affected reefs during the 1998 bleaching event. In addition, hydrodynamic and environmental factors also affect the level of bleaching. Corals may be more resistant to bleaching if they are near, or affected by: cooler oceanic water and upwellings, strong currents, winds and high wave energy; or are in shallow waters cooled through exposure to air at night. Corals with less exposure to UV light such as those in deeper waters or in turbid areas also tend to suffer less bleaching, and this is the same with corals in narrow channels in the reef or those angled away from the sun. In addition, cyclone conditions with high cloud cover and mixing of shallow with deep water reduces SST and helps mitigate bleaching as was the case with the Southwest Monsoon in the Indian Ocean in 1998.

Speed of recovery of a reef from bleaching or its resilience is affected by a number of factors. Connectivity with other reefs through currents; abundance of coral recruits; abundance of species that eat algae and create free substrate for coral larval settlement; level of anthropogenic stress and physical disturbance, sedimentation, pollution, and prevalence of bioeroders, corallivores and disease. Generally, reefs that are being stressed by other factors tend to show poor recovery. Relatively undisturbed reefs in the Lakshadweep Islands, India and Maldives have shown significant recovery from coral bleaching. In Sri Lanka, offshore reefs in the Bar Reef Marine Sanctuary have recovered much faster than fringing reefs along the south coast that are heavily affected by sedimentation and human impacts.

MONITORING AND MITIGATION

Even though there is no 'cure' for bleaching, MCPAs can play an important role in mitigation and aiding recovery, helping to maintain sources of coral larvae that can repopulate damaged areas and using zoning schemes to ensure full protection for resilient corals and reefs that consistently resist bleaching or recover quickly. Determining the start of a bleaching event is important but not always easy. Many



M. Richmond

Bleached Acropora corals off Zanzibar, Tanzania, during the El Niño event, May 1998

corals may show signs of stress including 'paling' but may not bleach. In some areas, seasonal variations in temperature and paling that does not result in bleaching is a common occurrence. Different categories of 'paling' tend to be subjective, but methods are being developed using standard colour charts (e.g. CoralWatch chart – see Sources of further information) or photographic/computer analysis techniques. Always seek expert advice if it looks as if bleaching may be starting. In addition to regular monitoring, MCPA managers should attempt to develop partnerships with research institutions (see chapters on research and monitoring G3, G5, G11) that may undertake detailed research and monitoring and also provide useful information on the possibility of a future bleaching event based on global SST observations. Efficient sharing of information is the most effective way to identify a bleaching event and obtain expert advice. In addition, monitoring of recovery will provide valuable information for incorporating reef resilience into MCPA management.

KEY POINTS FOR THE MCPA

- **Consider developing a bleaching response programme (as has been done by the Great Barrier Reef Marine Park) that includes identifying resistant and resilient reefs through research and monitoring, revising zoning schemes and boundaries to ensure such reefs are fully protected, checking regularly for bleaching as part of monitoring, and monitoring recovery and recruitment after an event.**
- **In South Asia, it may be useful to develop linkages with community groups such as ornamental fish collectors and scuba diving operators who are often able to inform managers of the first signs of bleaching especially in areas that may not be monitored regularly.**
- **Install temperature monitors (see sheet G5) and monitor SST web sites that give 'early warning' alerts for bleaching (see sources) – if the MCPA falls into one of these areas, increase monitoring activities in order to record the start date of any bleaching event.**
- **Inform MCPA users and stakeholders about bleaching so that they can understand why management interventions may have to change.**
- **Take all necessary steps to reduce stresses on reefs from human-induced sources (e.g. poor/destructive fishing techniques, pollution, siltation) and encourage conditions that will help corals to resist bleaching and recover quickly (e.g. protecting resistant corals). Build links with regulatory bodies in charge of controlling activities such as fishing and other types of reef usage, and develop regulatory actions in coordination with those organisations.**
- **In some cases, reef rehabilitation may be useful (see sheet H6) but seek expert advice first. Most reefs tend to recover naturally if other stresses are minimised.**

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CASE STUDY

Rapid Response to a Bleaching Event in Sri Lanka, 1998

Reefs throughout South Asia were seriously affected by coral bleaching associated with increased SST in 1998. The worst affected reefs were those in shallow water less than 10m in depth. A majority of coral reefs in Sri Lanka are either fringing or patch reefs within this depth range, and as such are particularly susceptible to bleaching. Global satellite observations indicated an increase in SST in the Indian Ocean around April 1998. Data loggers installed by the Sri Lankan National Aquatic Resources Research and Development Agency (NARA) confirmed a gradual increase in water temperature within the shallow fringing reef at Hikkaduwa Marine Sanctuary, reaching a high of around 35^{0}C in May 1998.

First signs of bleaching were observed by park rangers and scientists from NARA. Following this, temperature and reef monitoring was regularly carried out by NARA and park rangers, and several permanent monitoring sites were established using Global Coral Reef Monitoring Network (GCRMN) methods. Monitoring showed that branching and tabulate *Acropora* corals that dominated the reef were the most affected while *Montipora aequituberculata* and *Porites rus* species were unaffected. Overall, live coral cover decreased by over 80% due to bleaching induced mortality. A rapid reduction in SST was observed with the onset of the Southwest Monsoon which resulted in rough sea conditions and increased turbidity.

Long term monitoring has shown some recovery although recruitment of branching corals has been poor, probably due to increased sedimentation and pollution, both of which are known to reduce *Acropora* recruitment and survival. In fact attempts to transplant branching *Acropora* from elsewhere has had very limited success with corals showing poor growth rates. In addition to being resilient to bleaching *Montipora* is more tolerant of sedimentation and is now the dominant coral type in the reef. There has also been significant recruitment of *Pocillopora damicornis*. This shows that while natural recovery is taking place, factors other than bleaching and a change in the physical conditions are inhibiting complete recovery and have also led to significant phase shifts in coral communities.

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CORDIO Coastal Oceans Research and Development in the Indian Ocean - www.cordio.org

CoralWatch charts information available from www.CoralWatch.org

Great Barrier Reef Marine Park Authority Coral Bleaching Response Program - www.gbrmpa.gov.au/corp_site/info_services/science/bleaching/response_program.htm

Crown of thorns starfish H8

Crown of Thorns starfish (COTs) are predators of Indo-Pacific corals, and population outbreaks can devastate entire reefs. Outbreaks have historically not been well recorded in South Asia, and MCPA managers should be aware of their impact, so that appropriate action can be taken if needed. They should also be able to explain the significance of COTs to visitors who often notice these large animals when diving and snorkelling.

Adult Crown of Thorns (*Acanthaster planci*), feed exclusively on live corals. They are often seen as a few large individuals, sometimes reaching 60cm diameter in size, in relatively shallow reef areas. COTs prefer branching and tabulate species of *Acropora*, and foliose corals of *Montipora* and *Echinopora*. In the absence of the above they will feed on almost all other coral species. However, observations from South Asia indicate that they will avoid feeding on *Diploastrea heliopora*, *Symphyllia* spp, *Lobophyllia* spp and *Porites* spp if other species are available.

COTs leave clean, white areas of coral skeleton after feeding, which rapidly become overgrown by algae. The 'scars' differ from those of bleached or diseased corals in that there is no damaged tissue around them. Population outbreaks or 'plagues' of COTs can devastate whole reefs with up to 90% mortality of corals. Outbreaks have caused, and continue to cause, big problems on Australia's Great Barrier Reef (GBR), resulting in major reductions in coral cover. Other areas where outbreaks are common are the Red Sea, Japan, Palau, Fiji and Indonesia.

Although the impact of COTs in South Asia has not been widely reported historically due to the lack of monitoring programmes, COT plagues have been recorded in the 1970s in the Gulf of Mannar reefs found in Sri Lankan waters, as well as the eastern coastal areas of Trincomalee and Batticaloa in Sri Lanka (see case study), and reef damage was also seen in Maldives. More recently, small outbreaks have been noted in 1994 in Sri Lanka, 1998 in the Lakshadweep Islands (India), and 1999 in Maldives and the Andamans (India). The occurrence of COTs has not been observed in the Gulf of Kachch Islands of India to date.

Despite more than 30 years of research on the GBR the cause of COT outbreaks is still not clear. Three main theories receive scientific support:

- Fluctuations in COT populations are a natural phenomenon;
- Removal of natural predators has allowed populations to expand; known predators on the GBR are the giant triton Charonia tritonis, certain species of pufferfish and triggerfish and the Napoleon wrasse *Cheilinus undulatus*;
- Human use of the coastal zone has increased nutrient flow to the sea, causing an increase in planktonic food for COT larvae.

Note that most of the research carried out on COTs has been on the GBR, and that very little is known about this species' life cycle and population dynamics in South Asia. Even on the GBR, there are major gaps in knowledge and understanding; for example, despite the large numbers that may appear during an outbreak, it is not known what causes the relatively fast decline in numbers, or where they go at the 'end' of an outbreak, though it is thought that such declines are experienced after COTs destroy their own food supply. It has been proposed that COTs go into hibernation, given their ability to go without food for long periods. The disappearance of COTs was noticed soon after the bleaching event that affected the Bar Reef Marine Sanctuary in Sri Lanka, when almost all the corals were killed in a very large area. The shallow areas of the reef subsequently recovered considerably, and in some areas the coral cover is now near 100%, but COTs are not as prevalent as they were before the bleaching event.

MONITORING COTS

COTs should be included in any regular reef monitoring programme (50m belt transects is the standard method used in South Asia). If numbers are seen to increase, more detailed monitoring of fixed 10 x 10m plots can be carried out to look at coral colony mortality rates and recovery; monitoring of individual COTs is also possible.

On the GBR, the following system is used for defining outbreaks:

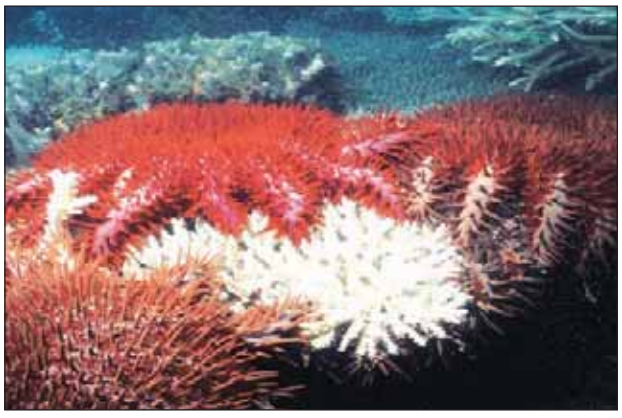
- Incipient outbreak – Meaning the density at which coral damage is likely. Occurs when there are 0.22 adults per 2-minute manta tow; or >30 adult and sub adults per hectare, where sub adults are 15-25cm diameter (2 years old) and adults are >26cm (>3 years old), using scuba diving counts. (N.B. starfish may be mature at 2 years or c. 20cm diameter, but for the definition of an outbreak >26cm is used).
- Active outbreak – COT densities are >1.0 adults per 2-minute manta tow, and adults are >15cm diameter; or >30 adult only starfish per ha if scuba diving.

RESPONSE TO AN OUTBREAK

Control of COTs is difficult, but there are two commonly used techniques for cleaning up infestations:

Physical removal – The easiest and cheapest for shallow water outbreaks; with COTs buried ashore. This method has been used in Indonesia successfully (see *Best Practices Guide*) and in India and Sri Lanka (see case study).

Killing individuals by injecting poison – A large mechanical syringe (cf the type used on cattle or sheep) is used and scuba diving skills are required. Sodium bisulphate (or dry acid, the swimming pool chemical) is considered to be the most effective, is relatively inexpensive and is harmless to other organisms when properly handled. Other poisons are copper sulphate, formalin, liquid ammonia, and hydrochloric acid.



M. Richmond

Adult COTs in localised outbreak

Note that cutting COTs under water does not kill them and may risk their numbers increasing. Unlike many other starfish species, COTs cannot regenerate from a part of a single arm, but can if cut into half. Cleaning up an infestation can be expensive and time-consuming, even if the simplest methods are used, so careful consideration is needed before embarking on this.

Cleanups are probably only worthwhile on reefs that are of particular importance e.g. for tourism or fishing, and experience suggests that they should be carried out only in the following situations:

- Reef damage from COTs or human activities is not already too extensive;
- The area involved is small enough to monitor: 5ha is manageable, 200ha is probably too large;
- The COTs population is small enough to control and the clean-up response is quick;
- Monitoring can be maintained after the clean-up.

Recently, scientists from Japan have identified a feeding attractant for this starfish derived from the viscera of the sea urchin (*Toxopneustes pileolus*). Arrachidonic acid and alpha-linolenic acid (both unsaturated fatty acids) are found to have biological activity and it is anticipated that these attractants could be used to control *A. planci* (Teruya *et al.* 2001).

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KEY POINTS FOR THE MCPA

- **Make sure that COTs are included in any reef monitoring programme and ask people to report their presence; if the scars are spotted, look nearby for starfish either on or under the corals.**
- **If an outbreak appears to be starting, obtain expert advice and gather the data to help you decide if a control method should be used.**
- **Handle live COTs with extreme care as the spines are poisonous, and can easily penetrate the skin, and break off causing considerable pain and sometimes infection; if this occurs, soak the affected area in hot water immediately.**
- **Make sure that some MCPA personnel can respond to visitors' enquiries about COTs; outbreaks in Australia received much publicity and tourists have often heard of this species and want to know if it is a problem in the MCPA they are visiting.**

CASE STUDY

COTs Outbreaks in India and Sri Lanka

An outbreak of COTs was first noticed in the Mahatma Gandhi Marine National Park, Wandoor, Andaman Islands during 1991. In February 1999, 15 individual COTs were observed on a fringing reef 300 sq m in size in the Rani Jhansi Marine National Park, Andaman Islands. The site was demarcated using a GPS, and the Line Intercept Transect (LIT) method was used to survey the abundance and distribution of COTs, determine the extent of the infestation and the course of action required. Data on the number, size, depth, associated substrate and association of single or groups of COTs found in a belt 2.5m on either side of the transect tapes were recorded by divers from the Zoological Survey of India (ZSI).

The surveyors recorded 60% live coral cover at the site, 40% of which were *Acropora muricata*, a branching coral (as preferred by COTs), which were heavily infested. Massive corals at the site such as *Porites*, *Favia* and *Diploastrea* sp had not been affected. In order to mitigate the damage caused by the COTs, ZSI researchers determined that it was necessary to remove the starfish from the reef. The COTs found during subsequent surveys were dislodged from *Acropora muricata* colonies with metal spikes and taken ashore by boat to be buried. The area was monitored for two days following this action to locate and remove any further COTs observed.

A COT plague occurred in the Gulf of Mannar reefs of Sri Lanka and in the east coast of the country near Trincomalee and Batticaloa in the early 1970s, resulting in massive reef damage. A large scale COT cleanup operation was conducted by the Department of Fisheries, which hired ornamental fish collectors and spiny lobster divers to carry out the clean up. COT removal camps were set up along both coasts in the affected areas and COTs were removed using metal spikes, loaded onto boats and taken ashore for burial. Thousands of COTs were removed systematically from extensive reef areas and the positive results of this operation were seen many years later when reefs recovered from this outbreak. Some reefs, such those of Pigeon Island National Park in Trincomalee, recovered only in the mid 1990s, as the 1970s COT plague resulted in the entire coral area being reduced to rubble. COTs are still present on reefs in Sri Lanka, mainly in the Gulf of Mannar and east coast reefs. However, COT plagues of the proportions described above have not been observed since the 1970s.

For more information on India contact Zoological Survey of India (ZSI) http://envfor.nic.in/zsi/

Mangrove restoration H9

Where areas of mangrove forest have been damaged (by natural or human causes) there may be opportunity for active restoration in which the MCPA can take a leading role. Mangrove restoration is generally inexpensive, has a high degree of success, and is being undertaken in many parts of South Asia. It is, however, labour intensive and requires a certain level of skill, at least for some species. This sheet provides general guidelines and sources of information on this topic.

Most mangroves in South Asia are under some form of pressure, and many mangrove areas in this region have been seriously damaged due to aquaculture developments, especially shrimp farming. Even so, mangrove forests are being successfully managed in some places, and there are sites that can still be considered pristine. Many of the MCPAs in South and South East Asia contain mangroves which are either totally protected or under some form of regulated exploitation, usually for subsistence use only. However, in many areas, protection alone is insufficient to reverse the trends in mangrove forest destruction. Even when disturbance is reduced, the altered soil conditions and limited natural dispersal mean that natural recovery can be very slow. Mangrove restoration aims to return an area to a condition more closely resembling its natural state, including restoring the full range of biological diversity and all the essential ecological processes.

Most mangrove species produce propagules that are relatively easy to collect and plant and, in the right conditions, growth is fast. Propagules may be planted directly which is generally adequate (particularly for *Rhizophora* spp.), although seedlings and saplings can be grown to a height of 0.3-1.2m beforehand. Partly because of the ease with which they can be replanted, there have been many attempts at mangrove restoration, undertaken often as forestry management initiatives though also for conservation of the ecosystem. Other advantages of planting nursery raised seedlings/saplings is that:

1. The death rate of germinating seeds can be reduced;
2. It provides employment to the local communities.

Community participation is essential in the management of mangrove ecosystems and providing livelihood options is equally important as mangroves do not provide usufruct values on the scale of some inland forests.

Replanting mangroves as a forest is a useful first step but to restore the full biodiversity values, the following need consideration:

- Determining what the 'natural' forest resembled originally. This requires deciding what the restored ecosystem should be like, including the abundance and distribution of other plants and animals in the community. Literature on the area before deforestation (if available) and studies from nearby intact systems will assist, and it is important to find out how the mangrove was destroyed, for example whether it is due to geomorphological and hydrological problems or due to social issues like over harvesting for domestic needs and over grazing;
- Deciding on the techniques to use which will depend on: whether the soils needs treatment (e.g. to reduce acidity) or physical reworking to attain suitable grain size; the species to be used; and the seasonal timing, seedling preparation, field support and developmental stage of the propagules. It is particularly important to determine the correct tidal height needed for each species;
- Monsoon season plays an important role in the better survival of the planted seedlings if the seedlings are planted after a thorough flushing of the area to be restored during the monsoon period;
- Developing a monitoring programme to measure the 'success' of restoration. Ideally, the restored forest should be compared to forests that have been left to regenerate without intervention. A treatment map of the area to be restored area would help in monitoring the restoration process.

Some of the earlier experiences of mangrove restoration in South Asia have been in Bangladesh and Goa, India in the mid 1980s, as well as in Andhra Pradesh and in Tamil Nadu, India during the late 1980s to mid 1990s. Since then many national institutions and NGOs have been involved in the restoration and conservation of mangroves in South Asia with the support of national and international agencies.

Restoration involves both canal construction methods and planting of propagules and nursery raised seedlings/saplings in the degraded areas and accreted zones. Restoration should only be carried out in areas where similar habitats have been degraded. The establishment of mangroves in other places, such as sandy beaches, that did not previously support mangroves, is not recommended and may undermine the successful functions already provided, e.g. a reduction in coastal protection currently provided by sand dunes.

J. Tamelander

Mangrove nursery in the Indus Delta, Pakistan

KEY POINTS FOR THE MCPA

- Endeavour to restore any degraded mangrove ecosystem within the MCPA boundaries.
- Ensure that the initial causes of mangrove degradation have been arrested. Consult appropriate organisations for support to find alternative means of livelihood for communities that may be affected by resource management measures.
- Consider establishing a mangrove nursery, if replanting activities are required in the MCPA.
- Before starting seek advice from experts and discuss the ideas with the Forest Department or government agency responsible for mangrove management and other stakeholders.
- Establish whether active restoration needs to be carried out or whether natural recovery could be supported.
- Identify people willing to help, such as local communities, school children and teachers (mangrove restoration is a good environmental education activity), or other volunteers.
- Develop participatory mangrove management guidelines involving the stakeholders.
- Establish a monitoring programme to follow the success of the replanting.
- Do not consider introducing mangrove and other species that are not indigenous to the area.
- Identify areas outside the MCPA that have mangroves and identify whether these habitats may be linked.
- If the expansion of shrimp farms is an issue, then seek legal advice and support from relevant government organisations.

Sources of further information

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CASE STUDY

Mangrove Restoration in Anhdhra Pradesh, India

The Godavari and Krishna mangroves of Andhra Pradesh have been degraded over a period spanning the late 1980s to the early 2000s due to natural causes (e.g. erosion) as well as human induced factors (e.g. clearance for aquaculture development). In response to this, a participatory community mangrove restoration programme was carried out in these areas by the M. S. Swaminathan Research Foundation (MSSRF) jointly with the Andhra Pradesh Forest Department and other NGOs. Target areas for restoration were identified using remote sensing imagery.

The proximate causes of degradation were largely hydrological factors and sedimentation along the canals which resulted in topographic changes. Taking this into account, fish bone type trapezoidal canals were dug to facilitate the in and out flow of tidal water. An area of 520ha of degraded mangrove was restored using the canal method in the Godavari and Krishna mangroves of Andhra Pradesh.

The resident villages have traditional fishing rights in the mangroves. Mangrove seedlings for planting were grown in community nurseries which provided alternative livelihoods for the resident community. The community were also involved in the planting and monitoring of the mangrove plantations. Training on the technical aspects of mangrove restoration was provided to the community members to ensure total involvement of the community and to save time, energy and resources.

The restoration of mangroves was carried out in reserved forest areas to ensure better protection for restored areas. Mangrove restoration activities, in addition to increasing the extent of healthy mangrove areas, prevented further degradation of adjoining patches. Canals in the restored areas increased water-spread areas, which in turn supported an increase in fishery resources. The mangroves were slow growing, especially in the restored areas, and analyses of 2004 satellite data revealed that degraded areas had experienced an increase in vegetation cover. Changes in the moisture regime due to increased vegetation from restoration activities provided a conducive environment for the natural regeneration of a large number of mangrove saplings, and crab populations were also found to increase in the restored area.

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Red tides and harmful algal booms H10

Red tides are natural and seasonal phenomena but some cause damage and are referred to as Harmful Algal Blooms (HABs). An MCPA may never be directly affected by a red tide or HAB, but MCPA personnel should be aware of this phenomenon, as they may be called upon to provide expertise in the case of a HAB elsewhere in the country.

Red tides or algal blooms are mass occurrences of a plankton species resulting from nutrient enrichment from intense upwellings, land runoff or other sources. About 300 species of algae are known to cause blooms, including dinoflagellates, diatoms, haptophytes and cyanobacteria, and some silicoflagellates. Algal blooms often occur in or adjacent to areas of upwelling when prevailing winds blow surface water offshore, causing cold, deep, nutrient-rich waters to rise up, bringing large quantities of phytoplankton with them that rapidly multiply due to favourable light and nutrient conditions. Algal blooms are most likely in South Asia at the beginning of the south-west monsoon around April, and in November at the beginning of the north-east monsoon.

Blooms tend to look like streaks of reddish-brown to greenish-yellow floating debris, depending on the species involved, and may extend for several miles. The term 'Red Tide' is often used, because of dinoflagellate blooms, which can colour the water reddish-brown due to the carotenoid pigment in their cells.

IMPACT OF HABs

Many red tides are harmless but about one quarter of the known species that cause blooms produce toxins. HAB or 'harmful algal bloom' is a generic term for events that result in poisonings, although not all of these occur as 'blooms'. HABs can be divided into those that cause human poisoning and those that cause fish and other animal deaths. The toxins tend to accumulate up the food chain when the plankton are eaten, becoming more concentrated at higher taxonomic levels. In this way, toxicity can cause severe health hazards even at a low abundance of toxin producers (this is particularly the case with ciguatera), and even result in the meat of sharks and turtles becoming toxic.

The toxins are generally classified according to the symptoms they give rise to, some of which are among the strongest known. There are indications that the frequency and intensity of HABs are increasing, perhaps due to increased nutrient run-off from agriculture and sewage effluent, or even to climate change, although this apparent increase may be due to better documentation.

The primary vector for human poisoning is shellfish, particularly bivalves, which can accumulate toxins quickly as they are filter feeders. Human poisoning is caused by dinoflagellates (may cause Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP) and Neurotoxic Shellfish Poisoning (NSP)), diatoms (may cause Amnesic Shellfish Poisoning (ASP)), and cyanobacteria (*Trichodesmium thiebautii*) blooms have been associated with breathing problems. *Lyngbya majuscula*, a primarily benthic species can cause 'swimmers itch'. Ciguatera poisoning can occur without a red tide, because ciguatoxins are produced by dinoflagellates (such as *Gambierdiscus*, *Ostreopsis* and *Prorocentrum*) that are invariably present in the benthic substrate. Some benthic species of harmful algae that may cause ciguatera poisoning live on coral reefs.

HABs frequently result in large scale fish mortalities or shell fish poisoning which can adversely affect aquaculture, coastal tourism and fisheries. These can be caused by dinoflagellates (such as *Gymnodinium breve* and *G. mikimotoi*, which also cause NSP), cyanobacteria (such as *T. thiebautii*) and haptophytes (such as *Prymnesium parvum*, *Chrysochromulina polylepis* – producing a toxin that increases the permeability of fish gills, resulting in osmoregulatory stress and death). High density blooms of some diatoms, haptophytes and silicoflagellates (e.g. *Dictyocha speculum*), can clog fish gills causing suffocation.

Note that some marine organism mortalities and human poisonings have other causes. For example, humans can be poisoned by the bacterium *Vibrio* in oysters, and fish and crustacean kills in East Africa, which has often been associated with high dissolved oxygen concentrations in the water rather than red tides. If calm weather follows a bloom in a closed or semi-enclosed bay, the plankton may use up all the nutrients and 'die out', leaving behind a large decaying biomass. This can cause a 'black' tide due to production of toxic hydrogen sulphide by anaerobic bacteria, with associated mortalities of marine animals from oxygen depletion and because their gills become clogged with plankton; strandings of crustaceans may also occur.

RESPONDING TO A HAB

The local Fisheries Department is usually responsible for dealing with a HAB. Fishers may be told that they can no longer catch or sell certain species and the general public and visitors may want to know if it is safe to eat marine products.

If historical data are not available, and there is no long term sampling programme, it will not be possible to identify the cause of a bloom definitively. However, samples should be taken immediately if there are signs of human poisoning, mortality of marine animals

J. Church

Porcupine fish washed up dead after a red tide

or discolouration of the water. Samples should be kept cold and in the dark, and sent for analysis preferably within 24 hours. Freezing samples can destroy cells and make species identification more difficult, but may be necessary if the analysis cannot be done quickly. Samples should include:

- Water – several samples of at least one litre, from different locations and depths;
- Tissue from dead animals (as fresh as possible), e.g. gills and livers, and entire animals can be taken if not too large;
- Algal mats and seagrass leaves (kept in water), in the case of suspected ciguatera (e.g. if there are human poisonings but no visible bloom).

KEY POINTS FOR THE MCPA

If a red tide occurs in or near an MCPA, the MCPA personnel must be prepared to help the Fisheries Department and provide advice as needed. For example:

- **Seek immediate technical advice from national, regional and international experts.**
- **Consult with relevant organisations in the area, and send samples for analysis immediately.**
- **Alert visitors and local residents of the problem and request them to keep a watch for dead organisms on the beach and other signs.**
- **Recommend that marine products should not be harvested or consumed until samples have been analysed; where livelihoods of local communities are affected, consider ways in which the MCPA might be able to help.**
- **Check NOAA satellite photos for increased level of chlorophyll.**
- **Designate one person the task of managing media, emails and any queries.**
- **Maintain a HAB monitoring system among fishermen, dive operators etc., as these groups would be the first to notice such blooms (when visible, such as red tides) and dead fish or other organisms floating offshore, within or outside the MCPA.**

Sources of further information

UNESCO's Intergovernmental Oceanographic Commission HAB Programme is the main global initiative: www.ioc.unesco.org/hab. It gives information on training courses, a Taxonomic Reference List of Toxic Plankton Algae, a Bibliographic HAB database and shows how to obtain the email newsletter and the following publications:

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CASE STUDY

Red Tide at Kiunga Marine National Reserve, Kenya

In January 2002, a HAB occurred along the East African coast from Mogadishu in Somalia to Lamu in northern Kenya associated with the strong upwelling of the Somali current and an unusually strong NE wind (force 5-6) that may have blown it onshore. In the area of Kiunga National Marine Reserve, in northern Kenya, the bloom lasted for 10 days, with extensive fish mortality during the first three days and numerous fish and other marine animals, such as turtles, being washed up on the beaches or found floating on the ocean surface. Consumption of and trade in fish from the area was banned for two weeks and trade in shellfish for four weeks. There were no human fatalities but some cases of eye irritations and headaches. The economy however, was seriously affected as local communities are almost entirely dependent on fisheries. Furthermore, media interest deterred tourists from visiting.

Because of the impact of the red tide on biodiversity and local livelihoods, Kenya Wildlife Service, WWF (which supports the MPA) and the Fisheries Department contacted HAB specialists in Kenya and South Africa. On their advice, water and tissue samples were collected and sent on ice to Nairobi, where some were analysed and others sent on to South Africa. Both laboratories identified *Gymnodinium* as a major component of the bloom, and satellite imagery for the period confirmed an increased level of chlorophyll in the area. Nevertheless, the exact reasons for the bloom remain unclear. The MCPA, with support from WWF, also helped with publicity and answering the numerous queries from the local and international media.

Diseases in marine organisms H11

Diseases are increasingly being reported from a range of marine organisms. This sheet gives a brief introduction to the topic and advises the MCPA manager on how to identify the causes of disease and deal with suspected cases.

During the last two decades, coral reef communities worldwide have deteriorated due to the increased prevalence of disease. Diseases not only affect the corals, but also fish, coralline algae and sea urchins, often with wide-ranging consequences. Disease is defined as any impairment in an organism's vital functions, systems or organs. A pathogen is an agent that causes disease, and can be biotic (in the form of a virus, bacteria, fungi or protozoa, predation, overgrowth of algae) or abiotic (such as a toxic chemical, nutrient imbalance, above-normal water temperature, or ultraviolet radiation). Biotic and abiotic disease agents are often closely connected. For example, some cases of coral bleaching are caused by newly discovered species of bacteria when water temperatures are elevated. Diseases are also classified as infectious, spreading from one host to another like influenza, or non infectious, such as a genetic defect.

In addition to the loss of coral tissue, disease can cause significant changes in reproduction rates, growth rates, community structure, species diversity and abundance of reef-associated organisms. To recognise disease, it is important to look for signs of change that indicate abnormal structure or function (including metabolism, morphology and behaviour), morbidity, or death in organisms.

CORALS

Coral diseases were largely unknown until the 1970s, but today are a catastrophic problem for coral reefs worldwide. Increasingly frequent observations of coral diseases in the wild suggest a worrying decline in the integrity of the wider marine environment. Although the exact nature of this global environmental change remains unknown, many speculate that direct and indirect human impacts on reefs are responsible. However, the role of human influence is extremely unclear and presently remains one of the most important yet most poorly understood aspects of coral diseases.

The most prevalent coral diseases and syndromes currently known and under study include: black-band disease, dark-spots disease, red-band disease, white-band disease, white-plague disease, white pox and yellow-blotch disease. These diseases have affected vast tracts of coral reefs worldwide. For example:

- White-band disease (WBD) was first identified in 1977 on reefs surrounding St. Croix. It is now known to occur throughout the Caribbean with devastating effects. In fact, WBD is thought to be a major factor in the decline of elkhorn and staghorn corals in the wider Caribbean. Since the 1980s staghorn coral, *Acropora cervicornis*, has been virtually eliminated from reef environments throughout the region. In the U.S. Virgin Islands, populations of *Acropora palmata* declined from 85% cover to 5% within 10 years, primarily as a result of WBD. WBD is currently the only coral disease known to cause major changes in the composition and structure of reefs. WBD has also been found throughout the Red Sea and on 34 species of massive, plating and branching corals in nine Indo-Pacific countries, including the Philippines, Fiji, Australia and Indonesia.
- Black-band disease (BBD) was first discovered on the reefs of Belize and Florida in 1972, and has since been identified in 26 countries. BBD is often present on most reefs at low levels, to depths of over 30 metres.

Coral bleaching can be an important sign of disease, indicating that the symbiotic relationship between the host coral and its zooxanthellae is impaired. Causes of bleaching include pathogenic bacteria, protozoans, and exposure to abiotic stressors. Note that coral bleaching caused by elevated water temperatures (such as during El Niño events) is not a coral disease.

While abiotic stressors and pathogenic micro-organisms can cause loss of tissue from the skeleton of corals, physical damage similarly removes tissue and must be ruled out when investigating disease. Coral predators including butterfly fish, parrotfish, Crown of Thorns sea-stars (see sheet H8) and snails (e.g. *Drupella*) can leave marks on coral colonies that look similar to disease-related tissue loss. Human contact can also result in lesions on corals that might be confused with disease. Skeletal damage is one distinguishing characteristic. For example, where parrotfish have been feeding, there will be clear bite marks, but it is important to be aware that some diseases do lead to the erosion of the skeleton.

FISH

Localised die-offs of aquatic life, often referred to as 'fish kills', may be caused by a number of factors, including harmful algal blooms (see sheet H10), but in some cases disease may be the underlying reason behind these. There are many problems associated with identifying fish kills that may be related to disease outbreaks, and while fish kills are readily noticed they are rarely investigated in South Asia. For example, on the west coast of Sri Lanka fish kills occur irregularly, mostly at the beginning and end of the southwest monsoon. The species of concern are blue triggerfish (*Odonus niger*) and more recently other species, including snappers and emperors.

A. Rasheed

Large-scale mortality of blue triggerfish observed in Maldives, 2007

This phenomenon has never been thoroughly investigated. A similar large-scale mortality of blue triggerfish reported from Maldives between July and December 2007 was suspected (but not proven) to have been caused by a bacterial infection. It is not clear whether there is any relation between the occurrence of bacterial infections and specific oceanographic conditions, such as upwelling, or anthropogenic stress.

SEAGRASSES

Seagrasses are a vital part of marine ecosystems, helping to clarify water, stabilise the sea bottom, serve as food sources for marine life, and provide habitats and nursery areas for many types of organisms, including shrimp. Diseases can have an impact on seagrass beds, as seen in the wasting disease that devastated eelgrass beds in the 1930s, and seagrass die-off in tropical waters in Florida Bay in the late 1990s. The latter was caused by a bloom of the slime mould *Labyrinthula* sp. perhaps triggered by sedimentation and pollution. Limited awareness of the functions of seagrasses, combined with anthropogenic threats and poor management has resulted in significant damage to them in the recent past in the South Asia region.

TURTLES

Green, Loggerhead, Hawksbill and Olive Ridley turtles can develop fibropapillomatosis disease (FP) which is characterised by irregular, often large, cauliflower-like tumours, primarily on soft tissues. These spread over the body, both internally and externally, and often cause death by interfering with essential bodily processes. First described in Atlantic green turtles in the 1930s, FP has become widespread especially in green turtles. FP is believed to be caused by herpes viruses interacting with tumour-promoting biotoxins. It has reached epidemic proportions in Florida, Hawaii and parts of Australia, and is possibly linked with pollution. Another poorly understood disease, coccidiosis, killed many green turtles in Florida in 2002.

KEY POINTS FOR THE MCPA

There are no known cures for most of the diseases of wild marine organisms, but it is important to ascertain whether observed changes are due to disease or other causes. If disease is suspected:

- **Keep records, particularly as part of the monitoring programme (e.g. ReefCheck protocol) but ensure that experts are consulted if there are any doubts.**
- **Clearly describe the changes from normal function or behaviour. For example, note the size, shape, colour and distribution of lesions; which species are affected; dates and times.**
- **Look around for possible hidden predators (e.g. fish, snails, COTs – see sheet H8) or abiotic factors (e.g. increased water temperature or turbidity, decreased salinity, algal blooms, chemical spills – see sheet K2).**
- **Link up with groups such as local communities, fishers and divers to obtain information on easily identifiable potential disease outbreaks, such as fish kills, and be ready to obtain samples for analysis.**
- **Try and identify the disease. As several laboratory procedures are often needed to do this, you might contact the local fisheries agency or a veterinary pathologist at an aquarium for assistance.**

CASE STUDY

Coral Diseases in the Gulf of Mannar, India.

An assessment of coral diseases in six islands – Shingle, Krusadai, Pullivasal, Poomarichan, Manoli and Hare – in the northern region of the Gulf of Mannar in south-eastern India has been under way since June 2007. The study used permanent quadrats fixed on diseased coral colony areas at a maximum depth of two metres, encompassing various coral size classes, in order to monitor and assess disease prevalence and status on a continuous basis. Diseased coral colonies were also tagged and monitored in order to get an understanding of the progress of disease.

Initial studies revealed that corals in the vicinity of all six islands had been affected by disease. The greatest prevalence of disease was observed in Poomarichan Island, followed by Pullivasal Island. The lowest disease prevalence was observed around Shingle Island. Coral diseases such as white band, white plague, white spot, pink spot, black spot, black band, yellow spot and yellow band diseases were observed. Large colonies of *Porites* sp. were seen to be affected by pink spot, black band, white spot, yellow spot, yellow band, and white plague. Colonies of *Montipora digitata* were highly affected by white band disease. *Acropora nobilis*, *Acropora valenciennesi* and *Acropora formosa* were not affected by any type of disease, even though they occur in close proximity to disease affected colonies. The study found that corals located at less than two metres in depth and which form large colonies were more prone to disease.

Sources of further information

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No-take areas I1

No-take areas, either as zones within MCPAs or as entire MCPAs, are important tools for biodiversity conservation and fisheries management especially when implemented in close consultation with stakeholders. This sheet describes the key issues involved and how MCPA managers can most effectively promote the establishment of no-take areas.

No-take areas (sometimes called marine reserves) are marine areas that are closed to all forms of extraction including fishing. In South Asia, they include Marine Parks in Bangladesh and Maldives, and entire MCPAs or no-take zones within multiple use Marine Parks in India and Sri Lanka.

BENEFITS OF NO-TAKE AREAS

An extensive literature exists on the role of no-take areas in protecting biodiversity and contributing to fisheries production. Though the details of how this technique works in relation to different species and habitats are still being debated by the scientific community and conservation specialists, no-take areas are nevertheless internationally accepted as an important conservation and management tool.

Protecting biodiversity

Research from many parts of the world has shown that species richness, biomass, and size and abundance of organisms are higher inside no-take areas than outside, or compared with the area before it was closed, even after a period of as little as three years. In Sri Lanka, the no-take MCPA of Hikkaduwa has been seen to hold larger fish and a higher diversity of fish species than fished reefs nearby, while the abundance of heavily targeted aquarium species such as triggerfish and food fishes such as rabbitfish and parrotfish are higher. Similarly, popular dive sites and house reefs of resort islands in Maldives where fishing is either prohibited or restricted tend to have healthier fish assemblages than heavily fished reefs, particularly with regard to high value species such as groupers that are targeted in hook and line fisheries. It must be noted that certain fish populations such as butterflyfish will not increase, even if there is no fishing, if the habitat quality remains poor. Therefore it is important to protect key habitats while implementing no-take areas in order to improve fish populations.

While higher biomass and biodiversity could be argued to be a feature of an MCPA which could have been selected precisely because it was naturally more species-rich, similar effects have been seen in areas closed for other reasons. For example, reefs in areas of Sri Lanka that have been subject to fishing restrictions due to the civil conflict tend to have healthier coral reefs and a greater biomass and biodiversity of reef fishes than reefs in areas with intensive fishing. Terrestrial protected areas (e.g. many national parks) where extraction is prohibited have similar biodiversity benefits.

Increasing fisheries production

Common sense dictates that no-take areas should be beneficial for the purpose of fisheries production, and the FAO recommends them as a tool for fisheries management. Well implemented no-take areas can allow fish to grow older and larger (thus producing more eggs and juveniles) and cause fish density to increase. This should result in the replenishment of adjacent fished areas through the export of larvae and movement of adults (the 'spillover' effect) across the MCPA boundary. A number of studies have demonstrated spillover effects associated with no-take areas, but some have been inconclusive. However, many fishers perceive catches to increase following the establishment of closed areas. In Sri Lanka, lobster fishers south of Colombo often attribute replenishment of populations to reefs immediately north that are closed to fishing due to security measures associated with the Colombo port (see sheet I6 case study). The extent of the spillover effect may depend on the size of the no-take area, the species taken outside, and the number of fishers displaced who may increase pressure on adjacent fishing grounds.

ESTABLISHING NO-TAKE AREAS

Closed areas in South Asia have been implemented with varying degrees of ease and success. Three key points to consider are adequate consultation, location and size.

Stakeholder consultation

Closing an area to fishing inevitably means that some people will either have to cease fishing or move their fishing effort elsewhere. Without adequate sensitisation and participation, communities may view no-take zones as a form of disenfranchisement. This can lead to unrest and the situation can become politicised making it more difficult to resolve, as seen in some places in Sri Lanka and India. Establishing no-take areas therefore needs to take account of the economic interests of fishers and other users. It is important, in advance, to spend time raising awareness of the potential economic benefits, such as increased fish catches or tourism revenue. Where stakeholders are receptive this process can be accomplished relatively quickly, but if there are entrenched negative perceptions it could take considerably longer. Either way, the time spent is an investment in conflict prevention. Study tours to meet fishers who already appreciate the benefits of closure are useful for communicating the message (see sheets B1 and B2).

Location

Protecting biodiversity versus enhancing fisheries productivity may involve closing different areas. For fisheries, habitats important for

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Large schools of fish can rapidly increase in no-take areas, boosting diving tourism

the target species, such as spawning aggregation sites and nursery grounds, may be the priority (and will also contribute to biodiversity protection). A full scientific study is rarely possible but fishers may provide helpful information if they are confident that it will be used for good management.

Size

The optimal area to close will probably depend on local conditions although scientists and conservation organi¬sations have recommended that networks of no-take areas should cover 20-30% of all marine habitats. The research on which these figures are based is not yet conclusive, but nevertheless MCPA managers should look at the feasibility of increasing no-take areas. It is essential to develop a clear plan for this in collaboration with stakeholders. Many MCPAs in the region are small and fragmented and may not be ecologically sustainable in the long term. Although several larger MCPAs also exist in the region, including the extensive Gulf of Mannar Biosphere reserve in India, actual no take zones are either small or poorly enforced. However, where closed areas exist already, it may be as important first to ensure that these are well managed and to gather data to demonstrate their positive impact before establishing new closed areas or MCPAs. In Sri Lanka for example, two of the existing MCPAs which were originally demarcated as marine sanctuaries were upgraded to the more rigorous protection level of national parks in 2003 despite the management authority being inadequately staffed and funded to manage them as marine sanctuaries. In addition, other forms of fishery management, such as eliminating the use of damaging gears (see sheet I2), must not be overlooked.

KEY POINTS FOR THE MCPA

- **Actively promote the establishment of no-take areas, in all habitats, with the full involvement of local communities, leaders, and fishers.**
- **Ensure that there is a good understanding of fishing patterns, other users and potential conflicts within an area before considering closing it.**
- **Establish a rigorous and verifiable monitoring programme as soon as a no-take area is implemented, designed to demonstrate its impact, and involving local fishers; data should be analysed regularly and made available to all stakeholders.**
- **No-take areas must be well demarcated, with the involvement of the fishers, to assist with enforcement and compliance; the boundaries should be visited with community representatives during the consultation, to ensure full agreement.**

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The Science of Marine Reserves – video and booklet available from PISCO (a consortium of US universities) www.piscoweb.org

CASE STUDY

Impact of No-take areas in Sri Lanka – Hikkaduwa National Park and Bar Reef Marine Sanctuary

Hikkaduwa National Park (HNP) was originally declared a Marine Sanctuary in 1979 and later upgraded to the status of a National Park. It is the only MCPA in Sri Lanka where no fishing is carried out. Despite an increase in other pressures to the reef, such as sedimentation, pollution and poorly planned tourism developments, fish diversity and biomass is considerably higher within the MCPA than in other similar reef habitats along the same coastline. This is most particularly evident in populations of some fish species targeted for the marine ornamental trade such as triggerfish, while popular food fish such as sweetlips and rabbitfish are also more abundant within the MCPA. Both ornamental fish collection and food fisheries have had a considerable impact on reef fish populations in shallow, easily accessible fringing reefs throughout Sri Lanka.

In 1998, all coral reefs in southern Sri Lanka suffered extensive coral mortality due to mass coral bleaching. Live coral cover within HNP was reduced to around 7%. However, numbers of reef fishes remained higher than in reefs with better habitat quality, indicating that the lack of fishing was having a positive impact on fish assemblages.

In 1992, the Bar Reef Marine Sanctuary was declared, encompassing 306.7km as a no take zone. However, lack of implementation of sanctuary regulations due to a combination of factors, including lack of political will, funding, staff and equipment, fishing pressure increased within the MCPA over time. Recently, it was decided to demarcate the core area which was originally identified as a no take zone while allowing non-destructive fishing within a larger buffer zone of the MCPA. However the demarcation is yet to be carried out. Meanwhile the local fishermen have voiced their concerns about losing fishing grounds when the no-take area comes into effect. This shows the complexities in enforcing a no take zone and the need to find a balance between increasing fish biomass, the needs of the community and the practicalities of MCPA management.

Managing fishing gear I2

Fishing gear has different impacts on marine resources and habitats, depending on a variety of factors. It is important for MCPA personnel to understand this in order to ensure appropriate enforcement of regulations covering types of gear, and the areas and seasons when they can be used. This sheet provides some guidance on the complex issue of gear management.

Marine resource management in South Asia has the dual objectives of improving coastal livelihoods and protecting biodiversity. Unsustainable fishing practices, such as the use of destructive fishing gear, dynamite and poison, prevents the achievement of both these aims. Some fishing gear are relatively benign when used in one way, but highly damaging when used in another, so attention must be paid to determining the most appropriate regulations. Some gear are used by groups of fishers, and control of their use may have an important social impact which will also need consideration.

GEAR TYPES

Hook and line

This gear is generally benign as well as selective. However, it may be unsustainable if top-level predators are caught in large numbers, for example there is concern that expanding hook and line fisheries for groupers destined for the lucrative live reef fish market is depleting stocks in Maldives. Although an MCPA could encourage fishers to release such species alive, particularly if, like triggerfish, they are not high value species, putting a limit on the number of fishers may be more effective, especially in a region such as South Asia where catch and release fisheries are not practiced. If such fishing is done from boats anchored on coral reefs or seagrass beds, this should be discouraged, and it is important to recognise that permanent moorings (which reduce anchor damage – see sheet F9) may cause localised over-fishing at the site and could result in conflict for use of a buoy.

Traps

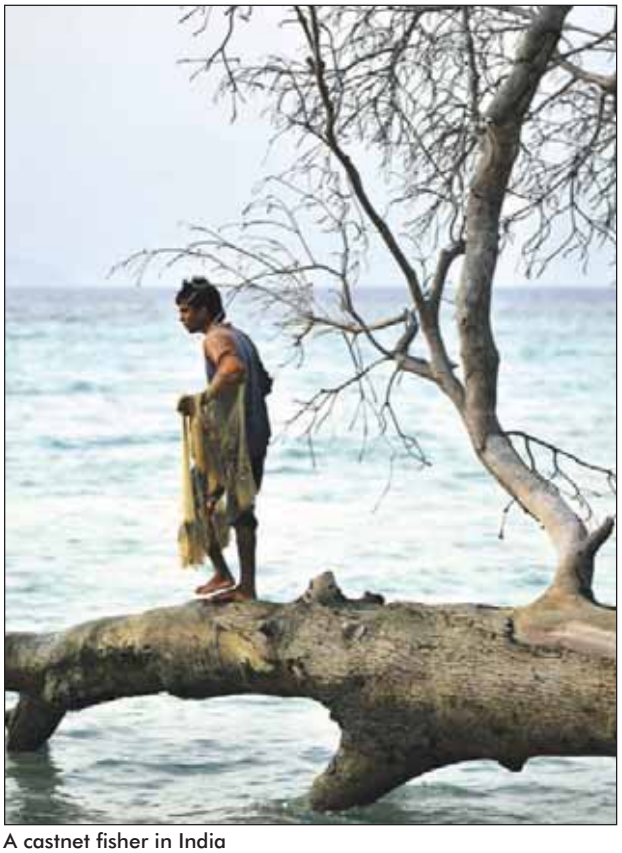
When made with small mesh, traps tend to take large numbers of juvenile fish. More traditional basket and fence traps (which catch fish as the tide goes out) that are designed to target larger, mature fish, and are made from bio-degradable materials are preferable. Such traps are common, particularly in estuarine areas of South Asia. Basket traps cause damage if they are dropped on reefs and break corals, or where fishers use broken coral to weight them down. Damage can be reduced by agreeing locations for their use, for example, in intertidal areas, bearing in mind that fishers may lose earnings if they move to a less suitable area.

Nets

Gill and seine nets are the main types of nets used in South Asia, and are often unselective. Gill nets can be selective, allowing some fish smaller than the mesh size to escape, and are generally not damaging to benthic habitats. However, they tend to catch overexploited fishes such as sharks and rays (see sheet I5), and result in incidental catch, which is one cause of the drastically reduced populations of dugong and sea turtle (see sheet H2). Lost nets sometimes continue fishing, termed ghost fishing, and get tangled around corals. Beach-seine nets are dragged across the seabed, often damaging seagrass beds and sometimes coral communities. Large beach-seine and small pelagic-seine nets are generally too costly for individual fishers to own, and are leased out by businessmen which makes enforcement difficult as they are not directly involved in the fishing itself. Ring-nets are used to catch pelagic fish in deeper water, which may be less damaging, but generally require a motorised boat. One form of fishing uses a purse seine with the assistance of scuba divers. The divers identify areas where fish are present and then drive the fish into a purse seine net. This type of fishing often targets spawning aggregations, and can lead to the overfishing of aggregations. Another form of net used in South Asia is the bottom set net for demersal fish and spiny lobster. This net is particularly destructive to habitats when used in reef areas as it causes considerable damage to corals through entanglement. In Maldives and Sri Lanka, a form of conical net is used in the collection of ornamental fish. This form of fishing has been banned as the collector uses a metal rod to damage the corals in order to drive fish into the net. Although the law is implemented in Maldives, this technique is still widely used in Sri Lanka.

Spear guns

Spear guns if used by snorkellers to selectively target larger, mature fish (i.e. not juveniles) cause little damage to fish populations. However, if used in large numbers over a small area, and if used with scuba gear, they can exert considerable pressure on some high value and/or vulnerable reef species and thus often tend to be prohibited in MCPAs and under national fishery regulations (e.g. Maldives, Sri Lanka). Although prohibited by law, commercial spearfishing with scuba has led to the depletion of large groupers and other high value species on many reefs in Sri Lanka.



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A castnet fisher in India

Collection on foot

This is typically done by women and children, who target small fish and invertebrates. The reef flat and intertidal area can be damaged by trampling if large numbers of people are involved. Certain high value species have been overcollected, such as sea cucumbers, shells and some species used in the aquarium trade (see sheets I6, I8 and I9).

REDUCING DAMAGE

The damaging impacts of fishing gear can be minimised through:

- Good enforcement of gear regulations (see sheet G2);
- Zoning, e.g. restricting certain gear to certain areas (see sheet C2);
- Encouraging fishers to use gear that are more benign, and/or to use their existing gear in a less damaging manner; a gear exchange programme where non¬destructive fishing gear are offered (usually free in the first instance) in exchange for destructive gear may be appropriate;
- Improving post-harvest treatment and marketing of the catch so that more revenue is generated, provided this can be done without encouraging more intensive fishing.

Gear exchange programmes

These can be difficult to implement successfully, especially where fishers resist changing from methods used for generations to new, unfamiliar or unproven gear. Education, training and patience may be necessary. The least destructive gear often require more time and energy (e.g. hook and line), or higher capital (long-lines and deep¬water nets) and fishers may be unwilling to invest in either of these. Some gear may not be used as intended (see Mafia case study). Exchange programmes should not be seen to 'reward' destructive fishers by providing them with new and better gear, or resentment may arise among those using non-destructive methods but not benefiting from the exchange. However, in some cases, the use of destructive fishing gear has been a recent phenomenon where fishers backed by local businessmen change from traditional fishing methods to using destructive methods in search of increased profit. In such cases, strict regulation of gear is necessary and gear exchange programmes are unlikely to be successful.

KEY POINTS FOR THE MCPA

- **In order to understand the fishing methods used in an MCPA, develop a profile and monitoring programme (see sheet G7) covering method and frequency of gear use, areas fished, financial returns, gear ownership, species caught, catches, marketing and environmental impacts.**
- **Ensure any regulations relating to use of destructive practices are well enforced.**
- **If a gear exchange programme might be appropriate, obtain technical advice and carry out a feasibility study; discuss potential options with fishers, identify which fishers to involve and mechanisms for carrying out the exchange (e.g. feeding new gear into the system slowly) and evaluate sustainability.**

CASE STUDY

Gear Exchange Programme in Mafia Island Marine Park, Tanzania

In 2002, Mafia Island Marine Park (MIMP) initiated a programme to encourage 17 groups of fishers using illegal small-mesh beach seine nets to switch to less damaging methods. 'Traditional' gear such as handlines, basket traps or fence traps were not acceptable to the fishers as they do not require them to work in their groups, which provide food and income security in the case of, for example, ill health.

Other forms of legal net fishing, that allowed them to maintain the groups, were considered. One group exchanged their gear for a purse seine net (and outboard engine) for use outside the park, taking out an interest-free loan, successfully adopting the new gear, and maintaining loan repayments.

Eight groups requested large mesh (13-15cm) gill nets which, despite the risk of by-catch and damage to benthic habitat if set for bottom-fishing (see main text), can also be used as drift-nets offshore, targeting large commercial pelagic species such as tuna with minimal by-catch. A large boat with an engine (and ideally an icebox) is needed and fishing has to take place at night, which Mafia fishers do not like. As a trial, two groups were provided with these gill nets and the process was monitored. During the first year the groups, as feared, modified the nets for bottom fishing which resulted in significant shark and ray by-catches. In order to persuade them to use the nets offshore, some group representatives were sent on a study tour to Zanzibar to learn about the offshore fishing method used there. This encouraged them to try the technique in Mafia, but further problems arose. Offshore eddies mean that boats have to travel further to find suitable conditions, adding cost in time and fuel, and one group now feels they need a larger boat for safety, requiring a further loan. Secondly, there is a limited market for tuna on Mafia although changes in fish trading laws are expected which should improve demand.

The Mafia experience shows that a large investment in time and personnel is needed to liaise with fishers to identify and resolve obstacles. Close technical supervision is essential, especially in the initial stages, and marketing issues should be carefully examined before gear exchanges start.

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Mariculture I3

Mariculture can potentially provide an income or food for local people in and around an MCPA and, when carried out in an environmentally sound way, it can ease pressure on marine resources. However, some mariculture operations cause problems and may have a negative impact. An MCPA manager needs to be aware of both the benefits and disadvantages in order to respond to investor proposals, and to decide whether to become actively involved in such enterprises.

Mariculture is the farming of marine species, whereas aquaculture is the farming of any aquatic creature and often refers specifically to freshwater activities. The farming of a single species is called monoculture, and the growth of several species together is termed polyculture. The contribution to world fish production of farmed aquatic foods, particularly salmon, trout, carp and tilapia species, has been increasing rapidly and now exceeds 35%, with growth expected to continue. There is a wide range of small-scale mariculture-based technologies and practices available and in operation throughout the South Asia region, such as Tiger Prawn, Shrimp, Mud Crab and Giant Sea Perch in coastal areas of Bangladesh, and a few species have been commercially farmed on a long-term basis, (e.g. pearl and edible oysters in India). The Marine Research Centre (MRC) in Maldives has initiated a programme on mariculture research and development to identify suitable commercial scale activities for the local environment, especially with regards to grouper species. Common pit falls for projects include a lack of aquaculture traditions and technology or local political instability and economic uncertainties.

Mariculture can be carried out in two ways. Extensive farming means animals or plants are grown in the natural environment relying on natural foods, using low densities of wild-caught juveniles or natural settlement of larvae. Costs are usually quite low, as are yields. Intensive mariculture requires maintenance of animals and plants at very high densities, often in enclosed ponds or cages; they are usually fed special diets and possibly antibiotics, and fertiliser may be added to boost production. Investments are usually high and profits are expected to be considerable.

ENVIRONMENTAL ISSUES

Depending on the location and species involved and the way in which it is carried out, both extensive and intensive mariculture can cause environmental damage in the form of:

- Destruction and conversion of natural habitats (e.g. mangroves for shrimp farms; seabed for intertidal species) and loss of productive fishing grounds;
- Pollution from uneaten feeds or waste products (e.g. faeces), cleaning fluids and antibiotics in the feeds, and excessive sedimentation from cleaning of ponds (see sheet K2);
- Introduction and escape of exotic species (see sheet K5) or disease vectors such as viruses.

SPECIES INVOLVED

Algae (seaweed) - Some 221 species of seaweed are utilised commercially. Of these, about 145 species are used for food and 110 species for phycocolloid production (e.g. agar). Seaweed is farmed commercially across the globe, with India placed within the top ten global seaweed producers. The seaweed industry in India involves cottage industry based on the natural stock, and large scale commercial cultivation and associated algin and agar extracting industries which have been established in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Gujarat.

Bath sponges - These can be grown in the sea from small cuttings fixed to lines, with minimal environmental impact. Sponges are farmed in the Mediterranean, parts of South East Asia, and the Caribbean. Although technically simple, commercial sponge farming is often not commercially successful as demand fluctuates and is generally low, with farms prone to disease.

Crustaceans - Shrimp, prawns and crabs are widely cultured and are the most commercially attractive marine species for mariculture. Penaeid mariculture accounts for up to 30% of world production of shrimp and there are significant operations in India, Bangladesh, and Sri Lanka, with a mostly experimental mariculture industry in Pakistan. Shrimp farms require ponds, and if constructed in sensitive areas, such as mangrove areas, they can result in immense damage to the surrounding ecosystems. The simplest systems obtain water and stock through natural flushing and little or no feed is given; annual production is about 400-900kg/ha. With greater investment, intensive ponds with pumped water, formulated feeds and higher pond-stocking densities, and hatcheries, can produce 7,000kg/ha annually. These highly intensive systems can have huge impacts on the surrounding environment due to their requirements of large inputs of nutrients and often significant use of antibiotics to combat disease outbreaks in densely stocked ponds. Mud or mangrove crabs (*Scylla* spp.) can be produced in extensive on-growing and fattening operations (ranching) using wild-caught juveniles. Crabs can also be polycultured with fish and shrimp. Juvenile crabs can also be produced in hatcheries, but the process needs further refinement. The common spiny lobsters (*Panulirus* spp.) are difficult to culture because of technical problems in rearing their larvae.

Molluscs - Pearl oysters (*Pinctada* spp.) can be cultured for pearls, and mangrove or rock oysters (*Crassostrea*) and certain mussels (*Perna viridis* and *P. perna*) for their meat. All rely on natural settlement of the seed (spat) onto surfaces or areas of seabed that can be visited periodically for harvest and to remove predators. Giant clams (*Tridacna* spp.), species of which occur in South Asia, have

S. Lelwala

Shrimp farms in Kalpitiya, Sri Lanka

been farmed in the Pacific and in South East Asia, and offer potential (with demand by the aquarium trade and for meat). The potential for the Culture of Giant Clams in Maldives was explored through the Bay of Bengal Programme in the early 90's.

Holothurians - Certain species of sea cucumbers are being successfully farmed in the Pacific (e.g. Solomon Islands and Japan), an industry which has a potential role in poverty alleviation and food security.

Fish - Much fish farming in South Asia involves freshwater species (e.g. carp, trout and tilapia). A thriving freshwater ornamental fish aquaculture industry is also in operation on a commercial scale in Sri Lanka, with exports to more than 25 global destinations. Industries for marine species such as milkfish (*Chanos chanos* in Sri Lanka) and mullet (*Mugil* spp.) and grouper (*Epinephelus fuscoguttatus* in Maldives) are also being developed.

KEY POINTS FOR THE MCPA

MCPAs experiencing fishing pressure on natural stocks might benefit from the development of small-scale fish farms.

- **Mariculture may be appropriate in or adjacent to an MCPA if it helps to generate income, employment and food for local communities, and thus reduce pressure on natural resources, provided it is carried out in an environmentally and socially sound manner and developed with the local communities.**
- **MCPA managers should consult guidelines for investment in mariculture enterprises (see Sources of further information) before approval of any project.**
- **If a proposal is provisionally approved, MCPA managers should ensure that a detailed independent EIA is undertaken (as required by most countries).**
- **If an operation goes ahead, a monitoring programme should be set up to assess impact on the natural environment; the skills and experience of MCPA staff may need to be strengthened to interpret monitoring results.**

CASE STUDY

Grouper Culture Pilot Project in Maldives

The Marine Research Centre, a government research body in the Maldives, initiated a pilot study in grouper mariculture in 2005 at the Bodumohoraa Field Station, to culture the Brown-marbled grouper (*Epinephelus fuscoguttatus*) and support commercial cage culture operations. The experimental project seeks to develop and adapt grouper culture techniques which build on existing approaches and are appropriate to the local conditions, while developing local capacity and skills for mariculture. Stages in the culture include rearing brood stock (parent fish) in floating net cages, and the production of fingerlings from captive brood stock (incubation of eggs and rearing larvae and juveniles).

Grouper brood stock is reared and maintained in floating cages in the sea, and fed with tuna flesh discarded from yellowfin tuna processing facilities. Brown-marbled grouper spawn in the new moon period and parent fishes demonstrating spawning characteristics during this time are placed in the hatchery (two males to each female). Approximately 300,000 eggs are released during each spawning period per breeding female. The fertilised eggs (which float) are removed and incubated separately. Mortality at this stage in the process is high as the larvae that hatch from the eggs are very small. The project is currently focusing on the successful rearing of 30-day old larvae.

Obtaining reasonable larval survival rates is identified as a major challenge in the aquaculture process. Currently at the field station several cohorts of hatchery-reared groupers (the oldest ones being a little over one year) exist, each of which consists of only 2-10 surviving individuals. The project currently focuses on improving the survival rates and rearing good quality animals to market size. Enhancing the nutritional quality at the early life stages would contribute toward improved larval survival, however carrying out nutrition trials has been a difficult task due to the unavailability of adequate infrastructure (tanks systems, water supply and filtration systems, etc).

Groupers are a popular marine food fish of high market value in many parts of the world including Hong Kong, Taiwan, Republic of China, Kuwait, Indonesia, Malaysia and Mexico, and a well developed global export market is in operation to support this form of mariculture. In addition fishing pressure on natural stocks is high.

Key issues to consider are:

- Unless carefully planned, mariculture may conflict with other uses of an area as boats can cause damage to sea cages and lines. If carried out within a MCPA, a zoning plan, developed with users of the area, can reduce this risk.
- Consider a multi-species approach to reduce risks related to species-specific vulnerability to disease and to fluctuation in consumer preference and prices.
- Enhance the skills and knowledge required for grow-out of grouper fingerlings through well-directed training and capacity-building activities and consideration of best practices.
- Projects should recognise the significant time taken for grouper to grow to a marketable size, and the initial investments in appropriate technology and infrastructure required, and plan accordingly.
- Conduct an EIA to establish the long-term environmental impact of cage based grouper culture in terms of shading of benthos, and increased nutrients.

Source:

Marine Research Centre www.mrc.gov.mv

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General guides on mariculture available online:

A coastal management perspective on mariculture development by the University of Rhode Island Coastal Resources Center - www.crc.uri.edu/index.php?themeid=1

Tanzania Mariculture Guidelines Sourcebook - www.crc.uri.edu/download/TAN_0046.PDF

Network of Aquaculture Centres in Asia-Pacific: has many resources, online publications and guidelines - www.enaca.org/

Fish aggregating devices (FADs) I4

MCPA managers may want to help fishers who use either the MCPA itself or the surrounding waters to find alternative fishing technologies that will reduce the impact of existing gears and take pressure off resources within the MCPA itself. FAD technology is one method that is proving to be appropriate in this aim, although the biological, economic and sociological effects of FADs for fisheries and associated communities are still being studied in the South Asian region.

Tunas and other pelagic species are often attracted to floating objects such as coconuts, logs, seaweed, and plastic bottles. These are often found at current boundaries and upwellings, which are areas of the ocean that are usually very productive (e.g. seasonal upwelling off the coast of Pakistan) and therefore good places for tuna to search for food. Local fishers generally know about such areas, but current boundaries, and the fish that feed around them, are never stationary. Fishers may have to search a large area to locate them, in order to take advantage of the good fishing.

FADs are floating objects that are specifically designed and located to attract pelagic fish such as tunas, and marlin and therefore allow fishers to find them more easily. The reasons why fish are attracted to FADs are numerous and vary for each species, but it is thought that the ropes, floats and the other materials used mimic the build-up of driftwood and seaweed found naturally in the sea. Some FADs comprise a large anchor (up to 1mt), a heavy-duty mooring chain (usually about 30m in length) and mooring rope, with about 50 purse-seine floats strung at the surface. The ropes and chain are joined using various shackles, rope connectors, splices and thimbles. A flag-pole can be attached to facilitate finding the FAD.

FADs may be deployed for use by both recreational and commercial fishers and can either be drifting or moored so that they float at the surface or lie subsurface. Subsurface FADs last longer due to less wear and tear from surface tension, but have the disadvantage of being harder to locate.

FADs may be placed in shallow (50-100m) or deep (500-3000m) waters. Deep-water FADs attract or aggregate Skipjack (*Katsuwonus pelamis*), Yellowfin (*Thunnus albacares*), and Bigeye Tunas (*T. obesus*) and also Sharks, Dolphin-fish, Rainbow-runner and other smaller fish such as Sardines, while shallow water FADs tend to aggregate the smaller tunas (e.g. Skipjack and immature Yellowfin). FADs anchored a few kilometres off the coast, and in depths of over 500m are generally more successful in attracting schools of tunas than shallow-water FADs, and are used by commercial fishing vessels, some of which utilise GPS systems for locating them.

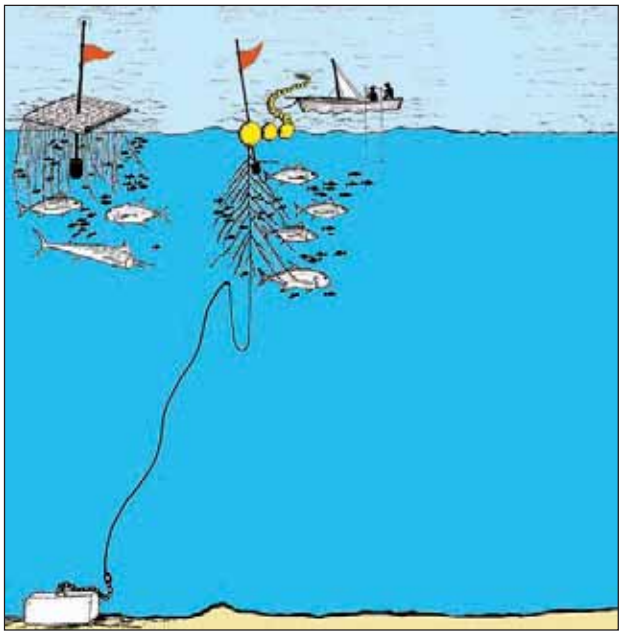
A key point to recognise is that FADs do not increase the biomass of fish (i.e. they do not increase size of a fish population). All they do is aggregate them in one place, making them easier to catch. Schools of tuna never actually 'live' under a FAD, but they associate with it for a few days or weeks, often ranging some kilometres away searching for food, before moving on. Boat captains have reported finding individual schools of tuna that exceeded 1,500mt in total weight and may hold more than a million individual fish.

The types of gears used around FADs will depend on local fishing vessels, but the following are typical:

- Drop lining - using a single hook and bait wrapped in cloth with slip knot and targeting deep-swimming tunas.
- Vertical long-lining - Similar to drop-lining but with a number of hooks hung off branch-lines (or snoods) and with single baits on each hook. Good baits include squid and oily fish. Baits do not have to be fresh.
- Trolling - A common and cheap gear used by many fishers world-wide. There are an enormous range of lures that be can tried.

There are several successful FAD programmes in the South Asian region. Traditional FADs comprised of branches and leaves have been historically used by artisanal fishermen to capture flying fish along the east coast of South India, and Sri Lanka, and Maldives have experimented with modern types of FAD technology since the 1970s. Bottom FADs, which involve a structure being placed on the seabed using materials such as tyres, were deployed around the islands of the Maldives during 1981-1982.

Analysis of catch rates demonstrated a 4–47% increase in catch rates and 5–114% increase in terms of weight in the vicinity of the FAD, confirming that larger fish could be caught near the FADs. FADs represent a valuable technique of increasing fishing



efficiency, but also can lead to overexploitation of populations if they are not used to support fisheries in a sustainable manner. The use of FADs for near shore, shallow water and/or reef-related species is of particular concern as these species are more prone to overexploitation. There is a need to understand viable population sizes in relation to using FAD devices, and any attempts to use FADs should be supported by a thorough understanding of fisheries resource base.

The technology of FAD-design continues to improve and in some areas around the world (e.g. Hawaii, Western Pacific) FADs can last for 2-3 years. Most research into FAD design and the behaviour of tuna around FADs has been done by the Institute de Recherche pour le Développement in La Réunion, and in the south-west Pacific Ocean.

Before investing in FADs, their potential success, impact and ecological sustainability must be evaluated. Key points to consider are:

- FADs ideally need to be sited in water at least 500m deep and a minimum of 3-5km from the coast;
- Fish species must be present and not overexploited in the general area, even if only on a seasonal basis;
- Fishers must have appropriate vessels, and ideally some experience of fishing off-shore;
- There need to be marketing opportunities for FAD-caught fish.

If the introduction of FAD technology seems feasible, the following steps will have to be taken:

Site survey - This must be done in collaboration with local fishers to make sure that they are able to get to the FAD safely. It is important to check local charts and find out about currents and seasonal winds in the area. High-powered sonar equipment (providing a signal of at least 2Kw) is required to measure the depth accurately, and to find an area that is relatively flat. sonar equipment can be bought or hired. The South Pacific Commission FAD Manual describes how to conduct a site survey (see Sources of further information).

FAD construction - There are two main designs: the Spar Buoy and the Indian Ocean FAD. The latter is probably the most popular and long-lived, but a detailed comparison of the two types is provided in the SPC FAD Manual. The sonar survey data allow the correct lengths of ropes (nylon and polypropylene) to be calculated (see SPC Manual). A FAD anchored in 1,000m of water would require 1,250m of rope. Prices vary depending on materials and import duties. Because the FAD will be deployed in a high-energy environment and subject to stress from currents and waves especially during the monsoon season, the construction procedure needs to be followed very carefully and expert advice should be sought.

FAD deployment - Although simple in design, FADs are very bulky and deployment in deep-water is potentially dangerous. Expert advice is required, as well as a good-sized vessel. The rope and surface component are usually placed in the ocean first and the anchor last, after all ropes are safely off the boat. The SPC Manual provides details.

Management and monitoring – While FADs have the benefit of reducing pressure on inshore fisheries and potentially utilising under-exploited pelagic fisheries in deeper waters, an effective management and monitoring strategy must be employed to ensure resource sustainability. Considerations such as number of anchored FADs in the area, overall fishing effort, types of gear used, monitoring of the fishery through catch and size data, and by-catch composition. Management methods used could include closed areas/seasons, licensing, stock assessments and reporting requirements. Management plans should be developed in line with national policy (if present), and international codes of conduct.

KEY POINTS FOR THE MCPA

FADs may be appropriate in or adjacent to an MCPA if they help to generate income and food for local communities, and help relieve pressure on inshore reefs. FADs are also recognised as being beneficial both in reducing time invested in fishing, thereby freeing up the fisher to invest time in alternative income generating activities, and increasing the size of fishing grounds which could assist in conflict resolution of other fisheries management regulations.

- **Since there are a number of options for assisting fishers who are affected by the presence of an MCPA, a careful evaluation is required before deciding to spend resources on a FADs programme.**
- **An MCPA itself is unlikely to have the resources/capacity/finance to install and maintain FADs directly; a better approach is likely to be to work with the Fisheries Department and other organisations.**
- **If it is decided that FADs represent a good solution to some of the problems facing the MCPA, seek expert advice, and consult all stakeholders at an early stage**
- **FADs may lead to the overexploitation of species (especially near shore, shallow and/or reef species) thus a careful analysis of the ecological sustainability of a FAD venture needs to be carried out.**

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For technical and management advisory services for sustainable coastal fisheries development and management in the Bay of Bengal region, go to the Bay of Bengal Programme (BOBP) website: www.bobpigo.org

CASE STUDY

Biosocioeconomic Assessment of the Effects of FADs in the Tuna Fishery in Maldives

FADs have proved very successful in Maldives. In 1993 a countrywide FAD installation programme was led by the Ministry of Fisheries and Agriculture (MOFA). The success of this initiative hinged largely on its relevance and applicability to existing fisheries.

As part of the project, two FADs were installed in two different sites and closely monitored with regards to the biological, economic and sociological effects of their use on the fisheries and on the island communities in the two areas. Ten months after the installation of the FADs in installation in Area 1 and six months after installation in Area 2, studies were carried out to assess the socioeconomic impacts of the use of FADs in each area. The findings were as follows:

- Almost 60 per cent of craft-owners fished regularly at the FADs, finding that they saved time and fuel costs by as much as a third. Their incomes were also perceived to have increased.
- Some fishermen at one site felt that that the FAD was located in too remote an area and that their vessels were not equipped to make the long journeys required.
- A number of fishermen felt that an insufficient number of fish were aggregating around the FADs, and also believed that the FAD was too small to attract aggregating fish.
- There was some reluctance to fish at the FADs by fishermen who alleged that the baitfish used by their fellow-fishermen turned away tuna. However there were no reports of any conflicts over fishing associated with the FADs and no attempts were made to damage the FADs.

Awareness materials on the design, fabrication and deployment of FADs were prepared in the local language and distributed among fisher folk, with the aim of improving their capability to fully

participate in the process. Radio was also used as a communication method which proved very effective. Although the majority of fisher folk perceived the FADs as belonging to MOFA, a few felt that the FADs were common property. All craft-owners expressed willingness to contribute to installation, repair and maintenance of FADs.

Source:

Naeem, A. & Latheefa, A. 1995. Biosocioeconomic Assessment of the Effects of Fish Aggregation Devices in the Tuna Fishery in the Maldives. Ministry of Fisheries and Agriculture, Male, Maldives. Bay of Bengal Programme.

Shark and ray fisheries

I5

Sharks and rays are under heavy pressure from fishing and habitat damage around the world, with many populations now depleted and some species considered to be under serious threat. This sheet provides some background to this issue and guidance as to how MCPAs might contribute to their conservation and sustainable management.

Sharks and rays, with over 50 and 30 species respectively in the surrounding seas of the South Asia region, are cartilaginous fish in the Subclass Elasmobranchii. Contrary to popular belief, most sharks are not dangerous to people. Many elasmobranchs are docile and include plankton feeders such as manta rays and whale sharks. Sharks and rays have little capacity to recover from intense exploitation because of their conservative life histories. They are among the latest maturing and slowest reproducing vertebrates, and their biology is more comparable to large mammals than to the bony fishes. For example, some species produce only one or two pups, and not until the adults are 10-15 years old, and in some species 20-25 years old. Many species are now considered to be at risk, particularly those that are readily caught in nets or are targeted in fisheries. Over 55 species of elasmobranchs are listed on the IUCN Red List (many as Data Deficient, meaning that insufficient information is available to assign a category – see sheet H1), and others are currently being assessed.

EXPLOITATION

Over the years shark meat has gained popularity in both domestic and international market resulting in increased harvest especially in South Asia, especially along the Indian coast, Sri Lanka and in Maldives. Growing trade in shark products like fins, liver oil, cartilage and skin has played a significant role in increased shark harvests. Such has been the rush that overexploitation is now beginning to threaten the survival of many species. In addition there is concern that with the trade being unregulated, intensive hunting for sharks is becoming environmentally and economically unsustainable. The steady decrease in the length of the sharks over the years is a clear indication that overexploitation is beginning to leave a telling effect.

Though shark and ray fisheries are found internationally, there are differences with regard to target species and gear/vessels used in different regions and areas. This fact makes it difficult to collect accurate information on yields, fishing efforts, and the status of shark fisheries overall. This is especially the case in South Asia, where there is a paucity of data on the subject.

Sharks and rays are directly targeted in some fisheries and caught as bycatch in others. Illegal offshore fishing is one of the major threats because of demand for a wide range of products:

- Shark and ray meat is eaten fresh or salted and sun-dried and is a valuable food item in most South Asian countries. In India shark meat is consumed locally, mainly in a dried [salt cured] form in Kerala and Goa on the west coast. It is also consumed both fresh and in the dried salted form in Sri Lanka. In terms of intra-regional trade, India, Pakistan and Maldives all export dried shark meat to Sri Lanka. Before 2001 India exported fresh and frozen whale shark meat primarily to Taiwan.
- Shark fins have a particularly high value and sharks are increasingly being caught for these alone. Dried shark fins are used for soup in many Asian countries. All five maritime nations of South Asia are involved in shark fin fisheries.
- Sharks have enormous livers that are rich in oil, and in India this has traditionally been, and continues to be, used as a wood preservative for small boats. It is also used in the textile, leather, lubricant, cosmetics and pharmaceutical industries, in fish meal production, and is now recognised as a important natural treatment for certain cancers which may increase its value.
- Shark curios or memorabilia, such as entire jaws, dried and varnished, or teeth set in jewellery are of secondary value (but can be very valuable and in certain cases may drive a fishery), as is shark skin for watch-straps or specialised furniture sandpaper. Shark cartilage also has an occasional demand from certain European countries for use in making tablets for heart diseases and eye fatigue.
- Although not a popular type of shark meat, whale sharks are also taken in Sri Lanka, India, Pakistan and Maldives, in part due to demand from overseas markets in East Asia, though local use in some countries, such as Pakistan, is known. Whale sharks tend to come into inshore areas especially during periods of heavy rain fall, probably to feed on the plankton that blooms with increased nutrients and coinciding upwellings.

MANAGEMENT

Data on the status of populations is inadequate for South Asia and there are no reliable statistics for the fisheries, which means that information for guiding management is lacking. Despite the 'boom and bust' nature characterising most shark fisheries, with recent evidence of collapse in some cases after only a few years of fishing, most shark fisheries are not monitored or regulated.

The International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), developed by FAO's Technical Working Group on the Conservation and Management of Sharks in 1999, is a voluntary agreement to promote the conservation and

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Shark fins being processed in curing plant in Pakistan

sustainable management of sharks and their long-term sustainable use. It has three guiding principles:

- Participation - States that contribute to fishing mortality on a species or stock should participate in its management.
- Sustaining stocks - Management and conservation strategies should aim to keep total fishing mortality for each stock within sustainable levels by applying the precautionary approach.
- Nutritional and socioeconomic considerations - Management and conservation objectives and strategies should recognise that in some low-income food-deficit regions and/or countries, shark catches are a traditional and important source of food, employment and/or income. Such catches should be managed on a sustainable basis to provide a continued source of food, employment and income to local communities.

However, primarily due to a lack of resources, progress with implementation of the IPOA-Sharks has been very slow in the South Asian region. Regional efforts to develop a management plan for shark fisheries are currently being carried out under the Bay of Bengal Programme. India, Pakistan and Sri Lanka feature in the top 20 shark catching countries. No statistics are available for Bangladesh. The status of the National Plan of Action (NPOA) for India and Pakistan is under preparation while the status is unknown for Sri Lanka and Bangladesh. Regional cooperation and education at all levels of society are urgently needed. In the case of some inshore species, for example reef sharks, MCPAs, if large enough, may be the only hope for their recovery and survival.

KEY POINTS FOR THE MCPA

- **Include shark sightings in monitoring programmes and encourage research on this group. This will help to improve knowledge of the biology and status of these species; if an MCPA has significant populations of these species obtain expert advice.**
- **Identify and protect critical habitats, including nursery, aggregation and breeding areas.**
- **Ensure that any legal shark fishery within the MCPA is monitored and assessed, and help to develop measures that will ensure its sustainability.**
- **Educate stakeholders on the value of sharks, both as top predators maintaining the health and balance of ecosystems, and also for ecotourism (diving and snorkelling with species such as manta rays and sharks).**
- **Work with SCUBA diving operators to promote better understanding and respect for sharks, and ensure that codes of conduct for shark watching are observed (e.g. no shark feeding, keep a safe distance).**
- **Document and report and, where possible, help to halt illegal fishing practices, especially by off-shore fishing fleets.**

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CASE STUDY

Managing Shark Fisheries, Dive Tourism and Tuna Fisheries in Maldives

Maldives is one of the most popular diving and snorkelling destinations in the world and observing a shark on a dive is a highlight for many divers. In 1992 it was estimated that the revenue generated for shark based tourism in Maldives was US$ 2.3 million. In addition to this traditional tuna fishermen support the protection of sharks due to the belief that the removal of sharks affects tuna catches. However, high prices and demand for shark products, particularly shark fin and shark liver oil, has led to the growth of the export oriented shark fishery, resulting in conflict between the tourism industry, tuna fisheries and the shark fishery.

Overall, the export of shark fins and meat in 1992 brought in revenue of only US$ 0.7 million, significantly less than that generated from tourism based on shark diving, and the tuna fishery. Furthermore results from a survey carried out at the same time showed that one live shark at a dive site is worth approximately US$ 3,300 per year through tourism revenue, indicating that sharks are worth more alive than dead. Maldives is also one of the few places in South Asia with a significant shark population, as decades of extensive fishing has dramatically reduced shark numbers elsewhere in the region. The growth of the shark fishery and corresponding declines in shark stocks has caused concern regarding the sustainability of the fishery and its potential impacts on tourism. As a result there has been considerable pressure on the Maldivian government to regulate the shark fishery.

In order to resolve the conflicts between user groups, shark fishing was banned at 25 popular dive sites that have been protected under the Environmental Protection and Preservation Act. In 1998, a 10 year moratorium was imposed on shark fishing within 20km from the atoll rims of 7 major atolls popular with dive tourists. Shark fishing was also banned at 2 sites that are important for the tuna fishery and around Fish Aggregating Devices (FADs), and fishing for sharks around tuna schools while tuna fishing vessels are in operation was also prohibited. Through these efforts the Maldivian government has attempted to reduce the impact of shark fishing on tourism and resolve conflicts between tuna fishermen and the shark fishery and support the sustainable management of shark populations in Maldivian waters.

Source:

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Spiny lobster and sea cucumber fisheries 16

In South Asia, there are numerous invertebrate fisheries that an MCPA may have to consider. Two of the commonest and most valuable are spiny lobster and sea cucumber. Both of these are now conducted on a commercial scale, both are poorly documented, and both are being overexploited. This sheet provides some suggestions as to how MCPAs might assist in their sustainable management.

The collection of lobsters in the region began with the demand for the tourist industry and export markets in the 1960s and has shown a steady increase since then. The sea cucumber fishery began to grow in response to increasing demands from East Asian markets in the 1990s. Both of these fisheries are now important economic activities in South Asia, particularly Sri Lanka and India. With the arrival of marine product processors and foreign buyers in recent years, fishing intensity for both groups has risen markedly, placing intense pressure on these resources.

SPINY LOBSTER

Lobsters (*Panulirus* spp.) are traditionally not a favoured food item among local communities in South Asia, but fisheries began to grow with increased demand from tourist hotels and restaurants. A thriving export trade has also contributed to increased collection. Sri Lanka has the most developed lobster fishery in South Asia and 5 species found around the island are collected for export as well as for the many hotels and restaurants in the country catering for tourists. *Panulirus longipes* and *Panulirus homarus* are the most abundant and hence most widely collected species. Lobsters are collected mainly through bottom set nets or by night by scuba divers. Despite the increases in collection effort, recent historical records show a marked reduction in the numbers, studies from the mid 1980s to the early 1990s show a steep drop in numbers collected, from 272 tonnes in 1986 to 146 tonnes in 1991, and this may at least in part be a result of overfishing.

A major problem associated with the industry has been the use of bottom set nets in reef areas. Despite being illegal in Sri Lanka, they are still widely used due to non enforcement of regulations and result in extensive damage to coral reefs. Improved management is necessary in order to sustain the trade by maintaining viable populations and also to reduce the destruction of coral reefs.

SEA CUCUMBER

About 80 species of sea cucumber (commonly known as 'bêche-de-mer') occur in shallow waters of the Indian Ocean. They have been collected for many decades in the Western Indian Ocean and South Asia. While not consumed in South Asia, at least 24 species are exported to South East and East Asia, particularly to Taiwan and Hong Kong, where they are considered a delicacy. The most commonly caught species in the Indian Ocean are *Thelenota ananas*, *Stichopus hermanni*, *S. chloronotus*, *Holothuria scabra*, *H. atra*, *H. nobilis*, *H. fuscogilva*, and *Bohadschia* sp. Generally, sea cucumbers are processed by boiling and/or drying prior to export.

N. Perera

Harvested sea cucumbers

As sea cucumbers are slow moving and defenceless (apart from sticky threads some species exude), they are easily hand collected on intertidal reef flats when walking, and in deeper water either by snorkelling or using scuba. Over harvesting has depleted sea cucumber populations in Sri Lanka to a depth of over 30m, and scuba divers now go deeper than 40m in search of catch, putting them at risk of decompression sickness. Several deaths and injuries have been reported. Recently some traders have diversified and are selling dried chank meat as an alternative to selling sea cucumbers. This is a separate fishery to chank fisheries for the curio trade (see sheet I9).

N. Perera

Sea cucumber collectors on the coast of Kalpitiya, Sri Lanka

The effects of over fishing of these important detritivores are not fully understood. Size limits may be appropriate for some species of sea cucumber, and the potential for listing sea cucumbers under CITES is being discussed (Ecuador has already listed *Isostichopus fuscus* in CITES Appendix III). Few countries have regulations for the fishery, but in the Great Barrier Reef Marine Park, sea cucumbers are managed as one of several 'harvest fisheries' which means that a permit is needed, numbers issued are restricted, and certain areas are closed to fishing.

POTENTIAL MANAGEMENT ACTIONS

Monitoring programmes for sea cucumber and lobster fisheries should be established where possible. Catch and effort data provided on a quarterly time scale may be adequate. Local data collection teams could be used, if trained and supervised. A regional training course on identification would probably be necessary as sea cucumber taxonomy is complex. Data should be analysed at least annually to provide regular assessments of the fishery and to determine the management actions needed.

In Sri Lanka, the Fisheries Act specifies a minimum size limit for lobsters and prohibits the collection of egg bearing females. In addition to this, harvesting and export of spiny lobsters is banned for two months of the year (February and September). However, most divers collect gravid animals and remove the eggs prior to sale to circumvent this regulation and illegal collection during February and September continues, with harvested lobsters being kept in submerged cages in the sea until they can be exported legally, or sold to local tourist hotels instead of exporting. Further research to find spawning peaks in lobsters' and sea cucumbers' reproductive cycles, and seasonal closures to protect spawning animals could be recommended. Within an MCPA, collection should be prohibited within no-take zones while collection in other areas should only be allowed for licensed collectors who pay a fee to the MCPA. Limits on size and numbers should be established and strictly enforced. Rotational fishing regimes with a different area exploited each day during the spring tide would also help to maintain a healthy size range and stock size.

KEY POINTS FOR THE MCPA

- **Initiate a monitoring programme for sea cucumbers and lobsters (the ReefCheck protocol includes sea cucumbers as an indicator species – see sheet G3).**
- **Strictly enforce existing national level fisheries regulations relating to sea cucumbers and lobsters within the MCPA.**
- **Include the issue of overexploitation of sea cucumbers and lobsters in awareness raising materials produced by the MCPA.**
- **Support research on sea cucumbers and lobsters, especially where this will contribute to understanding the role that MCPAs might play in their conservation and management.**
- **Where exploitation is allowed within an MCPA, consider limiting specific zones and/or introducing seasonal closures and rotational fishing regimes.**

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CASE STUDY

The Potential Value of No-take Zones in Lobster Fisheries in Colombo Harbour, Sri Lanka

Currently, management of sea cucumber and lobster fisheries is poor in South Asia, and indiscriminate collection is carried out even within MCPAs. Regulations have proven to be difficult to enforce and attempts to set aside reserves or no take zones have met with stiff opposition from collectors and the export industry.

However, since the late 1990s several reefs around Colombo have been included in a security zone as part of increased security for the Colombo Harbour. Fishing and diving in this area is prohibited and it is patrolled by the Sri Lankan navy. Many of the reefs in the security zone are also important lobster habitats and had been heavily overfished. The declaration of the security zone has now created a de facto no-take zone.

Observations on these reefs indicate an abundance of lobsters when compared to other reefs further south where uninhibited collection is carried out. Some divers even take the risk of illegally collecting lobsters on closed reefs due to the high numbers and potential high profits. This shows that the prohibition of lobster collection has led to an increase in populations in Colombo. Many collectors are beginning to understand the benefit of the closure and attribute good catches in other areas to the closure of some reefs. While not carried out for resource management, this shows that strictly enforced no-take zones are beneficial for the lobster fishery and with time may receive support from fishermen.

Sport and recreational fishing 17

Sport and recreational fishing are permitted in some MCPAs in South Asia. Sport fishing clubs sometimes want to establish themselves near MCPAs to benefit from the associated tourism and perceived better fish catches. This sheet provides MCPA staff with background information on the impact and potential benefits of these activities and some guidelines on appropriate policies.

Recreational fishing (or angling) refers to fishing, for food or to release, as a leisure activity or hobby. Sport fishing is carried out, often on a competitive basis, with the main aim of breaking size records, the skill lying in landing the largest possible fish on the lightest fishing tackle (rod and line). Both therefore differ from commercial or artisanal fishing which is the mainstay of the fishers concerned. Sport and recreational fishing activities are not as developed or as popular in South Asia as they are in many other regions. However, sport fishing clubs and services do exist throughout South Asia, and in some countries such as Maldives, is a popular activity among tourists. Sport fishing clubs often keep good catch records and can hold valuable historical data. For example, the Ceylon Anglers Club maintains records of fish caught in Sri Lankan waters.

FISHING METHODS

These depend on the environment and species sought. The main gears used are described below.

- Trolling - This is one of the most popular forms of sport fishing, and targets the big 'game' fish such as marlin, sailfish, tuna, mackerel and trevally. Trolling is mainly carried out offshore and involves dragging either an artificial lure (often fish or squid-shaped), or live or dead bait through the water, usually on a monofilament nylon line a few metres below the surface. Trolling is a popular activity in India, Maldives and Sri Lanka with several established clubs and charter operations.
- Fly-fishing - This mostly takes place in shallow waters, commonly for jacks (trevally) and the highly sought after and elusive bonefish. It may also be practiced in open water, with the fish attracted to the boat with lures before the fly is cast.
- Bottom fishing - Conducted mostly in waters 5-50m deep using baited hooks to catch groupers, snappers, emperors, sharks and other bottom-feeding fish. It may be conducted from shore or from a boat, using either a rod and reel or hand held lines. Fishing using monofilament hand lines is a popular tourist activity in Maldives and Andaman Islands.
- Drift fishing - Uses hooks (sometime using squid bait and light sticks) set at depths of over 50m specifically to attract swordfish (also known as broadbill).
- Spearfishing - Involves spearing a fish with a harpoon, usually fired from an elastic or rubber propelled spear gun. Larger reef fishes, such as groupers, are the main target species, but oceanic species such as billfish and tunas may also be speared. Spearfishing is prohibited in several South Asian countries including Maldives and Sri Lanka.

IMPACTS

If managed well, recreational and sport fishing can bring economic benefits through employment and revenue from businesses. Since sport and recreational fishers are not dependent upon fishing for their livelihood, they are more receptive to management regulations and can often assist with managing fishery resources. Sport and recreational fishing brings people together who have a common interest in protecting the environment in which they fish, and, through their clubs and associations, are in a good position to participate in environmental issues and contribute to improving the local situation. Sport and recreational fishers can act as 'watch dogs' and report incidents such as oil spills (see sheet K3), redtides (see sheet H10), fish kills (see sheet H11) or illegal fishing. However, the impact of sport and recreational fishing depends on the gear, the frequency, the location and the species. In some places, recreational fishing is now so intense that it is having a negative impact. Several gamefish species are on the *IUCN Red List of Threatened Species* (see sheet H3) as they are also targeted by commercial fisheries (e.g. swordfish); others are considered to be at risk as they are caught in by-catch (e.g. marlin) or are overfished for a variety of reasons (e.g. groupers on reefs). Spear fishing in particular may lead to declines in populations of target species due to selective fishing of older and larger individuals. Other potential negative impacts include anchor damage by boats. Conflicts may arise in some places between the tourism industry (particularly scuba divers) and sport fishing enterprises, while there may be conflict between commercial and recreational fishers if both target the same species.

MANAGEMENT

Given the decline of many popular gamefish species, fishing clubs in many countries have switched to partial or total catch and release programmes, particularly for large pelagic fish species. National level legislation may also restrict the number, size or species of fish that may be kept. However, catch and release programmes are currently not implemented in South Asia.

In some countries where catch and release programmes are enforced, the fish are usually also tagged, training is provided for fishers on how to handle the fish, and the results of analyses of the tag returns are published in sport fishing magazines. South Africa has one of the largest programmes in the Indian Ocean with 3,500 recreational

S. Wells

Sportfishing, as seen here in the Seychelles, is a popular activity in some regions of the world

fishers involved and over 120,000 fish tagged to date. The tag shaft holds the address details to which the tag should be sent. Tags are generally made of a barbed nylon point which is embedded in the flesh or under the dorsal fin, although older tags were made of steel. Attachment of a tag generally does not harm the fish; there are instances where tagged fish have been re-caught, even on the same day they were tagged, indicating that they were fit enough to attack the bait. New aids, such as the Aquatic Release Conservation (ARC) de-hooker, also help to reduce mortality of released fish. The results of tagging programmes have contributed to knowledge about growth and mortality rates, and movements of these fish.

MCPAs can potentially play an important role in the management of sport and recreational fishing. Those that are no-take areas by definition prohibit such fishing, but in others, it may be allowed in certain zones under permit and in payment of a fee. A checklist of good practices in recreational and sport fishing is being produced by a consortium of conservation and tourism organisations and provides useful guidance for MCPAs: www.celb.org/xp/CELB/downloads/Marine_Guide.pdf

KEY POINTS FOR THE MCPA

- **If sport and recreational fishing is allowed within the MCPA, restrict this to the catch-and-release method; ensure that it is well supervised, with guides who know the correct way to release fish without damaging them.**
- **Make sure that regulations (e.g. size limits, closed seasons) are clearly understood and are posted for visitors.**
- **Monofilament line and other gear should never be discarded overboard.**
- **Cooperate with local fishing clubs where appropriate, in order to share information about fish behaviour and movement from tagging programmes, and to obtain help with surveillance in areas not covered by MCPA patrol boats.**
- **Any landings from sport or recreational fishing within an MCPA should be recorded as part of the MCPA fishery monitoring programme.**

Sources of further information

African Billfish Foundation - newsletter: available from Tina Harris, PO Box 342, Watamu, Kenya, Tel: 254 42 20394/31387, Fax: 254 42 31288; e-mail: albatros@swiftmalindi.com

American Sportfishing Association – Information on national codes of practice www.asafishing.org/asa/

Aquatic Release Conservation (ARC). Guide to Handling and Releasing Fish, Sea Turtles, Marine Mammals and Seabirds. www.dehooker4arc.com/release_guide.htm

ANSA – the Australian National Sportfishing Association represents the recreational fishing industry and the recreational angler and has key resources on tagging programmes. www.ansa.com.au/

CELB/CORAL/IHEI/TOI 2004. Developing a Supply Chain Management Tool: working with marine recreation providers to adopt environmental and social good practices. www.celb.org/xp/CELB/downloads/Marine_Guide.pdf

Information on a voluntary National Code of Practice for responsible fishing used in Australia. www.recfish.com.au/best_practice/national_code.html

International Game Fishing Association (IGFA) – www.igfa.org - an international body working for the interests of sport fishers, including habitat protection.

National Coalition for Marine Conservation - www.savethefish.org

CASE STUDY

Sport and Recreational Fishing in South Africa and Mozambique

In South Asia, the recreational fisheries industry is in its infancy, but there are some interesting examples from the western Indian Ocean. South Africa may have one of the biggest recreational fisheries in the world, with an estimated 750,000 recreational anglers. There are several types of recreational fishing: shore angling (known as 'rock-and-surf') which is the most accessible and therefore most popular; fishing from small boats in estuaries; sport fishing for game fish offshore (with boats known locally as skiboats); fishing for rock lobsters and abalone; and spear fishing. Most recreational fishers agree that catches are getting smaller and more difficult to catch, and scientific studies have confirmed a decline in abundance of species caught by shore anglers, with the endemic species now considered over-exploited. There are comprehensive management measures: a recreational fishing permit is required; there are minimum sizes, a bag limit for all species, and closed seasons for some species; and certain zones within each MCPA prohibit recreational fishing, affording protection to breeding stocks of resident species.

In Mozambique, the Banco São Lazaro which is part of the Quirimbas National Park is being zoned as a Specific Use Zone specifically for sport fishing. The coral bank, which lies over 40km offshore, is already a popular sport fishing area. The zone will comprise the entire bank within the 100m depth contour, and only sport fishing and scuba diving will be allowed. There will be little conflict with artisanal fishers since they do not go out so far to sea. The sportfishing boats will play an important role in monitoring illegal long-line fishing boats and the fees that they pay (a surcharge will have to be paid for fishing here) will provide revenue for the Park. Elsewhere in the Park, sportfishing is prohibited in the Total Protection Zones but permitted in the Community Use and Development Zones provided it is done in accordance with the Mozambican sport fishing regulations (Regulamento da Pesca Desportiva).

Marine organisms for aquaria

18

Extraction of marine ornamental species is a major source of income for South Asian countries like Sri Lanka and Maldives, providing livelihood opportunities for many coastal communities. This may lead to conflicts between resource managers (MCPA managers) and resource dependent communities. This sheet gives background information on the potential benefits and problems of the aquarium trade, provides information on environmentally sound practices, and suggests appropriate policies for an MCPA.

Globally, about 1,500 marine fish species, 200 hard and soft coral species, about 500 species of other invertebrates (e.g. shrimp, molluscs such as small clams, and anemones) and thousands of tonnes of 'live rock' (benthic substrate with attached organisms) are collected for the aquarium trade. They are known in the trade as marine 'ornamentals'. Fish make up about 85% of the trade by value and most come from coral reefs. The blue-green damselfish (*Chromis viridis*), clown anemone fish (*Amphiprion ocellaris*), humbug and three spot dascyllus (*Dascyllus aruanus* and *D. trimaculatus*) and sapphire devil (*Chrysiptera cyanea*) are the most popular species, but angelfish, hamlets, damsels and blue tangs are also in demand. An estimated 20-24 million fish, 11-12 million pieces of coral, and 9-10 million other invertebrate species are traded each year. Around 1.5-2 million people have marine aquaria, of which almost 50% are in North America and 25% in Europe.

South East Asia, particularly Indonesia and the Philippines, currently supply over half the marine fish to this industry, and Indonesia and Fiji are the largest suppliers of corals and live rock, while in South Asia, Sri Lanka and Maldives are the major exporters of marine aquarium species. Sri Lanka has been identified as the world's 4th largest exporter of aquarium products in a global industry valued at an estimated US$ 200-330 million, and Maldives is rated the seventh largest. In terms of continents, Asia is the largest exporter of marine resources for aquaria, comprising nearly 55% of the total world exports. The main importers of marine ornamentals are the United States, Europe and Japan. This industry can be a viable activity if carried out in a controlled manner. Therefore it requires stricter controls and proper management. South Asian countries like Sri Lanka and Maldives have relatively good documentation of exported numbers and species as the government agencies have identified these ventures as a high income generating industry, while in countries like India no proper research or studies have been undertaken to explore the feasibility of marine ornamental fish culture as an alternative livelihood/income generating option. The levels of exploitation of marine ornamental species are quite low in Bangladesh and Pakistan.

BENEFITS FROM MARINE ORNAMENTAL COLLECTION

The aquarium industry as a whole is of relatively low volume, but of high value, thus providing more impetus for ecosystem conservation and also in providing livelihoods to coastal communities living in low income areas. Marine ornamentals have much higher value by weight than food fish, and may provide a good alternative to other forms of fishing. In South Asia ornamental species are generally collected by hand nets and, where sound practices are observed, cause less destruction to reef habitats than many other fisheries. Likewise, there is generally no by-catch of non-target species (except when damaging techniques are employed, see section below), unlike in the case in commercial fisheries for food purposes. The species involved are different from those targeted for food purposes, and if carried out with sound scientific backing and good management practices, marine ornamental species collection could serve as an effective alternative livelihood option for coastal communities. In addition ornamental fish collectors are a valuable source of information on reef condition and fish populations for MCPA managers.

POTENTIAL PROBLEMS

The above section highlights the benefits of marine ornamental species collection, but there are several potential problems in developing countries like those of South Asia, which if not addressed at the initial stages could cause severe impacts on the ecosystem and resource, thereby affecting the livelihoods of the coastal communities negatively in the longer term. These include:

- Lack of clearly stated sustainable exploitation limits for each locality, species and ecosystem, arrived at thorough scientific research;
- Inadequate infrastructure, packing and transfer technology, poor capacity/training in scientific and environmentally safe extraction methods, leading to fish mortality;
- Limitations and loopholes in legislations (export of wild collected specimens under the pretext of being cultured specimens where regulations such as CITES allow trade of cultured animals);
- Damaging techniques, generally involving the use of poisons (e.g. sodium cyanide, bleach, fish anesthetics), as well as destructive moxy nets, which are still used to collect specimens in some cases. These practices can lead to the death of both targeted and non-targeted species, including coral reefs;
- Endemic species or those with a very restricted range may be at risk if they are heavily targeted.

SUSTAINABLE MANAGEMENT

Since reef fish species are also at risk from other impacts, careful thought should be given before authorising a collection operation to go ahead in an MCPA. Collection of marine ornamentals is often regulated through national or municipal fisheries legislation and a permit is often required, while most countries also restrict the export of certain species. All corals, giant clams and seahorses are on Appendix II of CITES and so all shipments must be accompanied by a CITES permit issued by the national CITES authority.

The Marine Aquarium Council (MAC) is an international non-profit organisation, based in Hawaii that has set up a certification process for collectors, wholesalers and retailers, so that they can

U. Mistry

Anenomonefish are popular in the aquariam trade market

be certified as to the quality and environmental sustainability of their business. Certification is based on a set of 'International Performance Standards for the Marine Aquarium Trade' that covers the whole process from collection to the sales point. Thirty operations have been certified by MAC, in the Philippines, Fiji, North America and Europe, although few of these are collecting operations. Though MAC is not currently operating in South Asia, there is future potential to use this existing certification system or to learn from other global experiences. Certification requires compliance to international, national and local regulations, often includes assessment of sites before collection and implementation of a monitoring programme, and the formation of no-take MCPAs as replenishment areas within certified collection areas.

KEY POINTS FOR THE MCPA

- If an aquarium collector or dealer wishes to set up an operation in or near an MCPA it should be in line with MCPA objectives and regulations.
- The collecting operation should ideally only be allowed to operate if it has been approved by an environmental certification scheme (e.g. a system such as MAC which requires an EIA, management plan, and monitoring), but developing and strengthening national policies and enforcement systems would be equally important.
- Careful monitoring of collectors and the numbers of specimens collected should be conducted, using, for example, the logbook methods developed in Maldives and Sri Lanka, and by checking figures against export data available from airport customs as well as by inspecting export shipments.
- Establish no-take zones, (where no commercial activity of any type can be undertaken, particularly nursery areas) and monitor no-take zones, areas where harvesting takes place and activities regularly to detect any changes.
- Adopt best management practices from other parts of the region or other regions (e.g. a rotational system of use and non-use areas is being developed in Hawaii).
- Dive tourism and collection of ornamentals may be incompatible and may have to be physically separated through zoning; in some cases the conservation and economic benefits of dive tourism may be greater because it is non-extractive. However any such economic analysis would also need to examine the distribution of benefits (e.g. which option is more beneficial to local communities).
- Ensure local community level participation and that a major portion of the profits reach the local community as the involvement of big-time players in the industry could lead to individual traders, middle-people and exporters gaining the majority of benefits.

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CASE STUDY

A Review of the Marine Ornamental Fish Trade in Sri Lanka

Sri Lanka is widely considered a pioneer in the export of marine ornamental species, starting in the 1930s. Currently over 200 species of fish and nearly 50 species of invertebrates are exported, and in 2000 the trade accounted for export earnings of over US$ 8 million. Due to concerns regarding exploitation of rare and vulnerable species and overexploitation, several species have been prohibited from export while several others require a special permit to be exported. Some collection methods such as the moxy net have been made illegal due to reef destruction, but are still widely used since enforcement is poor. Monitoring data has identified some species that may be threatened with overexploitation and further research is being planned to identify sustainable quotas for collection and export. Limiting the number of collectors has also been proposed.

Collection is carried out during a limited time of the year due to rough sea conditions as a result of the monsoons. In general, collecting is carried out from October to April on the west and south coast and April to October on the east coast. Although this natural closed season could be expected to provide some time for fish populations to recover, it is very short and may have only limited impact in view of the reproductive patterns and growth rates of fish. It may also vary significantly between species. More research is needed on this topic.

Other than the Hikkaduwa National Park, collection of ornamental species is allowed within other MCPAs in Sri Lanka. There has been a growing recognition within the industry to improve management of harvesting reef resources and to employ better collection practices. Exporters and collectors have supported awareness campaigns and reef cleanups through financial and in kind contributions, highlighting the potential opportunities for collaborative action.

In order to protect the coral reefs the export of all species of hard and soft corals and gorgonians has been banned. International regulations such as CITES also limit the trade of some species. Efforts are being made to culture species restricted by CITES, for example captive breeding of seahorses for export is being carried out and further research is being conducted into culturing other species.

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Marine curios 19

Many MCPAs have shops or stalls that sell marine curios and visitors often want to know if they can collect shells and pieces of coral from the beach. Marine curio collection is often discouraged, although sometimes the same species are used locally for food. It may therefore be difficult for an MCPA manager to decide which activities are allowable. This sheet gives background information on the impact of marine curio collection and some guidelines on appropriate policies for an MCPA.

Marine curios, and handicrafts or souvenirs containing marine products, are sold to visitors and tourists throughout South Asia, often in the vicinity of MCPAs and in some cases within them, either by beach hawkers or even in shops managed by the MCPA. Corals, molluscs with attractive shells, starfish and pufferfish are particularly popular.

Gastropods and bivalves have been collected for centuries both as individual or 'ornamental' shells and for shellcraft (jewellery and handicrafts that are made of shells). In South Asia, cowries from Maldives were historically used as currency, Chanks (*Turbinella pyrum*) have been used for ornamental purposes in India and Bangladesh, and Pearl Oysters are collected and exported from Sri Lanka for the jewellery industry. Shells are still collected in fairly large numbers for sale to tourists, for export and for some handicraft industries. In many areas shell collection provides an important source of cash income for local communities, and also a source of food since some of the species are edible (e.g. *Lambis* spp.). Collection is carried out by men, women and children, generally on reef flats during low tide. Men may also collect shells while snorkelling or diving. In Sri Lanka the operculums of *Chichoreus ramosus* are harvested by removing them from the live shell using a special instrument. The animal is thrown back into the sea and many collectors believe that the animals survive and grow back an operculum, however, it not known whether these animals survive. The operculums are exported to the Middle East to be used in the production of a base for perfumes.

IMPACT

With regards to marine molluscs in particular, little is known about the status, population sizes and distribution of most species involved, and so the extent to which shell collecting poses a threat is poorly understood. Anecdotal evidence, particularly the observations of traders and retailers, suggests that many species are declining in size or becoming rarer, particularly those with the larger more attractive shells such as large cowries, helmet shells, the Giant Triton (*Charonia tritonis*), and Chanks. Field observations in Sri Lanka confirm that Chanks are now mostly confined to depths of 30m or greater.

Shells washed up on beaches are invariably damaged or have lost their shine and gloss and thus much of their value. Tourists and visitors nevertheless often find beach washed shells attractive. However, shells of dead molluscs have two roles: once broken down they contribute to the formation of sandy beaches (in some places beaches may consist entirely of sand made from shells) and they provide homes for hermit crabs. Shells destined for sale or as collector specimens are almost always collected from live molluscs, thus having a direct impact on populations. An additional impact of shell collecting is damage to the habitat, as collectors overturn rocks and corals on the reef flat in search of them.

MANAGEMENT

The lack of information on the impact of shell collection means it is difficult to determine the best management approaches. Collection of marine curios within an MCPA is often banned or controlled, as part of general regulations prohibiting the collection of living animals. In most countries, live molluscs can only be commercially collected and sold under licence (usually from the Fisheries Department), although such regulations are poorly enforced in South Asia. Most countries in South Asia protect certain species such as corals, turtles, and some shells under national legislation. Often however, protected species are openly sold in tourist shops adjacent to an MCPA. International trade in some marine curios is regulated, and MCPAs should be aware of this and inform visitors. Stony corals and giant clams are listed in Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) which means that export and import is allowed but only with the appropriate permits. Turtle products, such as carapaces and jewellery made from the shell of hawksbill turtles were once widely sold but their trade is now strictly controlled, but all marine turtles are listed in Appendix I of CITES which means export and import is prohibited.

G. Sriskanthan

These chanks collected in Tamil Nadu, India, will end up being processed for the curio trade

KEY POINTS FOR THE MCPA

- Ensure that regulations concerning marine curio collection in the MCPA are in place, are clearly understood by all MCPA staff and are posted in public for tourists and local people.
- Discourage tourists from collecting shells while snorkelling or diving and educate local boatmen so that they do not promote this activity; discourage collection of dead shells from beaches within an MCPA, particularly whole large ones.
- Do not allow the sale of shells, corals or other marine curios (particularly of protected or CITES-listed species) in the MCPA, either on the beach or in souvenir shops, as this gives a bad impression, may be illegal, and may promote an unsustainable practice.
- If there is good evidence to suggest collection of certain species is sustainable and in line with the management aims for the MCPA, allow this and explain how this is an 'eco-friendly' activity.
- Encourage research and monitoring on molluscs and other marine curios, involving local people and visitors where feasible.
- Provide information on molluscs, corals and other species used as curios so that visitors understand their importance as living animals.

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CASE STUDY

Shell Collection in St. Martins Island, Bangladesh

St. Martins Island, under the purview of Jinjiradwip and Jinjira Reefs MCPA in Bangladesh, is facing numerous anthropogenic threats, including curio collection. Collection of corals, shells, and sea urchins is carried out to supply tourist shops around St. Martins Island and Cox's Bazar. Items are also exported to countries where collection is prohibited. Major items traded are corals, molluscs, and sea urchins. Indiscriminate extraction has resulted in a reduction in numbers of popular species such as Cowries (*Cypraea* sp.) and Olive shells (*Oliva* sp.).

Shells are collected mainly by children during low tide, while some adults also engage in shell collection. Surveys indicated that 24 people were directly involved in collection during 2001-2002. Most of the items are collected live. Molluscs are buried to allow the flesh to decompose and the shells are then boiled and soaked in chemicals to clean them. Corals are soaked in bleach to remove the live tissue. The wholesale price for 100 small cowries is around US$ 1, while 100 sea urchins are sold at US$ 3. The cowries and other small shells are then sold at US$ 1/kg and sea urchins at US$ 0.13 each at Cox's Bazar.

With the declaration of St. Martin Island as an Ecologically Critical Area (ECA), prohibition of the existing curio trade was gradually introduced by the St. Martin Pilot Project from 2000 to 2001, and awareness and enforcement was conducted by various government agencies and NGOs under the National Conservation Strategy Implementation Project. Since then there has been a decline in the collection and trade of curios observed during the tourist season (September-April), but trade in souvenirs, including protected species, is still carried out. Management of wild collection and regulation of the trade at Cox's Bazar, together with increased awareness among visitors is essential to protect the remaining coral reef resources in Bangladesh.

Tourism policy and planning J1

Tourism and recreation are important activities in most MCPAs in South Asia, providing revenue and livelihoods for local communities as well as funding for MCPAs. However, they also have the potential for a negative impact. This sheet emphasises the need for clearly defined policies and plans to assist with tourism management.

Tourism is one of the largest global industries, much of it focused on coastal areas. MCPAs are becoming more important in determining the extent to which tourism focuses on the attractions of relatively pristine natural attractions is successful. A visit to an MCPA is increasingly part of a coastal holiday for foreign visitors, as well as an outing for local residents. Investors often want to construct tourism facilities near an MCPA, as this gives them additional marketing value. Visitors and tourism operators are thus key stakeholders in the MCPA, bringing benefits through revenue and employment. Tourism can however have both direct and indirect negative impacts through: increased resource use (for both food and souvenirs); habitat destruction and pollution through construction and development activities; social and cultural impacts; physical damage to sensitive habitats such as coral reefs and mangroves through direct recreational activities, and disturbance of wildlife.

Many MCPAs in South Asia have the promotion of tourism and recreation as an objective and thus need a clear policy on the type of tourism (e.g. high value, low impact) and number of visitors to be encouraged. A plan for preventing and mitigating adverse impacts, whether these originate inside or outside the boundaries, is also required. Additionally, planning can be linked to local communities, understanding their role in local tourist industries and ensuring that adverse impacts are minimised, while benefit sharing and accrual are maximised. Similarly, private sector, government and other stakeholders need to be considered as beneficiaries, as well as service providers of tourism, and costs/benefits in connection to these groups need to be understood. There is much literature providing guidance on sustainable tourism, as well as international schemes that give recognition to initiatives adopting high environmental and social standards. An MCPA may be able to link with one of these, or learn from these approaches.

POLICIES AND PLANS

The policy should lay out how the MCPA can maximise benefits from tourism while minimising environmental damage and conflict with local stakeholders; it should reflect national tourism policy and development plans. A tourism plan may be part of the management plan, a stand-alone document, or combined with a site tourism development plan if tourism is important. It should give:

- An explanation of the objectives of the MCPA that relate to tourism and recreation, the activities to be encouraged or excluded in different zones, and the facilities to be provided;
- The national context (e.g. tourism growth rates, impact of global or national socioeconomic events) and policies concerning tourism development;
- Carrying capacity and limits of acceptable change (see sheet J2);
- User fees and other income from tourism and local visitors, recognising that the latter are likely to provide less revenue but that their support for the MCPA is essential; and the extent to which tourism/recreation is expected to provide income for the MCPA and other protected areas in the national system, including details of how these funds will be allocated with attention to benefit sharing arrangements that take into consideration all stakeholders;
- Interpretation and education activities;
- Recognition that tourism activities and infrastructure must respect MCPA regulations and national legislation; these should meet required standards and demonstrate best practices; the MCPA will benefit from this through good publicity and potentially tourism awards;
- The roles of the MCPA, government agencies, the private sector and local communities in tourism development in and adjacent to the MCPA, and any potential or existing conflict between this and other economic activities e.g. fishing;
- Monitoring (see sheet G6); key parameters to monitor include visitor trends, social and environmental impact of visitors, quality of the service provided, whether visitors' needs are being met, and their perceptions of the MCPA (e.g. use questionnaires or a comments book).

M. Nightingale

Diving is becoming an increasingly popular tourism activity

KEY POINTS FOR THE MCPA

- Be aware of national tourism policies and plans and participate in discussions about tourism developments that relate to the MCPA.
- Ensure that there is a policy, strategy or plan if tourism is important to the MCPA, carrying out marketing research to determine the type of tourism that can be attracted and consulting with all stakeholders; prepare this in advance of approaches by investors.
- Develop a good relationship with tourism operators and encourage them to support the MCPA, financially or through management activities (e.g. beach clean-ups, removal of COTs, monitoring); develop a promotional strategy to encourage tourism in the MCPA (as appropriate) targeting tourism operators; inform them in advance about proposed changes in regulations or fees, and make the management plan available; offer to provide information to guests and clients.
- Assess whether tourism and recreation companies operating or wishing to operate in the MCPA will have a positive or negative impact (the CELB/ CORAL/ IHEI/TOI guidelines can assist with this) before approving operations, and help to promote local culture and traditions (e.g. songs and drama).
- Encourage community-operated initiatives which are environmentally sustainable.
- Respect EIA requirements and regulations when constructing tourism infrastructure within the MCPA.

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The Nature Conservancy - http://nature.org/aboutus /travel/ ecotourism/resources/

UNEP Tourism Programme (Division of Technology, Industry and Economics) - www.uneptie.org/pc/tourism/

The International Ecotourism Society - www.ecotourism.org

CASE STUDY

MCPAs for Dive Tourism in Maldives

Maldives consist of 23 atolls and 1,190 coral islands. Due to a relatively low population the extensive coral reefs of the country have been a major attraction for scuba divers from around the world. Tourism and fishing are the two main economic sectors, with tourism now the largest contributor to GDP. Growth of the tourism industry has been carefully regulated by the government by limiting the number of resorts permitted, and planned developments require a detailed EIA process for construction and adherence to operational guidelines on a variety of issues such as waste disposal, recreational activities, and cultural impacts.

Maldivian resorts and dive operators have taken a lead role in marine conservation, and the tourism sector provides most of the physical reef management. Though some individuals do not always follow regulations and dive operators don't always have the capacity to enforce rules effectively, most hotels actively try to promote responsible snorkelling and diving, and dive operators require divers to adhere to regulations designed to minimise physical impacts to the reef. Fishing and exploitation of sand and coral rock has been significantly reduced around resorts and dive sites due to conflicts with tourism interests. All existing MCPAs in Maldives were declared based on requests by the tourism industry, and although active management is inadequate, fishing has been reduced due to the efforts of dive operators. Currently, 30 sites have been declared as MCPAs, many of these protected dive sites, while the 'house reefs' around resort islands are also used only for recreational purposes, as controlled by the resorts that are in charge of them. Sometimes this can include extractive use, as house reefs can be used as a fishing resource for resort restaurants and for sport fishing for guests. Many resorts have initiated programmes to adopt a neighbouring island by investing in infrastructure such as healthcare and education. Revenue from the sale of souvenirs to tourists generates further income for the community. This ensures direct benefits to the community from tourism and provides an incentive for locals to refrain from resource extraction around resort islands.

Tourism is also strictly controlled to minimise cultural impacts. Visits to local communities are organised by resorts and visitors are not permitted to visit other islands or stay overnight. Initially, a large number of those employed in the tourism sector were from other countries while most resorts were also owned by foreign investors. However, there is a growing trend for Maldivian owned hotels, along with an increase in the number of locals working in resorts. This will lead to greater benefits for local Maldivians and the economy as a whole.

Other sources include:

World Tourism Organisation - www.world-tourism.org

Green Globe - www.greenglobe21.com

World Tourism and Travel Council - www.wttc.org

Planeta.com - www.planeta.com

Tour Operators' Initiative - www.toinitiative.org

Conservation International – Center for Environmental Leadership in Business –Travel and Leisure Programme - www.celb.org/xp/CELB/programme/ travel-leisure

Carrying capacities and limits of acceptable change

J2

MCPA personnel may devote a large part of their time to management of visitors and recreational activities. An MCPA manager may want to quantify or predict at what point environmental damage may occur from this and so needs to understand the concepts of carrying capacity and limits of acceptable change. This sheet provides information on some of the key issues to consider.

Promoting recreation and tourism so that visitors can learn about and appreciate an MCPA, without damaging the values for which it was established, can be challenging. Visitors potentially have many negative impacts including disturbing wildlife, trampling vegetation, eroding trails, leaving rubbish, removing 'souvenirs' and damaging reefs. Tourists may also unknowingly offend cultural standards, for example through improper dress or by taking photographs of people or traditional sites.

Visitors to an MCPA have different expectations of facilities and recreational and learning opportunities depending on their backgrounds and experiences. They also differ in their spending patterns and preferred activities. The main activities of interest are wildlife viewing, scuba diving and snorkelling, other water-based activities (e.g. swimming, sailing, windsurfing), recreational and sport fishing, and hiking. It is rarely feasible to meet all requirements, and some expectations may be inconsistent with the objectives of the MCPA. But it is important to understand the main characteristics of different types of visitor, so that at least some of their interests can be matched with what the MCPA can provide. Many tourists visiting an MCPA want to increase their understanding of marine life and what the MCPA is doing to reduce threats. Education and interpretation programmes, materials and facilities are therefore very important (see sheets J1 and J5) and can greatly increase visitors' enjoyment and appreciation.

CARRYING CAPACITIES AND LIMITS OF ACCEPTABLE CHANGE

An MCPA manager needs to know how much use the MCPA can withstand. The optimum number of visitors or of any particular activity within an area (i.e. how much is possible before damage occurs or the visitors' enjoyment is substantially decreased) is known as 'carrying capacity'. Quantifying carrying capacity is very difficult, and it will vary for each MCPA depending on ecological conditions, the resilience of ecosystems to recover from disturbance (which may vary over time) and the behaviour of the visitors. Often the information needed to estimate this is not available.

The concept of Limits of Acceptable Change (LAC) may be a more practical approach in that standards are set for the minimum acceptable conditions (note that these are not the desired conditions, but they are also not unacceptable). This involves defining the limit of ecological or sociological change (which may involve some degradation) that will be allowed at a site. The management actions needed to prevent change beyond the limit can then be identified. Monitoring is essential to indicate the point at which management should intervene i.e. when the minimum acceptable condition is reached. The LAC approach has been applied in Saba Marine Park, Netherlands Antilles. South African National Parks have developed another method, based on what is termed 'Thresholds for Potential Concern' for determining when management intervention is needed in a certain situation.

Most published studies looking at carrying capacity issues and MCPAs are concerned with the carrying capacity of coral reefs for divers. Research in the Red Sea and Bonaire (in the Caribbean) indicate a maximum of 5,000-6,000 divers per dive site per year but there is great variation between reefs. Large numbers of divers and snorkellers may in fact cause less damage than fishers using unsound fishing methods. Few studies have measured the number of fishers that a reef can support, although figures on sustainable yields (i.e. kg of fish per hectare per year) provide one estimate. There are conceptual limitations to the application of the carrying capacity approach in this way. In the case of diving, it assumes that the amount of diving is a reliable indicator of damage to the reef, whereas the behaviour of divers, the activities they carry out, and the physical and ecological characteristics of a reef all affect this. Additionally, what would be more useful is to look at the total impact of diving versus fishing on a larger area and the relative impacts of each of these activities on more than one component of biodiversity. Spending resources on trying to quantify carrying capacity may therefore not be useful, as figures generated would not be applicable indefinitely and would vary in different parts of an MCPA.

Thus, carrying capacity may have limited practical application. However, it is important to be aware of the concept and to recognise that too much use will ultimately damage the habitats or species within an MCPA, the cultural and heritage values, social customs and the visitor experience itself. The LAC approach to MCPA management is a more holistic and useful way of creating a framework for sustainable use, and the MCPA manager should try to apply LAC principles to their MCPA.

MINIMISING VISITOR IMPACT

If it seems that an MCPA is suffering from too many visitors, actions that can be taken include:

- Seasonal or temporal limits on use, e.g. limiting visiting times, or restricting car parking, accommodation facilities or public transport;
- Regulating group size, particularly for specialist activities, or requiring pre-registration (visits only by prior arrangement), and providing guided tours that allow for more control, ensure visiting occurs at appropriate times of day (which may vary diurnally and seasonally), and maximise enjoyment for visitors by increasing wildlife viewing opportunities;

M. Nightingale

High densities of tourists in beach areas can result in environmental and resource management issues

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- Ensuring that visitors stay on specified routes and do not trample vegetation or disturb animals, and that noise and the use of light at night (e.g. during visits to turtle nesting beaches) is minimised;
- Using zonation e.g. closing areas to visitors, or reducing visits to ecologically important areas. Demarcate areas clearly to show where visitors are allowed and where they can or can't go unsupervised;
- Increasing entrance fees at peak periods;
- 'Site-hardening' – i.e. constructing facilities and trails that reduce impact but allow more visitors and help them to see the wildlife, e.g. boardwalks (see sheet J8), hides and pontoons;
- Providing rubbish bins and information boards, to encourage visitors not to leave litter.

Visitor guidelines and codes-of-conduct can be made available at the MCPA or distributed through tourism facilities. The standard advice of 'take only photographs, leave only footprints/bubbles' is always valid. Good guides can make a big difference to a visitor's experience and willingness to return. A good guide should be able to help tourists understand the best way to view wildlife, be well informed of global and local environmental issues and preferably have some knowledge of the languages of the most common visitors. Guides should provide a briefing on safety and appropriate behaviour before a visit starts, and ensure that the MCPA regulations are observed. Field guides, maps, charts, checklists, first aid, and drinking water should be made available as appropriate. A guide should be able to say 'I don't know' if that is the case when asked a question, should never offer an experience that is not feasible and should explain that some species may be difficult to see. It may be necessary to adjust interpretation programmes to match the abilities of tourists.

KEY POINTS FOR THE MCPA

- **Make sure all staff know how to welcome and deal with visitors through appropriate training, particularly for those who will act as guides; enforce regulations in a friendly manner.**
- **Make available codes of conduct for particular activities, and ensure that MCPA personnel are familiar with them and can explain why certain activities and behaviours are not allowed. Ideally MCPA personnel should be properly trained according to a broader nationally or globally endorsed guiding system that could be part of an accredited system.**
- **Provide details on when and under what circumstances photography is appropriate and how visitors can best interact with local communities.**
- **Ensure impact and benefits of visitors are monitored; bring the LAC approach into the planning framework for the MCPA if appropriate; if doubt exists that damage may be occurring due to visitors, use the precautionary approach and limit numbers.**
- **Provide activities to involve visitors and opportunities for them to help either financially or in kind; provide a guest book and ask for suggestions.**
- **If appropriate, consider developing a Visitor Risk Management Programme as part of the emergency procedures for the MCPA (see sheet D4).**

Sources of further information

(see also J1 and J6)

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Publicity materials and promotion J3

Publicity materials and other promotion tools (often referred to as 'communication' tools) are essential for raising awareness about the issues that an MCPA is addressing, and for education and advocacy. Developing the appropriate skills and experience among MCPA staff is important. This sheet describes some of the approaches and materials that can be used.

Publicising and promoting an MCPA is essential for many reasons, including:

- Raising awareness among stakeholders on the benefits of the MCPA and encouraging their participation;
- Changing people's thinking and behaviour in relation to a particular issue (e.g. destructive fishing practices, waste disposal);
- Informing a wider audience about the MCPA and its achievements and any changes in regulations or management activities;
- Raising awareness about the MCPA at regional and international levels to strengthen linkages;
- Assisting with fundraising.

Tools for communicating information about the MCPA and its activities include printed materials, videos, websites, the media (TV, radio, newspapers) and exhibitions and special events.

PRESENTATIONS

Good oral communication is very important but is often difficult. Speaking in public and to the media requires skill and if unsuccessful can have negative impacts. Public speaking skills can be easily improved through training and practice. Some MCPA staff, particularly the manager and public relations or community development officers, may need to present to the public regularly and so training will be beneficial. Different types of presentations are required depending on the purpose and target audience (politicians, donors, communities, visitors, scientists) and it is important that the content is adapted as appropriate. Decision makers, such as Ministers and politicians often have many pressing matters to attend to, and may not be technically familiar with the subject matter. As such outreach materials for this audience should be eye catching and use simple language with minimal text and bright graphics that include photographs and graphs. It is often tempting to use a presentation prepared for another purpose to save time, but in the longer term this may not be effective.

A 'communications strategy' is a useful tool for planning and fundraising, and is sometimes part of the MCPA management plan. It should define target audiences, the types of materials and products most suitable, the issues to be addressed and the time scale. Conservation International has developed a strategic planning tool (see further information) which can be used to identify the problems, public, products and plan that are needed for effective awareness raising and communication. Note that environmental education (see sheet J4) includes similar activities to awareness raising but involves a more structured approach to help children and adults learn.

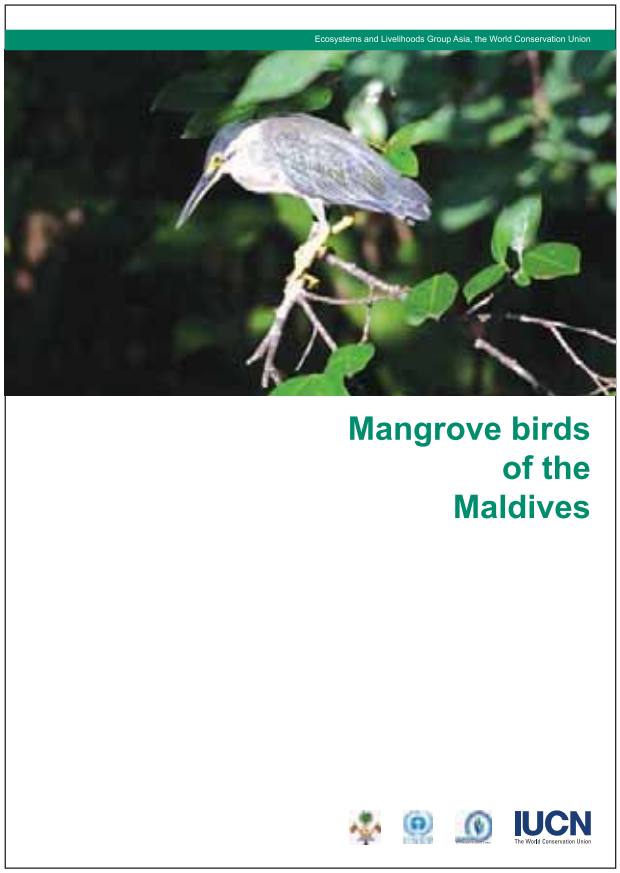
PUBLICITY MATERIALS

The publicity materials listed below are merely suggestions for the types of materials that can be used to support promotion of an MCPA. It should be emphasised that the MCPA management should carefully prioritise what kind of materials would be most useful. Available funds and priorities should dictate what kind of materials need to be produced, and, depending on the circumstances, the production of communication and publicity materials may be a priority (e.g. getting information out to communities in MCPAs where there is conflict over resource use).

Posters – Relatively inexpensive and can be displayed in numerous locations, such as the MCPA buildings, public buildings, community halls, and schools. Designs should be kept simple and eye-catching, with minimum text and a strong clear message and large font.

Leaflets – Generally inexpensive and can be used for advertising events and short term activities. A general leaflet about the MCPA is also useful. At a minimum this should provide background information on the establishment of the MCPA, list the goals of planned activities, the issues being responded to, and key partners involved.

Longer brochures and pamphlets – Useful for describing the MCPA in more detail, or for specific topics of interest.



IUCN

A leaflet produced on mangrove birds for use in Huraa Mangrove Nature Reserve, Maldives

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Newsletters – Should be produced at regular intervals and on time. Choose a catchy, easy-to-remember name and use clear headings and pictures. Length and format should be as simple as possible, and costs kept low. Many newsletters are produced irregularly (sometimes just once) and give a poor image of the MCPA.

Calendars – Have the advantage that they are displayed for at least a year and often have space for different messages and images. Messages can be tailored for MCPA user groups and local languages.

T-shirts, caps, badges, stickers, key-rings, drinks coasters, etc. – These can be sold to visitors and used as gifts and prizes. The quality of materials and whether the print is UV resistant varies considerably, and samples should be assessed beforehand.

Display boards – Can be purpose made for use at exhibitions and events, or can be simple, locally made, weather-proof boards fixed in suitable locations and used to advertise events or special activities. Regular checks are needed to ensure that notices and displays continue to be legible and intact (see sheet J5). Publicity tools that do not involve printing include:

Websites – These are now considered essential but require careful design, hosting and maintenance, all of which generate costs to keep the site up to date;

Video – Production (and screening) of a video requires careful thought. The costs can be considerable but will vary immensely depending on the scale of the production (a 30 minute documentary might cost anything between US$ 5,000 - 20,000), but a video can disseminate a message more strongly and more widely than printed material.

The above require specialised skills, and the work usually has to be contracted out to designers and printers. Costs vary depending on quantity and quality. The design cost is usually fixed, but printing costs depend on the number of copies required (cost per individual copy becomes cheaper the larger the print-run). It is always important to obtain at least three quotations, and to find out the cost of additional print-runs.

The number of items or size of the print-run required, as well as how the materials will be distributed and whether different language versions are required need careful thought. There is no point in producing materials if they are not distributed and used, and the effort and costs involved in dissemination can be substantial (e.g. purchase or hire of projector and/or generator for screening videos; postage or vehicle costs for distributing posters and leaflets). Remember that some publicity materials will go out of date quite quickly if the MCPA is being actively managed. Many MCPAs will also have stakeholders that use different languages, and so the additional cost of translation must be balanced against the need to get information to all stakeholders.

INTERACTING WITH THE MEDIA

Effectively interacting with the news media and the general public can greatly increase awareness around particular issues faced by an MCPA, and increase support for effective resource management. Newspapers, radio and TV reach large audiences, but care must be taken to ensure that the correct messages are being printed or broadcast. Particular skills are involved in preparing press releases, which must be interesting and factual. Often the first message received by the public will carry the most weight and will be used to contrast new information. The following tips can help to make an initial message more successful:

- It is important to present a short, concise and simple message, using non-technical language;
- Present only relevant and factual information, avoiding lots of background information;
- Make a brief introduction to yourself and your organisation/ agency/MCPA. This can be done in one or two sentences and should not be laboured;
- Repitition can help to highlight key messages;
- Make use of eye catching images and graphs ensuring that these illustrate key points and are relevant to the text.

The establishment of contacts within the media is always useful. Regular stories in local newspapers (or a regular column) about the MCPA can be an invaluable means of integrating it into community life. When interesting events happen in the MCPA (e.g. whales observed passing through the MCPA, coral bleaching event, visit by an important dignitary, a school trip, or workshop), inform the media and provide the necessary information for a story.

A press conference may be called for if the MCPA has an urgent message or recommendation to give to the public, or if regular updates on a specific issue have been requested. Successful press conferences require a lot of preparation and it is important that all parties agree in advance as to the subjects that will be covered and who will answer different types of questions. A short written press release (2 sides) should be distributed at the event to reinforce the messages and facts presented. Limit the number of spokespeople at a press conference to ensure a consistent message.

SPECIAL EVENTS AND EXHIBITIONS

Publicising the MCPA through exhibitions, talks and displays at trade fairs, local museums, schools, fish markets and activities organised by NGOs should all be encouraged. Drama and puppet shows in schools are also effective. If facilities allow, it is worth considering how online services such as daily blog updates, webcams, and video feeds, or the use of a mobile 'road-show' can be used to link the MCPA to more distant schools, communities, organisations.

Sources of further information

GreenCom (Strategic Participatory Communications): www.greencom.org - provides resources and information.

IUCN Commission on Communication and Education: http://cec.wcln.org - provides information and resources on communication, media and public relations.

Environmental Education and Communication for a Sustainable World: A Handbook for Intnernational Practitioners. 2000. www.usaid.gov/environment/greencom

Abadia, R., Castro, F. & Castro, H. 2006. Designing a Communications Strategy: The 4P Workshop. Conservation International, Washington, D.C, USA. www.envcomm.org/4P.pdf

Lemay, M. & Hale, L. 1989. Coastal Resources Management: A Guide to Public Education Programmes and Materials. Kumarian Press, W. Hartford, Connecticut, 57pp.

Parr, S. & Fielding, P.J. 2003. Module 5. Communication and Public Relations. p. 149-186. In: Francis, J., et al. (eds.) Training for the Sustainable Management of Marine Protected Areas: A Training Manual for MPA Managers. CZMC/WIOMSA.

Salm, R.V., Clark, J.R. & Siirila, E. 2000. Marine and Coastal Protected Areas: A Guide for Planners and Managers. 3rd Edition. IUCN, Washington, D.C., USA.

SEACAM. 1999. From a Good Idea to a Successful Project. A Manual for Development and Management of local level projects.

KEY POINTS FOR THE MCPA

- Dissemination requires knowledge of the audience, what they can do, and what information they need to affect changes in behaviour. Before initiating any awareness-raising activity, identify the message and the target audience clearly, and the most appropriate method and language for communicating the message (e.g. what is the level of education/awareness, including literacy, of the audience and the most appropriate language of communication?).
- Recognise that, other than direct stakeholders who should be involved in the management process and informed in a systematic and regular manner, there will be a range of different, key target audiences that need to be communicated with (e.g. other government departments, private sector, more distant urban populations).
- Check all publicity materials, press releases and other products for accuracy, and ensure that they are in line with agreed policy. Disseminating incorrect information about an MCPA can do more harm than disseminating none, and mis-reporting of controversial issues can be very damaging – the media unfortunately often prefer to report on a controversy or negative event rather than on something positive.
- Keep the messages to be delivered concise (KISS = Keep It Simple and Straightforward). Messages should be interesting, avoiding unnecessary background details. Pictures, diagrams and images should be used whenever possible since 'a picture paints a thousand words'.
- Develop a 'house style' or design theme that is used for all publicity materials, incorporating the logo where appropriate; this helps to make materials about the MCPA immediately recognisable.
- Following dissemination of publicity material, evaluate and quantify their usefulness so that improvements can be made in the future. Feedback and photos from event participants can be also be used to highlight the outputs and demonstrate impacts of activities.
- If there is a website ensure that materials are uploaded to the site and are easily accessible.
- Develop a logo – either for the MCPA itself, or for the management agency.

Educational activities J4

Careful thought should be given to developing environmental education programmes, especially in MCPAs where this is a specific objective. Educational activities are often carried out without any planning. This sheet gives a broad overview of the many opportunities available, and suggests how a more comprehensive approach can be taken.

The management plan for the MCPA may provide a frame¬work for developing an educational programme, but this is often overlooked. By working with schools, fishing groups, private sector and local government departments, as well as other government departments (e.g. departments associated with fisheries, ports, mineral exploitation, livelihoods etc), the MCPA can help to stimulate environmental awareness and to develop local capacity for marine resource management. The target audiences for educational activities will depend on the specific issues, sources of threats to the MCPA, and opportunities for building support. MCPAs are often more exposed to international issues than local organisations and can provide broader information of educational interest. This sheet specifically concerns education, but is closely linked with awareness-raising (see sheet J3).

TARGET GROUPS

It is important to identify the target groups, their needs, and how the MCPA can help before starting an education programme. These might include:

Universities and institutions - The MCPA can provide a venue for, and assist with input into, field courses and training activities.

Schools - Developing a joint environmental education programme, including workshops for teachers. Activities should be linked to the curriculum, so that both pupils and staff can see the relevance of the MCPA to broader issues that are being taught, and exploratory activities, such as field trips, should be encouraged and supported where possible (see case study on the Lakshadweep Islands). A good contact point within the school is essential for liaison with staff and parents.

General public and local communities - The MCPA could organise short courses (e.g. for fishers on fisheries management), one-day events, or talks and lectures (e.g. by visiting researchers). With local communities, discussion of topics such as first aid, coastal dangers or swimming may be a good icebreaker before moving on to subjects such as sustainable fisheries or MCPAs.

Tourists and casual visitors - Visitors may be equally interested in educational activities aimed at local people or schools, so advertise these and allow attendance by as many people as possible.

TYPES OF EDUCATIONAL ACTIVITY

The most successful learning is often that done through personal experiences and reflection, combined with 'sense experiences'. The five senses (touch, sight, smell, taste and hearing, in order of importance) can be used to maximise learning (e.g. through touch tanks or feel boxes). The manual by Doody et al. (see Sources of information) describes such activities and games for the classroom and for outdoors. If the MCPA has a visitor or interpretation centre (see sheet J5), activities can be based around its facilities. It is beneficial to involve local museums, the business community, and environment groups or wildlife clubs.

Non-field based activities tend to be cheaper to organise and include board and card games, jigsaw puzzles, and quizzes that can be designed to suit the MCPA. Others include visits to museums; variety shows with plays, mime, poems, story telling, environmental songs, or puppets; art activities, including costumes for plays and creation of displays; radio, TV, and video programmes with discussion and follow-up; sport and art competitions; recycling and handicraft projects; and special awareness-raising events (e.g. the Maldivian Ministry for Environment, Energy and Water organises annual events for World Environment Day, some of which focus on MCPAs).

Field activities are probably one of the best ways of creating awareness and can include: visits to intertidal flats, mangroves, rocky shores, beaches, coral reefs (glass bottom boats or snorkelling), turtle and bird nesting sites (if very carefully managed), dolphin, whale and whale shark watching, and participation in management activities such as planting beach vegetation and mangroves or clearing rubbish. Such activities can be costly as vehicles and boats may be required. Where MCPA authorities are short of funds, donors and the private sector are often eager to support such activities as long as they are well organised. Members of local communities may be able to help (e.g. providing a fishing boat for transport).

Providing incentives is a valuable means of increasing motivation for people to learn. Children are often more interested in field based activities, so these can be linked tightly with classroom work, for example, with swimming and snorkelling as incentives for completing course work. Educational programmes can also be linked with national youth award schemes where these exist, or the MCPA can develop its own system of awards and certificates.

SAFETY

Safety is a very important consideration when organising educational field trips (see sheet D4). Adequate footwear, life jackets, a first aid kit, and people trained in first-aid and life saving, are all essential. Children must be supervised when in the water. All activities that

V. Hoon

School children in the Lakshadweep Islands visit the reef and lagoon

rely on visits during low tide should be carefully planned to avoid participants being caught out in the field with a rising tide. A protocol for handling creatures (not taking them out of the water to examine them) and rocks/coral pieces (always replace them in the same position and same side downwards) is also important.

KEY POINTS FOR THE MCPA

- Develop an environmental education programme if this is appropriate, particularly if education is one of the objectives of the MCPA; if there is no education officer, find a means of obtaining the necessary staff capacity or a volunteer.
- Ensure that any school-based environmental education programme developed coordinates closely with local educational authorities, and make sure that activities are made relevant to the local curriculum if possible.
- Ensure that girls and boys have equal opportunities to participate in all aspects of any educational programme, including physical and outdoor activities.
- Develop a monitoring system to measure whether environmental awareness is increasing as a result of MCPA activities.
- Build on local, national or international celebration days and/or art, dance or song to spread the message, and ensure the education programme is sensitive to the social, cultural and religious context.
- Use existing materials as much as possible. A lot of good educational materials are available that with relatively little work can be adapted to a local context. Most organisations that have produced such material usually want to see it used and may be interested in assisting if asked.

Sources of further information

Centre for Environment Education 1999. Towards a Green Future – A Trainer's Manual on Education for Sustainable Development. Ministry of Human Resource Development, Government of India.

Doody, K.Z., et al. 2003. Experiential Environmental Learning: Facilitators' Manual. Rufiji Environmental Management Programme, Dar es Salaam. IUCN, Tanzania, 88pp. (in Swahili and English).

Francis, J., Mwinuka, S. & Richmond, M.D. 2000. A Schoolteacher's Guide to Marine Environmental Education in the Eastern Africa Region. UNEP/FAO. 40pp. - www.icran.org/PDF/EAF-SchoolTeachersGuidebook-complete.pdf

GreenCom 2000. Teacher's Environmental Education Handbook. GreenCom Environmental Education and Communication Project, USAID, TCMP, Dar es Salaam.

Wildlife Clubs of Seychelles 1999. Coastal and Marine Activity Book. Available, with other educational materials from Nature Seychelles, Mahe, Seychelles. www.nature.org.sc

Lemieux, G. Exploring The ocean and Coral Reef Ecosystem: Coral Reef Education Workbook for Primary and Elementary Grades. - www.oceanfutures.org

Shoals Rodrigues Association: can provide a range of educational materials - www.shoalsrodrigues.org

Teaching and Learning for a sustainable future: a multimedia teacher education programme - www.unesco.org/ education/tlsf/

International Centre for Conservation Education: affordable conservation education materials, including a CD on protected area case studies - www.icce.org.uk –

IUCN Commission on Education - a global network of experts in environmental communication and education; various materials available through www.iucn.org/cec/

CASE STUDY

Children's Perception of the Environment: Educational Activities in the Lakshadweep Islands, India

The Centre for Action Research on Environment Science and Society (CARESS), India, initiated a programme to work with schools on the Lakshadweep Islands during 2003-2004. The aim of the programme was to improve the knowledge that children have of their immediate environment and enthuse them to become more involved in and aware of local conservation as future 'custodians' of their local surroundings. The approach centred on the use of environmental orientation workshops for school teachers and the subsequent use of field activities with school children to incorporate local environmental and cultural features into their teachings in systematic way. The project was supported by the Ministry of Human Resource Development, Government of India and the Centre for Environment Education (CEE), India. It was carried out in 8 of the 11 inhabited islands of the Union Territory (UT) of Lakshadweep. The Directorate of Education, UT Lakshadweep was closely involved in the design and initiation of the project, providing logistical support in all the islands. It was in response to their requests that the project was designed to work at the site level on all 8 islands under the programme, instead of holding just one common workshop for teacher representatives from each island. Each island level workshop with the teachers was followed by classroom and field sessions with the schoolchildren.

The project drew on a number of different existing tools that were adapted for the local context, including a 'Green Teacher' CD developed by CEE, and the 'Ambassadors of the Environment' programme developed by Ocean Futures, USA. Teachers were trained in classroom sessions and field activities, and there was a focus on using a 'learning by doing' approach. Activities carried out with children included reef visits, mangrove planting, well water quality monitoring, and interacting with role models/experts in the community (e.g. cowrie collectors, traditional fishers, coir rope makers) to hear stories of how they use local resources. Successful tools included a web of life game, which illustrates how living and non-living components of an ecosystem are connected; helping students to understand that disrupting the food web also threatens the survival of human communities. The project found that the process of linking environmental learning to children's local environments made the topic more relevant to their lives, and was a well received and constructive approach to environmental education. The emphasis on strengthening the capacity of the teachers and ensuring that activities complemented the local curricula and did not interfere with existing curricula-based requirements, made the activity more successful. The techniques used in this project are currently being re-implemented and updated in the Lakshadweep Islands and similar activities were piloted in the Andaman Islands, India in 2008. Based on these experiences and the model used, a teachers' resource book is going to be developed in several major South Asian languages using CORDIO funding and will be made available to schools and MCPA authorities across the region in 2008.

Sources:

Hoon, V & Kanvinde, H. 2005. Children's perception of the environment: Know your island – U.T. of Lakshadweep. Centre for Action Research and Environment Science and Society, Chennai, Madras.

CEE - http://www.ceeindia.org/cee/index.html

Visitors centres J5

A centre where visitors can learn about the MCPA, and the natural environment that it has been set up to protect, is a very useful addition to the MCPA facilities and can become a major focus of MCPA activities. This sheet provides ideas on how to make such centres creative, educational and entertaining, even if resources are limited.

A visitor centre is extremely useful in helping an MCPA carry out the important task of interpretation. Good interpretation can affect the visitor's behaviour so that he/she can contribute to the conservation objectives that the MCPA has been set up for, and has several aims. These include bringing alive the meaning of the MCPA and its role, informing visitors about the marine environment and communicating to them its importance and value, as well as helping visitors to understand why the MCPA is managed in certain ways and what any regulations mean.

A visitor centre may have several components, with separate areas for displays and exhibits, meetings, talks and slide shows, as well as childrens' activities. Refreshments and souvenirs or education materials may also be sold there, ensuring that any exhibits are well protected from the eating area.

Displays and exhibits might include the following topics:

- Natural history (e.g. using touch tanks, 'guess the object' games, models, photos, specimens);
- Socio-cultural issues related to the MCPA;
- How the MCPA is managed;
- A map of the MCPA and surrounding area;
- Ways in which visitors can help with the management or funding of the MCPA.

There are several issues to consider when designing a visitor centre and its displays, including:

- Type of visitor - the main visitors need to be identified as this will affect the style and content of the displays, e.g. whether these are tourists, children, or local adults;
- Give consideration to how revenue generating features, such as a souvenir shop or restaurant, could be incorporated into the visitor centre;
- Language of displays – labels and information should include local languages and also the language of the main groups of tourists visiting the MCPA;
- Weather-proofing - protection is needed from weather (sunlight, rain) and from human contact (children touching, salty water if visitors enter the centre from the beach);
- Durability - displays and exhibits generally need to be fairly robust and durable to survive time, handling and harsh environmental conditions;
- Portability - there may be a need for components of the exhibition to be portable, for temporary exhibitions in other parts of the MCPA or for use elsewhere;
- Safety and security - theft possibilities (e.g. if exhibits such as shells are left uncovered) and threat from falling exhibits (and thus danger to visitors) need to be minimised;
- Location - siting of the centre is important to ensure that visitors are drawn to it quickly and easily.

Multi-media exhibits may be appropriate in some instances, but are expensive to install and maintain (especially in tropical coastal areas), risk breaking down, and sometimes create a 'barrier' to experiencing the real, natural environment. It is better to have something simple that is sure to work. Use the space, walls and surfaces in the display area carefully and order the exhibits so that they make sense to visitors, and perhaps follow a pattern, rather than displaying information randomly. Ensure there is good lighting of exhibits and displays, whether natural or artificial; if the exhibits receive a lot of natural light, printed materials will need to be UV proof to avoid rapid fading.

Visitors from developed countries may have high expectations of interpretation materials and visitor centres, as they are used to professional standards in their own countries. It is generally better to have a small, focused visitor centre that is well designed and of high quality, than a large one of poor quality. A mix of passive and active displays is recommended. Passive displays are those that are just read or looked at (e.g. posters, charts, specimens, models). Interactive displays include for example, live animals in tanks, 'guess the object' games, or small panels that flip up to find an answer. Make sure there is a good balance of pictures and objects and text (the latter kept very brief and in large clear font so it can be read easily, as people rarely read much). Lectures, slide shows, videos, guest talks, tours and special sessions for school children can be scheduled at appropriate times.

KEY POINTS FOR THE MCPA

- If your MCPA has no visitor centre, consider how you could create one. Do you have a staff member who could work on this? What materials do you have available?
- Donors or corporate sponsors often like to fund such initiatives as they are very visible contributions to MCPA management. Consider preparing a proposal to upgrade your centre, or create a new one if none exists.
- Obtain professional advice on preparing and maintaining displays – there will often be qualified people, such as graphics designers, based in local towns. If the displays are aimed at children, get advice from creative/innovative teachers. Museum personnel also may have good experience of display preparation.
- Ensure good upkeep of displays – neglected, faded, dusty, old displays reflect a general attitude of indifference to visitors.

CASE STUDY

Muthurajawela Wetland Sanctuary Visitor Centre, Sri Lanka

The first fully functional visitor centre in a Sri Lankan MCPA was established at Muthurajawela in 1996. The visitor centre (named the 'Marsh') was located in an old hotel building adjacent to the wetland. The main building comprised information displays, exhibitions, and a souvenir shop (called 'Marsh Memories') selling T-shirts, postcards, hats, posters, booklets and locally produced handicrafts. All displays were in local languages (Sinhalese and Tamil) and in English. A restaurant was also located within the main building complex. Both the souvenir shop and restaurant generated income for maintaining the centre while guided tours were also available for a fee.

A special children's area provided displays, 'nature plays' and games designed for children, providing fun and interactive ways to learn about the wetland. An auditorium was available for screening videos about Muthurajawela and other wetland ecosystems. A model fishing village was set up within the property to highlight local traditions and cultural practices, and a 2km nature trail was developed, consisting of dry tracks and boardwalks leading to a bird watching tower. The main attraction was a guided boat trip through the varied landscape of the wetland, which includes marshes, a river, lagoon systems and a sixteenth century Dutch canal. An organic herb garden was established to provide visitors with fresh herbs and also to provide income for local women. All staff were employed from the surrounding area in order to provide benefits for the community and increase support for the visitor centre.

A marketing campaign to promote the visitor centre resulted in an increase in visitors. Staff visited local hotels in order to highlight the wetland and the visitor centre as an attraction for tourists. Within its first year of operation the visitor centre generated adequate income to cover almost all operational expenses and proved to be a great success.

In 2001, the visitor centre had to be closed as the site was acquired for the construction of a highway. However, a new visitor centre was started in a nearby location on the initiative of the staff. The new visitor centre has retained many of the original centre's features and remains popular with visitors including school groups. The guided boat trip remains a very popular activity and continues to attract nature lovers seeking to explore the Muthurajawela wetlands.

Source:

www.cea.lk/muthurajawela.htm

Sources of further information

Eagles, P.F.J., McCool, S.F. & Haynes, D.A. 2002. Sustainable Tourism in Protected Areas: Guidelines for Planning and Management. IUCN, Gland, Switzerland and Cambridge. 183pp.

British Natural History Museum site - www.nhm.ac.uk/education

Visiting the reef J6

Coral reefs are a major attraction in many South Asia MCPAs for tourists and local visitors. Reef-related activities encourage people to take an active interest in the MCPA and perhaps subsequently support it, by giving funds or volunteering. This sheet addresses the main visitor activities that involve this ecosystem and provides guidance on how they should be managed.

Scuba diving and snorkelling allow direct observation and interaction with coral reefs and thus can be likened to walking or bird watching in a terrestrial protected area. Glass-bottom boats and guided reef walking provide a less direct experience, but allow those not wanting to get wet to see a reef at first hand. Care must be taken to prevent damage, given the vulnerability of reefs, and there are safety issues that need to be considered. Reefs are home to many creatures that can cause harm, and diving and snorkelling can be dangerous if individuals are not experienced or supervised (see sheet F8).

SCUBA DIVING AND SNORKELLING

Divers and snorkellers can cause damage by breaking corals, stirring up sediment, and disturbing animal life. Coral breakage is the main problem, caused by poor buoyancy control, careless kicking with fins, and standing on the reef. Underwater photographers and novice divers may have greater impact but experienced divers may also break corals as they tend to swim closer to the reef. Though research suggests that most divers and snorkellers have little overall negative impact on reef habitats, it is important that the MCPA management authority are able to understand and control these impacts in terms of the Limits of Acceptable Change (see sheet J2) that should form part of the management plan, in order to plan recreational activities sustainably.

Many MCPAs have codes of practice or guidelines for divers and snorkellers. Dive boat operators using an MCPA should be required to implement these codes of practices and guidelines. These include: securing trailing scuba equipment, such as gauges, and making buoyancy checks at the beginning of a dive; discouraging use of gloves to deter divers from touching marine life; and carrying out practice activities (e.g. mastering buoyancy control, snorkelling for beginners) away from coral. Novices should always be with someone experienced. Good briefings before visitors enter the water have been shown to reduce damage to coral reefs and should be made obligatory. Even very simple measures, such as explaining to visitors to ensure that they look before they step or stand while in the water and reminding them not to step on coral, can be valuable. If a beach entry is necessary, provide an access point away from corals. Monitor the impact of divers and snorkellers and limit numbers if coral breakage or other disturbance increases (see sheet J2).

UNDERWATER TRAILS

Underwater trails, whether guided or not, provide added value for visitors. These must be designed so that they do not concentrate people at fixed points, thus causing damage. On the Great Barrier Reef Marine Park (Australia), rest stations (e.g. poles and floating inner tubes that snorkellers can hold on to) have been installed. If underwater signs are used, they should be placed in areas of sparse coral cover or on sandy bottoms. They are often difficult to read, particularly for those who cannot duck dive, and need regular cleaning of algae and other fouling organisms; numbered markers, with portable waterproof information sheets explaining each point, may be a better means of providing information. Visitors should be briefed in advance about the trail, and visitor numbers and group size may need to be limited occasionally or the trail periodically closed to aid recovery. Trails should be sited away from waves and strong currents for safety reasons, and in water sufficiently deep to avoid fin damage but shallow enough to provide good viewing. A minimum depth of 2.2m is recommended.

REEF WALKING

If an environmentally sound trail can be established over a reef flat, it can provide an enjoyable and educational activity, particularly for visitors who may not wish to snorkel or dive. However, reef walking should be discouraged if it will cause damage by trampling. The impact can be minimised if the trail is sited on existing routes (e.g. those used by fishers), sand channels, and areas without living coral. It should be marked and visitors should be required to walk in single file and not stray. They should have suitable footwear, and use a pole for balance. If an organism is picked up for interpretation (i.e. for a guide to elaborate on the species and its ecological role), it should be returned to the same place; organisms attached to the reef surface should not be removed.

FISH WATCHING AND FEEDING

Colourful reef fish and large 'charismatic' open water fish are always popular with visitors, and some can be observed underwater or from glass bottom boats (as is conducted at Hikkaduwa National Park in Sri Lanka). Identification guides add to a visitor's enjoyment, and many divers like to participate in monitoring programmes (see sheet D3). Fish feeding, to increase numbers and activity, should be discouraged as it disrupts normal behaviour, sometimes making fish aggressive, and altering their diet. If considered necessary, it should take place away from areas used for fishing or research and not when people are in the water. It should be done only by trained personnel, the food should be thrown rather than fed directly by hand, and only raw fish or fish pellets, in limited amounts (max. 1kg/day/site), should be used.

U. Mistry

Snorkellers over a reef watch a turtle

GLASS BOTTOM BOATS

The greatest risk from glass bottom boats is physical damage to corals from anchoring or operating in shallow water. Boatmen should be trained and must understand the importance of avoiding contact with corals in shallow water. Boats must be well maintained (see sheet F5), and mooring buoys should be installed near popular reef viewing areas (see sheet F9).

KEY POINTS FOR THE MCPA

- A code of conduct for reef visits to the MCPA should be developed and enforced. Tourists should be given pre-departure briefings by tourism operators or MCPA personnel using or adapting existing codes-of-conduct (see sources of further information).
- Reef visits should be planned in advance, taking account of the tide, and publicised, particularly reef walks which can only be done at low tide.
- Regular meetings can be held with boat and dive operators to inform them of MCPA activities and opportunities for participation and to discuss visitor issues; if appropriate, support can be given to local communities to set up reef tourism operations.
- Responsible boat management should be required.

CASE STUDY

Reef Visits at Hikkaduwa National Park (HNP), Sri Lanka

Hikkaduwa is one of the more popular coastal resort areas in Sri Lanka. Hikkaduwa Marine Sanctuary was created in 1979 and is relatively small (44.5ha/110 acres) compared to other marine sanctuaries around the world. The sanctuary was subsequently awarded national park status, and is now referred to as Hikkaduwa National Park. The popularity of the Hikkaduwa area for tourism and the small size of the protected area have led to a conflict in resource use with significant detrimental impacts being noted on not only the coral reefs, but the broader marine and coastal ecosystem in the area. This is further compounded by the inadequate management structure and interventions, and the lack of the implementation of codes of conduct and best practices.

Local and international tourists frequently visit the reef using glass bottom boats. There are no mooring buoys installed near the reef which has led to glass bottom boat operators tossing anchors overboard onto the reef and damaging the delicate coral life. Landing of glass bottom boats on the reef flat is also a frequent occurrence during low tide, and also on high water turbid days, as boat operators try desperately to show corals to their customers.

HNP does have a prescribed zoning plan that incorporates a glass bottom boat area. This is however not well implemented and as a result glass bottom boats operate all over the reef including the reef lagoon, reef flat and outer edge of the reef. HNP would benefit from tighter restrictions on the number of glass bottom boats and specific regulations for boat operators (e.g. weight limit or type limit for food used in fish feeding) and other reef users (e.g. snorkellers).

HNP illustrates the potential pitfalls and impacts when coral reef visitation is inadequately managed and monitored.

Sources of further information

Barker, N.H.L. & Roberts, C.M. 2004. Scuba diver behavior and the management of diving impacts on coral reefs. Biological Conservation 120(4): 481-489.

CELB/CORAL/IHEI/TOI 2004. Developing a Supply Chain Management Tool: working with marine recreation providers to adopt environmental and social good practices. www.celb.org/

CELB/CORAL/TOI 2004. A Practical Guide to Good Practice: Managing Environmental Issues In the Marine Recreation Sector - www.celb.org/xp/CELB/programs/travel-leisure/tour_operators.xml

Davis, D. & Tisdell, C. 1995. Recreational scuba-diving and carrying capacity in marine protected areas. Ocean & Coastal Management 26(1): 19-40.

Dearden, P., Bennett, M. & Rollins, R. 2007. Implications for coral reef conservation of diver specialization. Environmental Conservation 33: 353-363.

Halpenny, E. 2002. Marine Ecotourism: Impacts, International Guidelines and Best Practice Case Studies. The International Ecotourism Society. Burlington, Vermont, USA. 100pp. Available for Purchase: www.ecotourism.org

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Medio, D., Ormond, R.F.G. & Pearson, M. 1997. Effects of briefings on rates of damage to coral by scuba divers. Biol. Cons. 79: 91-95.

Zakai, D. & Chadwick-Furman, N.E. 2002. Impacts of intensive recreational diving on reef corals at Eilat, northern Red Sea. Biol. Cons. 105: 179-187.

Coral Reef Alliance (CORAL) – fact sheets on coral friendly diving and snorkelling, and guidelines for tourists. www.coralreefalliance.org

Great Barrier Reef Marine Park Authority - Responsible Reef Practices www.gbrmpa.gov.au/onboard/home/high_standards/responsible_reef_practices

PADI Project AWARE Foundation – www.projectaware.org – information for divers on helping to protect the marine environment

US National Marine Fisheries Service: Shore Diving Responsible Guidelines www.shorediving.com/content/know_the_law.htm

Mother Jones Action Atlas – Divers Guide www.motherjones.com/coral_reef/dive.html

Artificial reefs J7

Artificial reefs are established for a range of purposes including fisheries enhancement and management, coastal protection, reef rehabilitation and recreational diving, but can be controversial. Different materials and structures have been used with variable success. This sheet provides an overview of their advantages and disadvantages and indicates under what circumstances they can assist with the management of MCPAs.

An artificial reef (AR) is a structure that is deliberately or accidentally introduced to the seabed and is performing the function of attracting marine life. The creation of man made structures to enhance marine resources is the basis of a specialised branch of marine technology known as 'artificial reef development' and is widely considered as a tool for protecting the natural ecosystem and enhancing fisheries production (also refer to H6 for more on coral reef rehabilitation). An AR provides shelter from predation and surfaces for larvae to settle on; the organisms that are attracted create new food sources and attract other species, thus a matured AR site (3-5 years) may also play a role in increasing biodiversity in and around the AR site. Coastal communities in some countries have traditionally used ARs to increase their catches. They are now established with the involvement of governments, the private sector and NGOs for various reasons, using a diverse range of materials from disused oilrigs, ships, vehicles and railway tracks, to purpose made concrete blocks and bamboo structures. AR construction has different purposes in different countries, for example, in the United States ARs are constructed mainly to improve recreational fisheries; in Japan, to benefit commercial fisheries; and in some European countries, to control inshore trawling and to increase fish production for rural fishing communities.

The purpose of an AR, the ecology of the targeted species, as well as the main chemical and physical parameters, determine how it is installed, the materials to be used, and whether it is an appropriate activity. Some AR may fulfill more than one purpose, but all ARs do not serve all purposes. Although they can be beneficial, there are potential negative effects, including intensification of overfishing and damage to benthic habitat through movement of the structure in storms, which must be evaluated.

ARs are usually installed for the reasons described below.

FISHERIES ENHANCEMENT

The main purpose of AR construction is often focused on the aggregation effect of different fish species attracted to the AR by the provision of shelter and an increased food supply. But despite much research, the role of ARs in fisheries enhancement is controversial. Some studies indicate that production is enhanced, but others suggest that ARs act more as Fish Aggregating Devices (FADs) (see sheet I4), concentrating fish but not increasing overall population. An AR can very quickly display high fish densities and attract heavy fishing, but the surrounding area may experience a reduction in fish populations. ARs thus potentially contribute to overfishing unless carefully managed, in which case it may be appropriate to designate the structure as a no-take area.

Ultimately there may be an overall increase in fish density due to the increase in available habitat, but this could take a long time if fishing pressure is high. Ideally an AR should develop to have similar species diversity and population densities as natural reefs nearby.

In South East Asia, artisanal fishing communities traditionally used natural materials such as bundles of brushwood, boxes of leaves and coconut palm fronds to attract fish. Now ranges of materials, including tyres, are used. The topography and height of the structure are believed to be important in attracting certain fish species.

ARs can also be used to create obstacles for trawlers and other large fishing vessels to prevent them using inshore fishing grounds. However, this should not be necessary in an MCPA and should only be attempted in close consultation with all involved. ARs can, however, reduce pressure on natural reefs by redirecting fishing and tourism elsewhere (see case study).

Seamarc Pvt. Ltd.

Coral transplants are fixed to a metal frame structure as an artificial reef creation technique in Maldives

Seamarc Pvt. Ltd.

After 3 years the growth of the corals can be seen to be significant

RECREATIONAL DIVING

For dive sites, an interesting structure is important. Preferred materials include various kinds of plastics, perhaps reinforced with fibreglass, concrete and steel, but decommissioned ships are popular because of the aesthetic value of wrecks for divers. Scrap materials however are often less durable than reefs made from new materials. The materials should be stable, non-corrosive or non-polluting and able to withstand extreme weather conditions. Wrecks must be thoroughly cleaned and materials that might result in pollution (e.g. cables, oil, paints and alloys that might contain heavy metals, and anti-biofouling coatings) or that are loose (e.g. plastics, cabling, and oil residue) removed. The vessel is then transported to the site and sunk, which can be expensive. For dive sites, ARs should be placed at the appropriate depth, usually at 20-40m, preferably on a featureless seabed, in order not to disturb the living reef.

When the artificial structure is a dive site, installation and monitoring can be carried out in partnership with dive operators. Monitoring should cover diver usage as well as ecological aspects. Photography can be used for monitoring, and provides an educational tool to demonstrate reef development (see sheet G3).

COASTAL PROTECTION

Specially designed modular ARs can be used as submerged breakwaters to protect coastal areas from erosion. This should only be considered if expert advice is available and conducted in close consultation with all stakeholders (see sheet K1).

REEF REHABILITATION

This may be necessary after impacts such as bleaching, ship groundings, and dynamite fishing and is described in sheet H6.

KEY POINTS FOR THE MCPA

- Before installing any AR, clearly define the purposes for which it is needed. MCPAs with a shortage of interesting, accessible dive sites might benefit, but a careful cost-benefit analysis is needed; if the proposed purpose is fishery enhancement, the potential role of the AR in relation to other fisheries management mechanisms must be considered. Refer to the ICRI guidelines for Artificial Coral Reef Restoration and Rehabilitation for guidance (see Sources of further information).
- An EIA may be a legal requirement (see sheet A6) but if not, a full assessment of the environmental and socioeconomic impact of the proposed AR should be undertaken.
- If coral transplantation is used in AR development, transplants must be taken with care not to negatively impact on donor sites (see sheet H6).
- If the installation of an AR is for recreation, consider partnering with a hotel or dive operator who wants to make their diving sites more interesting for tourists, and is willing to cover the costs, but lacks the scientific expertise. If the purpose is for fishery management or coastal protection, partnership with scientific institutions is essential.
- Consultation with stakeholders is essential from the start to avoid conflict with fishers and other users of the area. Relevant authorities (e.g. port) should be consulted to ensure that there is no conflict with existing or proposed shipping routes.
- The reef sites should be regularly monitored to collect scientific data in order to record any positive or negative impacts, and to clean/remove unwanted materials such as torn nets and other wastes.

CASE STUDY

Artificial Reefs in India

In India, communities have a history of constructing ARs to enhance local fisheries. During the Second World War, a ship was sunk off Anjengo fishing village, 45km north of Trivandrum (Kerala), and lies in 45m of water. The wreck, along with a wartime wreckage from the nearby Indian Space Research Organisation (ISRO) and Vikram Sarabai Space Centre (VSSC), matured into a rich artificial fish habitat that attracted many local hook and line fishermen, who benefited from the enhanced catches in these areas.

The 1960s saw the introduction of new fishing technology such as intensive bottom trawling, which degraded the productivity of local fishing grounds, and had negative impacts on dependant communities. Following this, the concept of Artificial Fish Habitats (AFH) resumed, attracting interest from the government, national and international funding agencies, and non-governmental organisations, which advanced the planning and development of ARs along the Trivandrum coast.

In May 2002, the Suganthi Devadason Marine Research Institute (SDMRI), in collaboration with the Coastal Zone Management Centre and The Netherlands, deployed ARs in the Tuticorin coast of the Gulf of Mannar with support from the local community. The deployment of the triangular ferro-cement AR modules was part of the *'India-Netherlands Water and Coastal Cooperation Programme'* for the enhancement and management of biodiversity and socioeconomics of fisher folk. Careful planning using baseline data on the ecological and biological parameters and socioeconomic status of the target population was undertaken in advance, and continuous monitoring was carried out to study the succession of biodiversity. Monthly monitoring included the collection of data on water quality parameters, plankton and productivity, sediment analysis, benthos, fishes and macro invertebrates, and daily fish landings.

The outcomes of the research demonstrated that the ARs were highly efficient in attracting and aggregating biological resources. Fish diversity in AR sites was 90.8% higher than the control site without AR modules. The presence of invertebrates also increased by 87%. When compared with control sites, catch per unit effort analysis proved that there was a high aggregation of fish (70%) and molluscs (65%) in AR sites. The AR modules also served as good substrate for coral larval settlement, featuring both branching and massive corals.

Contact SDMRI (http://www.sdmri.org/) for the final progress report of the AR project, 30 pp.

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(See also sheet H6)

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D'cruz, T & Vivekanandan, V. 1995. Impact of artificial fish habitat on artisanal fishing communities in Kerala, India. pp. 720 – 726.

Jensen, A & Collins, K. 1995. Artificial reef research in European union: A review. pp. 824 – 829.

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Websites:

Resource page on prefabricated artificial reef units - www.artificialreefs.org

Reef Ball: a US-based organisation promoting prefabricated concrete artificial reefs: Reef Ball Foundation Services Division - www.reefball.com

Reef Ball Foundation Charity Division, an associated non-profit charity that provides grants - www.reefball.org

Practical Action: Technology Challenging Poverty. Website for technical assistance - www.practicalaction.org

NOAA Coral Health and Monitoring Programme: Information on artificial reefs - www.coris.noaa.gov and www.coral.noaa.gov

ICRI resolution on Artificial Coral Reef Restoration and Rehabilitation - www.icriforum.org/library/ICRI_resolution_Restoration.pdf

Visiting the mangroves J8

Many MCPA visitors have never experienced a mangrove forest, and have no knowledge of this unique, generally muddy environment. Walks at low tide, snorkelling and boat trips at high tide and, best of all, an elevated boardwalk, are good ways to experience the forest. This sheet provides advice on how to visit mangroves, whether for educational or recreational purposes, and how to build and manage a boardwalk.

WALKS, SNORKELLING AND BOAT TRIPS

Fiddler crabs, mud skippers, wading birds and other foraging birds are just some of the inhabitants that can be encountered in most mangrove forests at low tide. In many South Asian countries, local fishers and villagers make footpaths through mangroves to allow access, and these can often be incorporated into a low tide shore walk. Alternatively, new paths can be designed perhaps with the addition of gravel or stone to consolidate the mud. Loops in paths can be included to route users through interesting areas (e.g. into a *Rhizophora* part of the forest) returning the walker to the main path further along. Damage to trees, interference with natural drainage patterns, and disturbance of the fauna should be avoided when making paths.

Snorkelling can be a rewarding experience preferably during slack high tide when the water is clear, and activities of fish and invertebrates can be observed. Clear water is usually found only in a few areas e.g. in small inlets or on offshore islands, away from large sediment-rich rivers. Care should be taken to avoid damaging branches and pneumatophores (aerial roots), as well as personal injury from attached oysters and barnacles.

Irrespective of water clarity, boat trips through mangrove forests at high tide are an enjoyable and comfortable way of viewing trees, birds and often fish. Paddle canoes are best; motorised vessels should try to keep noise levels down and minimise pollution from fuel.

MANGROVE BOARDWALKS

Walking through the mangroves along a purpose-built platform or boardwalk is the simplest, safest and most accessible for visitors. Walkways (usually made of wooden boards) provide footpaths over water and mud allowing easy access at high or low tide. The deck provides access for pedestrians, as well as cyclists, wheelchairs and children's pushchairs.

Well-situated, designed and constructed boardwalks with good information on flora and fauna can raise public perceptions and increase stewardship for the forest among users. They are a powerful tool for recreation and education in an MCPA and as such, construction and maintenance of boardwalks can be an important management activity. Examples from South Asia include: the Sunderbans in India and Bangladesh; Coringa in Andhra Pradesh, India; the Indus Delta in Sindh, Pakistan (see case study); and Muthupet, Tamil Nadu, India. In addition to the board walks, interpretation centres in Chilaw, Sri Lanka and Orissa, India provide necessary information and act as awareness generation tools. Many boardwalks are capable of generating enough funds from visitor usage to cover maintenance costs and provide a contribution to community development projects. Boardwalks in other habitats can also be a useful visitor facility like in Bhitarkanika, Orissa, India.

Design and construction

This should follow a careful assessment of the anticipated uses, and should recognise the sensitive nature of the mangrove habitat. The routing of the boardwalk must take into account the purpose of the walkway, and should try and show the diversity or extent of the forest. Negative impacts on marine and shore life should be minimised, especially during construction. Choice of the start and end points should aim to minimise possible shoreline erosion and should give an overview of the flora. Damage to trees should be minimised and the canopy left intact where possible, with paths skirting around trees. If some tree felling is needed, replacement trees may be planted where appropriate to reduce erosion and stabilise the sediments around the construction. The design and size should be in keeping with the natural setting, and aimed at being aesthetically pleasing.

The deck height must be carefully calculated. In the South Asian region the maximum tidal range is about 6m in Sunderbans and in Gujarat in India, but in the southern regions of India and in Sri Lanka it is around 2m. The mangrove zone is half the tidal range, so at sites with a 4m spring tide range, deck height at the seaward end may need to be 2m. Overall pile length may need to be 3m, to allow for a metre into the substrate; it may need to be more if the piling is

J. Tamelander

The mangrove boardwalk developed by IUCN Pakistan with DFID (UK) funding in the Indus Delta

incorporated into the handrail, or less where the tidal range is small. Deck width and length will be determined by type and amount of use (e.g. pedestrians only or wheeled vehicles as well) and cost. Deck surfaces should not retain water and may need to be smooth to meet wheelchair requirements. Spacing between wooden planking can prevent water accumulating. Banisters and handrails should be well designed for safety reasons.

Materials and maintenance

The life span of a boardwalk will be influenced by the materials used and the effectiveness of maintenance. Materials must be resistant to borers such as gribble (amphipods) and ship-worm (bivalves). Treated medium density wood (including pine) and hard woods are often used. Fasteners, clamps and bolts should ideally be stainless steel or brass to avoid preservatives. Treatment substances for wood, such as creosote and preservatives based on poly-aromatic hydrocarbons, are toxic and their exposure to sediments and water should be minimised as much as possible. Annual inspection is needed and replacement of rotten planks and piles must be budgeted for.

Financial considerations often determine whether and how a boardwalk is developed. Prices of materials vary from place to place.

KEY POINTS FOR THE MCPA

- **Investigate the options for establishing a mangrove boardwalk or other mechanisms for visitors to experience mangrove forests where diversity of flora and fauna are rich.**
- **A code of conduct for visits to the mangrove should be developed and enforced, and this should be supported by adequate staff capacity.**
- **If a boardwalk is an option, seek advice on design, construction and budgeting.**
- **Ensure proper maintenance of the boardwalk, using revenue generation activities to help cover costs where possible.**

CASE STUDY

Mangrove Boardwalks in the Indus Delta, Pakistan and the Coringa Mangroves, India

Funded by the DFID (UK) through its environment project fund in 1986, a 1km wooden boardwalk was built by IUCN-Pakistan with the participation of the local community in the Indus Delta. The mangroves in this area are of interest due to the scale of its creeks, the range of mangrove flora, and the abundance of interesting fauna. From the boardwalk it is possible to see 80 different species of birds, as well as mammals such as jackals and dolphins. Since its completion, the walkway has drawn a steady stream of local and international visitors, providing an alternate source of income to local residents who act as guides and are involved in the upkeep and management of the boardwalk. Furthermore, it has served to generate greater interest in the mangroves in this area, and increased the local community's appreciation and interest in maintaining their local mangrove ecosystems.

The Coringa mangroves are located in the Godavari mangroves in the State of Andhra Pradesh, India (Mittal, 1993). In order to increase knowledge of mangrove ecosystems among tourists, academics and children, and to generate awareness of the importance and need for conservation of mangroves, the Coringa Wild Life Management, Andhra Pradesh Forest Department constructed a 300 metre long boardwalk along the Matlapalem canal. Tourists can visit the sanctuary after paying an entry fee of Indian Rs. 10 (US 25 cents) for adults and Indian Rs. 5 (US 15 cents) for children. Information on the flora and fauna of the mangroves are displayed along the boardwalk. The boardwalk therefore generates revenue as well as playing an educational, tourism and recreational role.

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The following sites contain information on boardwalk construction:

www.epchc.org/docks_and_boardwalks.htm

www.dnr.state.md.us/criticalarea/guidancepubs/

www.vcc.vic.gov.au/siting

www.entech.co.za/Projects/Coast/P_Gonubie.html

Coastal engineering K1

Coastlines are dynamic environments where erosion and deposition are natural phenomena. Human activities and the effect of sea level rise compound historical movements. This sheet introduces the complex subject of coastal engineering and offers the MCPA manager some guidelines.

Coastal dynamics are complex, with river estuaries, beaches and other features constantly changing. Some changes are cyclical (e.g. due to seasonal weather patterns), some are sudden and unpredictable (e.g. due to cyclones), and others are long term, taking decades or hundreds of years for change to be effected. Coastal dynamics in the region are understood under normal conditions in some well studied coastal stretches, but more poorly understood in others. Most of the countries in South Asia have substantial coastal engineering and modelling capacity. Human activities can have profound impacts on these coastal dynamics, thus creating both indirect as well as direct physical changes in the coastal zone. Coastal engineering actions tend to focus on immediate outputs, such as creating harbour infrastructure or protective revetments to tackle immediately visible needs. However they do not always take into concern the impacts on biophysical processes, which shape coastal areas and often depend upon the dynamic stability of ecosystems. Sea level rise, one of the main consequences of global warming, and caused by thermal expansion of the oceans and melting glaciers and ice sheets, is also likely to have a major impact, and is already causing erosion in some areas. The International Panel on Climate Change has predicted that sea level will rise by 18-59cm by 2100.

COASTAL PROCESSES

South Asia's coastal areas have a particularly variable physical and ecological geography, ranging from the alluvial deltas of Bangladesh, Pakistan and India, to the extensive shorefront mangroves of India and Bangladesh, and the coral atolls of Maldives and the Lakshadweep Islands, India. There are a number of physical processes, such as waves, tides, littoral transport and currents, influenced by weather patterns and coastal topography/ bathymetry, that contribute to patterns of coastal dynamics and these can vary greatly across the region. Factors such as tidal amplitudes (seen in their extremes in areas such as Gujarat, which has one of the highest tidal amplitudes in the region), wave action, and susceptibility to extreme weather events (e.g. cyclones, storm surges) can differ widely depending on the locality. Under monsoon and storm conditions, the variables affecting coastal processes become highly complex, and the outcomes less easy to predict.

Patterns of erosion and accretion can have particularly profound impacts on the formation of coastal areas. Erosion in a coastal context refers to the removal or displacement of solid particles due to the action of physical processes such as currents, wind and waves. Accretion refers to the opposite effect, namely the deposition of solid particles, as facilitated by similar physical processes. Beach erosion and dune erosion are technically different, with the former being caused by wave action, and the latter primarily caused by wind action. Erosion can have serious economic and conservation consequences, such as damage to buildings and roads and loss of turtle nesting habitats. It may be sufficiently severe that beaches have to be artificially replenished if they have economic value, as in tourism resort areas or along urban sea fronts. Furthermore, changes in beach profile can create dangerous rip currents, making the area unsafe for bathing and swimming.

The continual movement of sand and sediment along the shore, or on and off it, by waves and currents, is known as littoral transport, and often results in a seasonal cycle of erosion and accretion. Where breakwaters, formed by rocky headlands or artificially constructed promontories, interrupt longshore currents, beaches are eroded from the promontory and built up elsewhere. Stormy weather and rough seas often cause seasonal deposition of sand on an offshore sandbank, or further along the shore. Erosion can occur with replacement of natural vegetation with trees for beautification or of commercial importance (e.g. coconut plantations, monocultures of tree wind breaks – see case study). Erosion also results from reduced replenishment, if dunes have been lost or stabilised by vegetation or if beach sand is mined. It may also occur where vegetation and flotsam and jetsam are regularly removed from beaches by hotels, and where protective coral reefs have been destroyed.

Erosion tends to be cyclical under normal conditions. Coastal processes may scour and erode during one season, but erosion impacts will usually be restored during the following season. When this process is obstructed by engineering, erosion impacts may become permanent. Construction activities, whether for coastal development or to stall shoreline change (e.g. construction of harbours, jetties, pontoons, seawalls, slipways, groynes, breakwaters, and the dredging of channels for navigation) often change the levels of accretion and erosion. This can be seen in some islands in Maldives, where extensive reclamation activities and coastal engineering interventions have changed erosion and accretion patterns. For example, seawalls erected to prevent erosion may ultimately increase erosion levels by cutting off the supply of material from the inland areas. However, properly integrated engineering planning can produce long term results for sustaining multiple uses. An example of this are the combinations of offshore breakwaters, groynes and revetments, such as those found in the Lewis Place coastal stretch of Negombo, Sri Lanka.

LIVING WITH CHANGING COASTS

Engineering solutions to coastal problems must be carefully chosen, keeping the potential medium to long term implications in mind. There is a distinction between 'hard engineering' solutions and 'soft engineering' solutions. Hard engineering focuses on the use of

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Revetments on Ullal Beach, Mangalore, India provide protecton to life and property during the southwest monsoons

man made structures, such as sea walls, groynes and breakwaters. Soft engineering, in contrast, is based on accepting natural change and building on natural protection systems. Techniques include:

- Defining setback lines in legislation for coastal construction;
- Minimising damage to coral reefs and promoting their growth (see sheet H6), protecting mangroves and other coastal ecosystems that provide protection;
- Creating artificial reefs to absorb wave energy, where appropriate (needs to be carefully evaluated before being carried out – see sheet J7);
- Beach nourishment (putting sand back where it has been lost – only appropriate where cause of sand loss has been sufficiently addressed);
- Using coconut matting and jute mesh for sand dune stabilisation.

In some cases 'soft-engineering' should be considered as a more appropriate way to deal with shoreline changes. However, well-planned hard engineering solutions can provide positive and sustainable solutions to coastal development problems. In Bangladesh, hard structures, the embankments of polders, have contributed to settlement expansion, land creation, increased food production, and the protection of life and property. Thus the choice of hard and soft interventions is context specific.

IMPACTS OF COASTAL ENGINEERING

It is often essential to carry out engineering activities, such as the construction of harbour and landing facilities, within the boundaries of an MCPA. An MCPA will also be affected by engineering activities that take place outside its boundaries. In some cases, an MCPA will have to deal with levels of erosion that are greater than those that would be expected by natural processes and take a decision on whether to try to mitigate the impacts. Coastal engineering has an environmental impact both during the construction phase and when the structure is in operation; both must be assessed, and consideration given to alternatives (e.g. whether to install floating pontoons or steel and timber framed jetties instead of concrete jetties). It is essential to obtain good impartial advice and to be clear about the real needs of the MCPA before inviting tenders or engaging a contractor. The following must be considered:

- What goods, services, numbers of people, size of boats and vehicles will use the facilities? What are the mooring requirements?
- Is a fixed structure necessary or could shallow draft boats and beach landings be used?
- Is this the optimal location, in terms of annual sea and weather conditions, tidal range, navigation needs, aesthetic considerations, proximity to land facilities, and likely impact on local flora and fauna?

Building materials such as mangrove poles should only be used if the forest is sustainably managed. Maintenance costs over time must be balanced against initial construction costs. Where there are already structures in place, it may be environmentally preferable to continue their use, depending upon their age. If structures are derelict, they can often be left to collapse, if there are no safety and aesthetic issues. Removing large concrete or steel structures may have a negative short term environmental impact. Underwater structures may have the potential to become artificial reefs and can perhaps be left unless they are a hazard to navigation or fishing (see sheet J7).

Dredging can be essential in certain circumstances where silt loads and deposition are high, as dictated by the hydrodynamic conditions and user needs. However, it should be avoided where possible as it is expensive and, if undertaken to facilitate navigation, often has to be repeated regularly. Unless professionally carried out using appropriated techniques and mitigating measures, damage to adjacent coral reefs is likely to occur (refer to PIANC WG15 guidelines for dredging and port construction around coral reefs – see Sources of further information).

KEY POINTS FOR THE MCPA

- **Monitor shoreline changes within the MCPA to identify areas of erosion and deposition and whether these are natural, or due to human impact; seek expert advice if problems develop.**
- **Ensure that MCPA facilities are placed well back from areas vulnerable to erosion or flooding and that set-back limits are observed.**
- **Ensure that dune systems are appropriately managed.**
- **Lobby for banning of sand mining from areas adjacent to the MCPA, to maintain sources of beach sand replenishment.**
- **Ensure that full EIAs are carried out for any construction or activity that might affect the MCPA, and that these recommendations are taken up as a requirement in the implementation process (see sheet A6).**
- **Provide guidelines for hotels concerning beach raking.**

CASE STUDY

Problems with Physical Coastal Management in the Andaman Islands, India

In the Andaman Islands, beach sand has been used extensively for the construction of concrete buildings and urban infrastructure for many years. In the past, roads connecting villages along the coast were constructed using coral boulders, beach sand and coral debris as substitutes for rock and gravel.

Beaches at many localities have lost much sand due to the growth of the local construction industry from the early 1990s to very recent years. Additionally, sea walls were constructed using sand from other beaches that were not so badly damaged to protect those that were damaged due to sand mining. Beaches have been earmarked for sand mining with quotas and tenders. More often than not, sand has been mined outside these jurisdictions causing sea water ingress and accelerated erosion. Additionally native coastal vegetation has been exploited in some areas and some regions have been converted into plantations. These activities have also caused erosion and land loss along many beaches. This example highlights how poorly planned coastal engineering interventions can result in long term problems, the loss of coastal land, and ultimately call for further interventions and investment to correct these issues. Properly planned solutions may be more cost effective in the long term and prevent severe environmental problems.

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Nutrient and sewage pollution

K2

Nutrient and sewage pollution may affect MCPAs from sources both outside and within MCPA boundaries. Ensuring good water quality in the MCPA is important, not only for marine plants and animals, but also for visitors if recreational activities are an attraction. This sheet provides an overview of these problems and general principles that should be observed by the MCPA.

Wastewater discharges, including domestic waste and sewage, effluent from commercial and industrial establishments, pollution from small recreational vessels as well as larger vessels, and urban run-off, combined with agricultural run-off and aquaculture waste that may contain fertilisers, are major threats in terms of nutrient pollution. This damages not only biodiversity but also human health through illnesses contracted from contaminated water. Furthermore, there may be a loss of income from tourism if pollution and unsanitary conditions deter tourists. Failing to maintain safe standards for swimming and diving can seriously affect visitation to an MCPA. International standards for water quality in recreational areas exist but are often not applied in South Asia. Fisheries may also be affected if fish and invertebrates suffer poisoning and/or mortalities as a result of the biological degradation of organic matter which can lead to hypoxia, anoxia, and anaerobic conditions. Nutrients such as nitrogen and phosphorus encourage algal growth that may smother corals, and cause algal blooms (see sheet H10). Nitrogen is primarily responsible for eutrophication in ocean waters, while phosphates can also play a role. Other constituents of wastewater also have negative impacts. Suspended solids cause turbidity and may shade seagrasses. Toxic organisms, metals and pathogens can kill marine organisms or affect reproduction.

ADDRESSING SOURCES OUTSIDE THE MCPA

Some forms of pollution originate from point sources such as untreated urban sewage pipelines and factory outlets; others have more widespread origins, such as terrestrial run-off and river outflows. MCPA managers often have little control, as these sources are usually the responsibility of other government agencies. However, there may be opportunities to sit on Integrated Coastal Management committees (see sheet A5) and lobby for better practices. For example, in Australia, the Great Barrier Reef Marine Park Authority helped to persuade the Queensland sugar industry to adopt better practices to reduce agricultural run-off and nutrient enrichment of coastal waters. In Sri Lanka, sewage and wastewater pollution from nearby hotels was identified as a problem in the Hikkaduwa Marine Sanctuary, and measures have been undertaken to improve wastewater treatment and discharge as part of a Special Area Management Plan for the area.

N. Boucher

Healthy corals in an undisturbed reef area

REDUCING SOURCES WITHIN THE MCPA

Wastewater treatment can be very expensive, particularly the traditional forms of treatment plant. These consume much energy, generate large quantities of sludge that need disposal, and require relatively sophisticated equipment that needs maintenance by trained operators. If the MCPA is connected to the main sewerage system, treatment will occur off-site and the MCPA itself may have little influence on methods. However, there are simple, inexpensive options that an MCPA should consider for disposing of wastewater and sewage on-site, and in many MCPAs selecting one or more of these methods will be essential.

UNEP (2001) provides a guide to appropriate and environmentally sound systems for wastewater management, with checklists of recommended practices and procedures.

Reuse of wastewater is the first priority. A fully integrated wastewater disposal system uses effluents for agriculture, gardens and aquaculture, either directly or by growing vegetation that is used to feed farmed fish or invertebrates.

O. Naim

Dead coral with high macroalgae cover in a reef in the same area following high urban and agricultural pollution

Natural systems such as wetlands can be used to absorb sewage. Effluent flows into lagoons or stabilisation ponds and the nutrients are taken up by natural vegetation. Small-scale stabilisation ponds, using reeds or vetiver grass, are easily constructed and may attract birds and other wildlife, becoming an asset to an MCPA in themselves. Note that any use of introduced vegetation should utilise locally appropriate species (see sheet K5).

Septic tanks and pit latrines are low-cost and locally manageable technologies and may be suitable. However, freshwater-based systems contribute to water depletion and pose a risk of pollution to the water source. Boreholes should be well separated from latrines and septic tanks to avoid contamination, the minimum distance depending upon the soil and ground conditions. Local advice should be sought. Regular maintenance of septic tanks is very important and seawater should not be used as salt kills favourable bacteria and destroys the natural decomposition process. Care must be taken in

the siting and design to avoid exceeding the absorption capacity of the ground (this will lead to groundwater pollution and soil destabilisation) and so that storm water does not flood the system.

Dry or composting toilets are one of the most environmentally sound approaches to sewage disposal, allowing odour free, natural composting of human waste. The residue can be used as a fertiliser. However, they can be expensive to install and require careful maintenance.

Discharge into the sea should be avoided if other mechanisms are available. It should only be undertaken if the sewage can be piped out to deep water with good currents, where its impact will be minimised.

Sources of further information

Dept Water Affairs and Forestry 1996. South African Water Quality Guidelines. Vol.1. Domestic Use, Vol. 2. Recreational Use.

Grange, N. & Odendaal, F. 1999. Guidelines for the Environmental Assessment of Coastal Tourism. SEACAM, Maputo, Mozambique. 197pp.

Hambrey, J., et al. 2000. Guidelines for the Environmental Assessment of Coastal Aquaculture Development. SEACAM, Maputo, Mozambique. 213pp.

Sonani, A. & Aggarwal, S. (eds.) 1998. Pollution Prevention and Abatement Handbook – Part III. World Bank. www.worldbank.org/watsan

UNEP 2001. Guidance on Municipal Wastewater. Practical Guidance for Implementing the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) on Sewage. Developed by UNEP/GPA, UNEP/IETC and IHE in collaboration with the World Health Organisation (WHO), the United Nations Centre for Human Settlements (UNCHS-Habitat) and the Water Supply and Sanitation Collaborative Council (WSSCC). www.gpa.unep.org

UNEP International Environmental Technology Centre (UNEP/IETC) – guidance on environmentally sound technologies www.unep.or.jp

Websites covering nutrient pollution:

www.undp.org/water; www.sanicon.net; www.globalcoral.org
www.coral.org/media/watershedsm.pdf

Websites on wastewater treatment:

www.compostingtoilet.org; wastewater-treatment-options.pdf
www.lboro.ac.uk/well/resources/technical-briefs/64-
www.leeds.ac.uk/civil/ceri/water/tphe/publicat/pdm/india/india.
www.vetiver.com

European Clean Beaches programme and water quality standards - www.goodbeachguide.co.uk

Fact sheet on impact of nutrients on Great Barrier Reef Marine Park - www.reef.crc.org.au

KEY POINTS FOR THE MCPA

- **Monitor nutrient levels within the MCPA if expertise and resources are available (see sheet G5); there are no widely accepted simple methods but 'bioindicators' (species that respond to changes in nutrient levels) have been useful in some situations, and include boring sponges (clionids) on reefs, and stomatopods; samples of algal tissue and coral rubble can also be assessed for nutrients.**
- **Develop links with agencies responsible for pollution (often the Department of Environment) in order to monitor future pollution threats to the MCPA from coastal development activities; lobby for effective use of EIA to help mitigate such threats (see sheet A6).**
- **Within the MCPA, ensure that there are no sources of nutrient or sewage pollution; keep toilet facilities clean.**
- **Introduce the most environmentally sound methodologies for sewage and wastewater disposal within the MCPA as a demonstration model.**

CASE STUDY

Eutrophication of a Coral Reef on La Réunion

The impact of nutrients on a reef and the difficulty of identifying their source is demonstrated by the reefs in the MCPA on La Réunion. Planch'Alizes is a degraded area of the Saint-Gilles/La Saline fringing reef characterised by high coral mortality and abundance of macroalgae. In contrast, the Toboggan/Trois-Chameaux reefs are dominated by branching corals (*Acropora* spp.) with high live coral cover. Significant amounts of nitrate are discharged to the Planch'Alizes back-reef zone through groundwater that has become a chronic source of pollution. The cause of this is still being studied but appears to be a combination of urban and agricultural discharge from the watershed associated with the MCPA area.

Research by biologists at the University of Réunion, to determine why some reefs are badly affected and others are not, suggests that nutrient-enriched groundwater discharge increases the amount of organic matter produced on a reef. However, this depends on how much the reef is influenced by open oceanic waters (e.g. the Toboggan/Trois-Chameaux reefs receive more open ocean water). Lack of grazing sea urchins (*Echinometra mathaei* and *Diadematidae*), which are rarer at Planch'Alizes than at Toboggan/Trois-Chameaux, may also contribute to high algal cover. The low urchin population may be related to low oxygen concentrations during the night at certain times of year because of the algae.

This complexity illustrates the importance of obtaining expert advice if eutrophication and nutrient pollution is suspected, and also demonstrates the need to take a precautionary approach and minimise the potential impact of nutrients through appropriate wastewater disposal mechanisms. In La Réunion, this goes beyond the direct mandate of the MCPA. However, representatives of the organisations involved in the economic development of the watershed are being sought to participate in the management structure for the MCPA.

Oil spills K3

Oil spills can result from local incidents within an MCPA or from events hundreds of miles away that cause oil to be dispersed over an MCPA. The seriousness of the impact will depend on the species and ecosystems present, and the type and quantities of oil. MCPA staff must be prepared for dealing with an oil spill and practiced in the procedures for different scenarios.

South Asia lies within busy international shipping lanes with a significant amount of transport of oil from the Middle East to East Asia. In addition, commercial shipping vessels use the same routes as well as using several major ports in India and Sri Lanka. This emphasises the need for MCPA personnel to be prepared for oil spills. However, only about 12% of the oil released into the sea is from tanker accidents such as collisions or groundings, and it is important to be aware of other sources, such as:

- Rupture or leakage of land-based storage facilities and marine pipelines;
- Loading and unloading of oil in port or at offshore facilities and transhipment of oil at sea;
- Operational spills from vessels engaged in construction work, or while anchored;
- Illegal bilge washing, which is linked to tar balls on beaches;
- River discharge and terrestrial run-off containing oil.

Many countries in South Asia are parties to the 1973 International Convention for Prevention of Pollution from Ships (MARPOL), which covers oil pollution, transport of noxious liquid substances and sewage from ships. The International Oil Pollution Compensation (IOPC) Fund pays compensation for oil pollution from shipping to member States only when ship owners are exempt from liability or when they or the insurance cannot cover the damage.

ENVIRONMENTAL IMPACT OF OIL

The impact of a spill depends on many factors, including the type of oil, weather, and weathering processes. Light fuels (petroleum, paraffin and diesel) are more liquid and toxic than heavy crude oil (e.g. Bunker C fuel for large marine and industrial engines), which is very persistent if spilled and disperses less rapidly. The main weathering processes affecting spilled oil are:

Spreading of surface slick - The speed of this depends on oil viscosity, air temperature, wind and currents.

Evaporation - Up to 50% of crude oil may evaporate after 48 hours in warm countries, with the toxic fraction being lost particularly fast.

Dispersion - Oil can disperse into small droplets rapidly depending on the weather, and this speeds up biodegradation.

Emulsification - Rough seas can stir oil slicks into an emulsion that is a serious threat to marine life, particularly as it mixes easily into beach sand that is difficult to clean.

Sedimentation - Oil often mixes with sediments, particularly in mangrove creeks and estuaries where suspended sediment levels are high. If oil mixes with sand, it may form tar balls.

Biodegradation - The speed of breakdown of oil by fungi and bacteria depends on temperature, oxygen and nutrients levels.

Smothering and direct ingestion of oil are the main impacts. Sessile fauna become smothered, and the oil coating prevents resettlement. Toxic residues may persist in sediments, killing marine life. The reproductive cycle of inshore marine invertebrates can be affected by oil contamination. A tar mat may form on intertidal flats and salt marshes killing the infauna and smothering mangrove aerial roots (pneumatophores). Coral reefs may not directly suffer, unless exposed at low tide.

Birds and marine mammals are often the most visible victims, suffering greatly from damage to feathers or fur, which affects buoyancy and thermal regulation. Ingestion of oil during preening may also be a problem. Toxic effects on fish and other marine life may negatively affect fisheries, mariculture and the tourism industry, and particularly activities reliant on intertidal areas.

OIL SPILL CONTINGENCY PLANS

The most important points in dealing with oil spills are prevention and contingency planning (including mitigation). Ideally, MCPAs should have an Oil Spill Contingency Plan (OSCP), but if not they should be linked to and be aware of national OSCPs produced by harbour authorities or environment departments, and other emergency procedures (see sheet D4). In some countries, OSCPs are the responsibility of special authorities or departments and it is important that MCPA managers work closely with such institutions especially in the event of an oil spill. OSCPs are generally divided into the following three sections.

Strategy

This describes the scope of the plan, including geographic limits, links with other plans (local, national or regional), perceived risks, and the proposed response strategy. It should include maps showing habitats ranked according to their sensitivity to oil, actions needed to protect them, and a risk assessment, outlining all relevant shipping, marine and inland activities in the area. Responses are described according to three tiers depending on spill size. For each tier, the OSCP should identify who is responsible for response and containment, what equipment is available, where it can be deployed and by whom, and roles of the MCPA and other organisations. Response options include:

- Containment and recovery, which involves removal or guiding oil into less sensitive environments;
- Use of dispersants to help break up and disperse the oil (recognising that some can cause further damage);
- Shoreline clean-up to physically remove oil and tar balls;
- In some circumstances, burning off the oil.

The strategy should include monitoring of the spill's movement, and assessment of habitats and species affected. Rehabilitation, including repair of damage caused during emergency operations, must also be considered.

Actions and operations

An incident organisation chart should be prepared. Clear lines of responsibility are required, especially if several agencies are involved. Usually one individual acts as a single notification point, controlling all initial off-scene tasks, classifying the incident level, activating response groups and providing proper document control. Ideally someone should also be made responsible for ecological and conservation issues, since much damage can be caused by the emergency operations. If the track of the spill can be correctly predicted, vulnerable sites can be protected in advance. Prediction requires navigation skills, knowledge of tides, currents and winds, and relevant charts. All oil is toxic to humans, hence protective clothing is essential and direct contact must be minimised.

Data directory

This must include all relevant maps and charts for the OSCP area, phone and contact details (e.g. key agencies, information on coastal facilities, access roads, hotels).

KEY POINTS FOR THE MCPA

- MCPAs should ensure procedures are in place to minimise the risks of local spills within MCPA boundaries.
- An OSCP should be prepared for the MCPA especially if there is no national plan; if there is a national OSCP, MCPA personnel should be aware of, and fully understand it, and have good relations with those responsible for it.
- Where necessary, MCPAs should lobby governments to adopt legislation minimising oil spill risks, e.g. reducing the risk of vessel collisions near the MCPA.
- Ensure responsibilities of the MCPA and other organisations are fully understood in relation to different types of oil spill.

Sources of further information

International Petroleum Industry Environmental Conservation Asso¬ciation (IPIECA): www.ipieca.org – have produced the following reports:

Guidelines on Biological Impacts of Oil Pollution.1991. Vol. 1. 15pp. Biological Impacts of Oil Pollution: Coral Reefs. 1992. Vol. 3. 16pp.; Sensitivity Mapping for Oil Spill Responses. 1993. with IMO Vol. 1. 24pp; Choosing Oil Spill Responses to Minimise Damage. Net Environmental Benefit Analysis. 1993. 20pp.; Biological Impacts of Oil Pollution: Mangroves. 1993. Vol. 4. 20pp.; Biological Impacts of Oil Pollution: Sedimentary Shores. 1993. Vol. 9. 20pp.; Biological Impacts of Oil Pollution: Rocky Shores. 1995. Vol. 7. 20pp. 1995; Biological Impacts of Oil Pollution: Fisheries. 1997. Vol. 8. 28pp; A Guide to Contingency Planning for Oil Spills on Water. 2000. Vol. 2. 28pp.

IOPC Fund: www.iopcfund.org and www.londonconvention.org/marpol_73.htm - information, membership and manuals.

International Maritime Organisation: www.imo.org - information on pollution, shipping and marine law.

IMO/UNEP. 1988. Catalogue of oil spill response equipment and products. UNEP Regional Seas Directories and Bibliographies. FAO, Rome 86pp.

CASE STUDY

Sinking of the Amaanat Shah off Sri Lanka's South Coast

In September 2006 a Bangladeshi cargo vessel, Amaanat Shah, capsized in rough seas off Koggala, on the south coast of Sri Lanka resulting in large amount of diesel fuel oil being released into the ocean. Rough seas further complicated the situation and emulsified oils posed a serious threat to marine life and nearby coastal habitats, which included coral reefs, mangroves and a brackish water lagoon. The Marine Pollution Prevention Authority (MPPA) is the lead agency for managing pollution of coastal waters in Sri Lanka and immediately set about the task of controlling the spill and minimising environmental impacts. A disaster management committee was set up that included government officials, scientists, the military and volunteers. The Sri Lankan military and police were mobilised to assist with the cleanup and to control public access. Two Indian Coast Guard vessels were also dispatched to assist in managing the spill.

The lack of adequate booms and dispersants hampered the operation but large amounts of oil were contained at sea and prevented from reaching the coast and as much oil as possible was pumped out of the fuel tanks. An improvised floating boom was successfully deployed at the lagoon mouth to prevent oil intrusion into the lagoon. Officers from the MPPA worked together with other government agencies to dispose of the oil safely while volunteer groups, including environmental NGOs, undertook a large clean up operation to remove oil from mangroves and intertidal rocky habitats. Plans to salvage the vessel were abandoned due to the risk of rupturing fuel tanks and releasing more oil that was trapped within the hull.

Despite many shortcomings it was possible to contain the oil spill with minimal impacts to the environment. A major reason for this was the prompt action of relevant agencies and efficient coordination among all those responsible. This highlights the importance of an effective oil spill contingency plan with clearly defined roles and responsibilities. Improved training and better resources will also support a more effective and efficient response in the event of future oil spills.

Solid waste disposal K4

MCPAs have to deal with a variety of forms of solid waste, some of which is generated within the MCPA and some of which will come from beyond its boundaries. This sheet describes how an MCPA can help to address this issue, including various methods of disposal such as beach cleanups and recycling.

Increasingly, there is a vast amount of debris floating in the oceans, comprising:

Plastic - This is the most common material as it is very buoyant, does not degrade and can travel long distances across the ocean. About 50% of beach debris comprises food and drink containers; there are also large quantities of flip flops, bags, sheet wrapping, fishing floats and fishing nets, ropes, condoms and syringes;

Glass - Includes bottles, bulbs, TV and computer screens;

Metal - Items such as tin cans, spray containers, and even shipping containers;

Wood - Pallets, assorted timbers, logs;

Paper - Newspapers, labels, cigarettes and cigarette stubs (30% of all beach litter comprises smoking-related materials).

Marine debris can be a major hazard to wildlife, entangling seabirds and turtles in particular. It is also hazardous to human health, as injuries and infections can be caused by glass and syringes. Its unpleasant appearance can have an economic impact if tourists are deterred from visiting. It can also be a hazard to shipping and the propellers of fishing craft.

DEBRIS FROM OUTSIDE THE MCPA

Most marine debris originates from land-based sources such as coastal construction and land-fill sites, rubbish dumps, and river discharges. A large proportion also comes from shipping, drilling rigs and other marine sources, as both deliberate and accidental discards, although the International Convention for the Prevention of Marine Pollution from Ships (MARPOL) provides a mechanism and framework for limiting this. Some floating materials remain offshore for years and eventually sink, but many eventually wash ashore. An MCPA has little control over this but can participate in activities to reduce it and to clean it up.

Few MCPAs in South Asia are serviced by municipal solid waste agencies but it may be possible to raise awareness about the issue. Depending on the situation, the MCPA or a local authority will be responsible for cleaning beaches. Through reporting of incidents and problems, and by creating publicity, the MCPA can help to improve waste management. An MCPA can also carry out, or help to promote, regular beach cleanups in collaboration with local communities and government agencies. The International Coastal Cleanup programme which has been running since 1986 and is organised by the US-based Ocean Conservancy, involves almost 5 million people from nearly 120 countries, who volunteer their services. In 2002, the annual cleanup resulted in 4,000 tonnes of debris being collected around the world. Underwater clean-ups can similarly be organised, involving divers and snorkellers, but these need careful planning and organisation. If possible, debris from any clean-up should be recycled.

SOLID WASTE FROM WITHIN THE MCPA

Construction and maintenance of buildings and facilities, as well as day-to-day operations, generate a range of solid waste materials within the MCPA. A waste management strategy should therefore be prepared, based on four guiding principles:

- Reduce the amount of waste generated, e.g. by purchasing products with less packaging or that are long-lasting, even if they are more costly, or request borrowing or sharing of products, packages or bags;
- Recycle materials, e.g. containers, bags, plastics and paper, and encourage the use of cloth or wicker, instead of plastic bags. Where possible, support commercial recycling facilities that purchase or accept materials such as metals, paper, glass, aluminium, oil and plastics;
- Select products that use recycled materials;
- Reuse products where possible, and choose to purchase products that can be reused over disposable versions.

Once waste has been generated, it must be appropriately handled, sorted, stored, and transported to a suitable disposal site. Different kinds of waste should be stored in separate areas until in large enough quantities for economical transport and disposal. Some types of waste can be disposed of within the MCPA but others will need removal.

Metals, plastics, and rubber should be recycled because of their slow natural degradation rates, and this may require storage and transport to an appropriate facility. In some regions tyres are reused (e.g. for artificial reefs, sandals, as well as flip flops), although there is very limited use of tyres in this manner in South Asian MCPAs. Burning of plastics and rubber is not recommended because of the toxic gases produced, unless a facility is available for safe high temperature incineration. Recycling is most appropriate for glass; it can even be mixed with concrete, converted into blocks, and used in artificial

CRMP Project Sri Lanka

Trawler bycatch poses a solid waste problem in the Bar Reef area, Sri Lanka

reefs. Reuse and recycling is most suitable for paper, cardboard and wood, although these can also be used as fuel. Open air incineration should be a last resort.

If stored, organic matter should be made inaccessible to scavenging animals. Garden clippings, leaves, kitchen food wastes and vegetable matter from the beach can be composted in a frame of wood planks, wire mesh, or cement blocks. Washed up seaweed, rinsed with fresh water, is a good additive, and moisture and oxygen are important to the process. Dryness of the pile can be a fire hazard, and the pile may become a refuge for snakes and undesirable pests. A successful compost pile requires some initial supervision, but should produce a rich soil additive within three months in the South Asian climate.

Burial, or disposal as landfill, should be a last resort, used only if no other options are available. Recommended methods should be followed for establishing a sanitary landfill, which should be carefully sited to avoid groundwater pollution. Dumped wastes should be covered daily by inert material (e.g. sand, gravel or sawdust), and carefully managed to keep out scavengers and disease-carrying animals.

KEY POINTS FOR THE MCPA

- **Prepare and implement a waste management strategy, setting an example to local communities, tourism establishments and other businesses, and collaborating with local authorities.**
- **Install waste disposal facilities for visiting boats.**
- **A small-scale incinerator may be useful to dispose of some solid wastes to reduce the amount in landfills.**
- **MCPA authorities may be able to lobby relevant government authorities to abide by and enforce international or regional waste and pollution prevention conventions and agreements.**
- **Use education and awareness raising activities in order to mobilise the public and schools, e.g. organise regular beach cleanups, and participate in the annual international coastal cleanup, involving other stakeholders as appropriate.**

Sources of further information

Barnes, D.K.A. 2003. Natural and plastic flotsam stranding in the Indian Ocean. p. 193-205. In: Davenport, J. & Davenport, J.L. (eds.) The Effects of Human Transport on Ecosystems: Cars and Planes, Boats and Trains. Royal Irish Academy, Dublin.

Henry Doubleday Research Association - A European organic membership organisation that can provide advice on composting in tropical environments - www.hdra.org.uk

International Coastal Cleanup (ICC) organises the global annual event and produces a newsletter Coastal Connection - www.coastalcleanup.org

UNEP 2003. A Manual for Water and Waste Management: what the tourism industry can do to improve its performance.

www.uneptie.org/pc/tourism/library/waste_manual.htm www.coral.org – provides guidelines on underwater cleanups.

IUCN's post-tsunami information site - www.iucn.org/tsunami/

IUCN Series on Best Practice Guidelines (Sri Lanka). (A selection of the most relevant Information Papers are listed below) - www.iucn.org/tsunami/resources/guidelines.htm

After the Tsunami: Cleaning up Reefs and Beaches (Information Paper No. 4)

After the Tsunami: Solid Waste Management (Information Paper No. 5)

CASE STUDY

Cleaning up Debris from Beaches and Reefs in Sri Lanka after the 2004 Asian Tsunami

The 2004 Asian tsunami resulted in a huge amount of debris being deposited in coastal and marine areas. In response to this, a number of organisations contributed to beach and reef clean up operations in the months following the tsunami. Activities were aimed at preventing further damage to and promoting further recovery of coral reefs, and improving the prospects for recovery of the tourism sector which is a vital source of income for the surrounding communities. These clean ups included physical cleaning of debris and awareness campaigns for selected affected communities. The clean ups were carried out in Unawatuna, which borders two MCPAs: Rumassala Marine Sanctuary and Hikkaduwa National Park.

In this effort, IUCN and other relevant local governmental, non-governmental and private organisations teamed up in an attempt to tackle the problem and pool resources in a more coordinated effort. All participants were also provided with a briefing on best practice, and leaflets describing the environmental needs and benefits of the clean up were distributed to raise community awareness.

These clean ups required the expertise of both divers and snorkellers and the debris removed included rocks, rubble and concrete, clothes, shoes, plastic bottles and electrical wire; as well as glass, barbed wire and other damaging or dangerous human-made debris. Up to 50 volunteers were involved in these clean up activities and some divers were able to remove large nets from the outer reef that were causing considerable damage to the environment.

At one location, four tractor loads of debris were removed and dumped at a site recommended by the Central Environmental Authority of Sri Lanka. Generally these dump sites were abandoned coral mines in barren, non-populated areas. Subsequent to this activity best practice papers on 'Cleaning up Reefs and Beaches' and 'Solid Waste Management' were developed. These initial clean ups also inspired local communities and schools to engage in further clean ups.

Alien invasive species

K5

Alien invasive species (AIS) are one of the greatest threats to biodiversity. Introduced mainland species on islands can cause major damage to native vegetation, seabird populations and endemic invertebrates. The situation in the marine environment is less well documented but severe problems are developing. This sheet aims to alert MCPA staff to this emerging issue, so that preventative action can be taken if required.

Species that have been moved, intentionally or unintentionally, as a result of human activity, into areas where they do not occur naturally are called 'introduced species' or 'alien species'. Of these, the ones that find the local conditions suitable enough to establish themselves are called alien invasive species. Terrestrial, marine and freshwater ecosystems within an MCPA can be affected by alien invasive species from several sources. This sheet focuses more on marine alien invasive species as this is a relatively new issue that may be unfamiliar to MCPA practitioners.

MARINE INTRODUCTIONS

Marine plants and animals can be transported huge distances on the hulls of vessels or in ballast water. Organisms can also be introduced as a result of aquaculture activities, or through the live and fresh seafood trade. In terms of hull and ballast water introduced species, most do not survive but many do, some with major consequences. For example, the European Green Crab (*Carcinus maenus*), native to the Atlantic and introduced to Southern Australia, South Africa, the United States and Japan; has also been reported in Sri Lanka. It competes with and displaces native crabs, consuming and depleting many other species. Areas affected by marine AIS include:

- Australia where there are now a known 250 alien marine species;
- Guam, where several non-indigenous sessile species are found on reefs, having been introduced via ships hulls; hydroids have spread particularly widely and rapidly;
- Hawaii, where introduced species of algae, soft coral, crustaceans, sponges and fish have been recorded on reefs, with algae having a major negative impact;
- Western Atlantic, where two species of Lionfish of Indo-Pacific origin have been establishing significant populations along the East Coast of the United States and the Bahamas. The Lionfish is a predator of small fishes and other invertebrates which may have an impact on native coral reef community structures.

There are several vectors for the spread of marine AIS, the strongest being shipping. Ballast water, carried on empty ships to provide balance and stability, is discharged when loading cargo, often introducing alien species from the port of origin. The International Maritime Organisation (IMO) estimates that the 10 billion tonnes of ballast water that are used annually, for distributing 80% of the worlds commodities, may move some 10,000 alien species of plant and animal around the planet at any one time. With 7,500km of coastline, India has a substantial volume of shipping activities through 12 major ports. An average of 5,000 ships call at Mumbai port alone and require approximately 2 million tonnes of ballast water each year, generating a substantial risk of alien species introductions. Further, many sessile species settle and grow on ship hulls, and are transported to new areas as the ship moves.

Aquaculture and the seafood trade can move many species very quickly over vast distances, as well as recreational activities such as yachting, diving and fishing. Leisure yachts often move freely over large sea areas, visiting coastal areas on the way, and can spread species especially through hull fouling. Species may also be carried unnoticed on damp diving or fishing gear. In some instances introductions are intentional, e.g. for aquaculture or even ornamental purposes.

COMBATTING MARINE AIS

Eradication of AIS once established is usually very difficult, much more so in the marine environment, where it has been largely unsuccessful to date. However, it might be feasible if an introduction is identified early enough and is limited in distribution. It is thus essential to have an effective monitoring and early warning system in place.

The GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast) has provided training for several countries using standardised methods developed by the Centre for Research on Marine Pests (CRIMP) in Australia. A project has been set up in India to assess the existing flora and fauna in the Mumbai and Jawaharlal Nehru Port area, and a port base line survey has been conducted that will allow tracking of invasive species and help to determine associated impacts and risks. In total, surveys using the CRIMP Protocols have been carried out at over 70 ports around the world, with many more planned. The IUCN Global Marine Programme has also piloted a general protocol for monitoring invasive species on coral reefs, also based on the CRIMP Protocols. Programmes to assess and monitor alien species, particularly in MCPAs, have been set up in several countries

Prevention is the most desirable option. Reballasting at sea helps to reduce the transfer of alien species, but has safety implications for ships and is not 100% effective. Alternatives include filtration or treatment by thermal, chemical or radiation means, but these technologies are still being developed. The IMO provides voluntary guidelines to minimise the transfer of harmful organisms through ships' ballast water, and the International Chamber of Shipping has developed a Model Ballast Water Management Plan that is being

C. Bambaradeniya

Prickley pear, Opuntia dillenii, is a voracious invasive that affects many coastal areas in Sri Lanka

adapted for national use by some countries. The International Convention for the Control and Management of Ships Ballast Water and Sediments, adopted in 2004 (currently only ratified in South Asia by Maldives in South Asia), requires parties to ensure all ships implement a ballast water management plan and provides technical guidance that may help to reduce the threat by promoting better practices.

Similarly, keeping hulls free of biofouling is important. However, dry-docking and cleaning large vessels is very expensive. There is also concern about an increase in hull-fouling linked introductions after the adoption of the International Convention on the Control of Harmful Anti-fouling Systems on Ships. While this convention contributes to better protection against the harmful effects of the tri-butyl tin paint compounds, there is no equivalently efficient alternative as anti-fouling treatment.

AQUACULTURE INTRODUCTIONS

Aquaculture (see sheet I3), second only to shipping in terms of introduced species, has resulted in the spread of many very damaging alien species throughout the world. For example in Hawaii, three species of algae were introduced in a feasibility study for seaweed farming. One of these, *Hypnea musciformis*, has spread widely and is washed up on beaches each week, costing over US$ 100,000 a year in beach cleaning. A tool being used in combating invasive algae in Hawaii is the Super Sucker, an underwater vacuum cleaner that removes algae from the reef and places it on a barge so that non-invasives can be sorted and returned to the water. The invasive species of algae is then packed in sacks and sold as fertilizer. In many estuaries and lagoons in Sri Lanka food webs have been distorted by exotic cichlid species (*Oreochromis/Tilapia* species) introduced initially into freshwater bodies. The Food and Agriculture Organisation of the United Nations (FAO) urges countries to take a precautionary approach to restrict the use of Alien Species in aquaculture or mariculture activities, and to show preference for native stock. Information on aquaculture species that may pose threats is available from the various information sources and databases cited below. The IUCN Global Marine Programme and the Government of Chile have piloted an approach to reducing threats posed by alien species use in aquaculture systems by providing methodologies to assess the risk of invasions, and to control and manage escapes and invasions when they occur.

RECREATION

Paradoxically, setting up a MCPA may lead to an increased risk of invasion, due to the increased attraction to the area for marine tourism, including recreational boating, yachting, the diving and snorkelling industry, and where allowed, fishing. These activities may to lead to introduction of non-indigenous marine species through hull fouling, ballast water (of some cruising yachts), the accidental transfer of species via anchor wells and chains, on wetsuits as spores or microscopic phases, and as bait material from recreational fishing. It is important that MCPA visitors are made aware of the risks, but provision of information is frequently insufficient - a survey by the IUCN Global Marine Programme found that, while 92% of MCPAs produce awareness materials, only a quarter address AIS. MCPA regulations may also seek to limit introductions e.g. by regulating boating, anchoring and fishing.

TERRESTRIAL INTRODUCTIONS

The impact of terrestrial introduced species, especially on small islands, is well documented. In India, introduced species of particular concern include flora that out compete indigenous vegetation such as the Water Hyacinth and Lantana, and fauna such as the notorious Giant African Snail. Many animals are affected by introduced predators that feed on molluscs and other invertebrates, and on eggs and the young of nesting seabirds and turtles. Island environments are particularly vulnerable, and rats, cats and goats, for example, can cause significant damage to local ecosystems and biota if introduced. Numerous techniques have been developed and tested for eradicating such species, with varying degrees of success. Codes of conduct and protocols are available that can be used to minimise the risk of introductions (see Sources of further information).

MCPAS AT RISK

Many MCPAs are located adjacent to ports and shipping lanes, or to sites that will eventually be developed as ports. MCPAs are also at risk from species carried on the hulls of yachts and fishing boats, as has been discovered in Guam. Further, there is frequently aquaculture in or in the vicinity of MCPAs. A study by the IUCN Global Marine Programme found that a quarter of MCPAs have aquaculture within the MCPA, and half within 100km of the MCPA, in many cases culturing exotic species. This means that, outside ports, MCPAs are often the first point of AIS outbreak, and 33% of MCPAs surveyed already have invasive species. AIS threaten the core values of the MCPA as well as surrounding areas, and are thus an important threat to consider.

KEY POINTS FOR THE MCPA

- **PREVENTION is the key to successful management of marine alien invasive species. Ensure staff are aware of the risks and key prevention methods, and provide sufficient information to visitors.**
- **Undertake a baseline survey around the MCPA to catalogue natural biodiversity.**
- **Check for alien species (e.g. known global "travellers" and species known to have become established in other parts of the region) when biodiversity surveys are being carried out in an MCPA, particularly if the MCPA is adjacent to a port, shipping area, or mariculture enterprise.**
- **Ensure that alien species are included in the MCPA monitoring programmes to increase chances of early detection.**
- **If alien species are identified as a problem, contact experts for advice on mitigation and ensure that populations are monitored.**
- **Maintain good contact with local Port Authorities and inform them of the risk.**
- **Keep abreast of the topic; research is reported through newsletters and websites, and initiatives are underway to develop monitoring and assessment methodologies.**

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CASE STUDY

GloBallast Initiative Against AIS, India

Capacity building and policy, legal and institutional reforms remain key hurdles in managing marine bio-invasions in several regions. Building on a successfully completed GloBallast Project, a second phase '*GloBallast Partnerships*', will aim to remove these barriers by forging strategic alliances at the global, regional and national levels, and by working closely with IMO member States and public/private sector stakeholders for more effective ballast water management. In India, the lead agencies are the National Institute of Oceanography (NIO) and the Fisheries Survey of India (FSI).

There are 12 major ports and numerous minor ports along the 7,500km long Indian coastline, which may act as gateways for marine bio-invasions. In addition to the introduction of alien species in these marinas, the threat of dispersal to neighboring environments and the diverse coral reefs of the Andaman and Nicobar Islands, and the Lakshadweep Islands is also a possibility. In the light of this it is essential to monitor all the ports simultaneously and to adopt suitable ballast water management protocols.

For example, the black striped mussel *Mytlopsis sallei*, a small tropical estuarine bivalve native to the Caribbean, has successfully established itself in major ports along the coasts of India, notably Mumbai and Visakhapatnam, and is also becoming prevalent throughout the waters of East Asia. Genetic sequencing of invasive populations has shown that there continues to be a mixing of gene pools in spite of their separation in physical distance and salinity, indicating there is a continued influx.

Draft legislation has been prepared and submitted to the government authorities, and a nationwide campaign is underway to generate greater awareness within the shipping industry, maritime institutes, ports and the coastal community. The project hopes to engage neighboring countries like Bangladesh, Sri Lanka, and Maldives, for knowledge sharing and a coordinated approach to the hazards of marine bio-invasion through ballast water.

For more information on the programme, or for a copy of the Ballast Water Risk Assessment for the ports of Mumbai and Jawaharlal Nehru, India, go to www.globallastwaterindia.com

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