Managing Marine Protected Areas

A TOOLKIT for the Western Indian Ocean

2004

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Preface

Marine protected areas (MPAs) have been established throughout the world for a variety of purposes such as conservation, tourism and education. At the time of producing this Toolkit there are more than 70 individual sites (nationally and internationally designated), in the Western Indian Ocean (WIO), over which some form of management exists. Most of these sites are managed under formal government mandates while some correspond to traditional or localised arrangements, and span the spectrum from fully protected "no take" areas to multiple use areas. Every country in the region now has one or more MPAs and the number is on the increase.

The revitalization of the Convention for the Protection, Management, and Development of the Marine and Coastal Environment in Eastern Africa (the Nairobi Convention, adopted in 1985) has contributed significantly to this increase and has also resulted in the establishment of the Group of Experts on Marine Protected Areas in Eastern Africa (GEMPA-EA), hosted jointly by the United Nations Environment Programme (UNEP) and the Western Indian Ocean Marine Science Association (WIOMSA).

A number of other regional initiatives have also contributed to the progress in MPA establishment and management, including:

- A Norwegian Agency for Development Co-operation (NORAD)-funded project - the WIO Marine Biodiversity Conservation Project, which has identified MPAs as a priority theme for attention.
- The Coastal Zone Management Centre (CZMC) of the Netherlands - supported project on Capacity building in MPA management in the Western Indian Ocean region. Implemented in collaboration with WIOMSA, the project aimed at providing training in skills, techniques and tools necessary for effective management of MPAs in the region.
- World Wide Fund for Nature (WWF)'s Eastern African Marine Ecoregion (EAME) Programme, which covers the mainland coast from southern Somalia to the northern coast of South Africa, and promotes, amongst others, the establishment of a regional representative network of MPAs based on the ecosystem approach.

IUCN's Eastern Africa Regional Programme (EARP) initiated the WIO Marine Biodiversity Conservation Project in 2000 with a range of partners, to assist with implementation of the Jakarta Mandate within the Eastern African region. The project is led by a Task Force representing six of the Parties to the Nairobi Convention, as well as a number of regional organisations including WIOMSA, UNEP, WWF and IUCN-EARP. The project also provides a mechanism for assisting with implementation of the Nairobi Convention, since the Convention and the Jakarta Mandate share similar objectives.

The Nairobi Convention calls upon the Contracting Parties to 'formulate and adopt guidelines, standards or criteria concerning the identification, selection, establishment and management of protected areas'. Furthermore, the Biennial (2000-2001) Work Programme of the Nairobi Convention proposed that existing MPA global guidelines should be 'regionalised' with the intention of improving their relevance to the situation in the WIO region. The Task Force of the WIO Marine Biodiversity Conservation Project therefore suggested that such guidelines could be prepared as one of the Project's activities.

A needs assessment was first undertaken to determine more precisely the requirements of MPAs in the region. The assessment, which was based on questionnaires, email correspondence and focused discussions, involved a range of practitioners and experts from within and outside the region, and benefited from contributions from members of the Task Force and GEMPA-EA. The assessment revealed that MPA managers and practitioners felt that many guidelines, training manuals and other relevant materials already exist and largely fulfill their intended purposes. However, the remote locations of many of the WIO MPAs, and their inadequate funding and communication facilities, mean that they have very limited access to simple and practical information. It was therefore recommended that a Toolkit be prepared to assist MPA managers and practitioners access existing information relating to all stages of MPA establishment and management, including site selection, planning, day-to-day management, sustainable financing, management effectiveness and monitoring and evaluation.

The Toolkit is designed to complement and build on the Regional Training Course in Marine Protected Areas Management in the Western Indian Ocean Region and a manual entitled *Training for the sustainable management of Marine Protected Areas: A training manual for MPA managers*. The Toolkit aims to act as a first point of call in the search for information on issues that MPA managers and practitioners face in day-to-day operations.

The Toolkit reflects work by many individuals and organizations that, over a period of three years, have collaborated together on conception of the idea, to the writing of theme sheets, to reviewing them. We hope this collaboration will continue since the production of this Toolkit is a small step forward in our long march to improve the management effectiveness of the MPAs in the WIO region.

Julius Francis
Executive Secretary, WIOMSA

MPAs in the WIO are supported by a host of managers, wardens, rangers, community members and others. These MPA 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. These may range from purchasing a boat, managing staff, annual planning, monitoring fish populations in the MPA, 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 need, partners involved in the IUCN/NORAD WIO Marine Biodiversity Conservation Project decided to publish a Toolkit for managing MPAs in the WIO. This consists of a ring-binder of theme sheets, each of which addresses a key issue faced by an MPA manager, with a focus on the situation in the WIO. The Toolkit also has a complementary website (**www.wiomsa.org\mpatoolkit.htm**) and CD-ROM.

The Toolkit was designed to support MPA managers in the WIO by providing them with a hands-on guide to a diverse array of topics, ranging from Communications, Monitoring Coral Reefs, Energy Sources, Solid Waste Disposal, to Octopus and Sea Cucumber Fisheries. The Toolkit is designed to address management issues relevant to all types of MPAs, from community based, locally managed areas, to nationally gazetted marine parks. The geographical scope of the Toolkit comprises Comores, Kenya, Madagascar, Mauritius, Mozambique, Réunion (France), Seychelles, Somalia, South Africa (but only Kwazulu Natal) and Tanzania; the ten countries that are signatory to the Nairobi Convention. The Toolkit represents a significant review of global information but draws heavily on information from the WIO region, with case studies from nine countries. Although written for the WIO where it will be distributed, it is certainly relevant to other tropical regions.

This first Edition of the Toolkit contains 78 theme sheets, most of which include a case study to help illustrate each topic. The Toolkit is arranged in two parts: 1) The Management Process and 2) Conservation and Sustainable Use. Although comprehensive, there are certainly gaps and emerging issues that are not yet included. The Toolkit has been designed as a ring-binder so it is a dynamic product that will be revised as new information becomes available, or as new sheets are developed. WIOMSA and GEMPA-EA have been instrumental in the development of this Toolkit and will act as the focal point for this ongoing review and updating. Comments and reviews should be addressed to: **secretary@wiomsa.org**.

It is now widely accepted that MPAs in their various guises are one of the most effective ways of protecting marine biodiversity and also serve as a vital management tool for coastal fisheries. The latter is particularly relevant in the WIO where coastal people still widely depend on marine resources for their subsistence and livelihoods. Two economic sectors, in particular, benefit from MPAs and demonstrate how MPAs can help to alleviate poverty: fisheries and tourism. There is a growing body of evidence that MPAs can generate substantial income through tourism, and potentially play a major role in the recovery of over-exploited fisheries.

It is intended that this Toolkit will be pivotal in assisting MPA managers in their important role as custodians of the WIO's marine biodiversity.

Melita Samoilys
Programme Coordinator - Marine and Coastal Ecosystems
IUCN Eastern African Regional Programme

STRUCTURE

The Toolkit consists of a ring-binder containing double-sided 'theme sheets', a series of introductory pages, and a CD-ROM. 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 it is planned that individual theme sheets will be up-dated over time; the old versions can thus be replaced by the new ones. Additional theme sheets and other materials can also be added. Editions of the Toolkit and CD-ROM are also being prepared in Portuguese and French.

The Toolkit has three parts:

Introductory section - This comprises seven main parts, including two maps of the WIO showing the location of all MPAs in the region and a table with details of dates of their establishment and size. Addresses and contact details for each MPA, an annotated list of global and regional conventions and initiatives relevant to MPAs (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 in so many ways.

Part 1 The Management Process - Seven sections contain theme sheets on management topics or inputs (human, financial, organizational and technical) required to effectively manage an MPA 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 MPA 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 MPA management in the WIO region. The text aims to provide:

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

A survey carried out before the Toolkit was developed indicated that the main need of MPA personnel in the region is assistance in obtaining information on different subjects. 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. Given that all theme sheets have a single 2-sided page format, this means that some subjects are covered in more depth than others. As the Toolkit evolves and expands, it is intended that the gaps should be filled and other topics added. Each theme sheet stands alone, but contains cross-references to other relevant sheets.

The theme sheets were compiled and reviewed by numerous regional and international experts. 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.

CD-ROM

The CD-ROM contains a full electronic version of the Toolkit. Theme sheets are in Portable Document Format (pdf) to allow easy viewing, navigation and printing. The CD-ROM is identical to the website.

General information and operating instructions for the CD-ROM, including instructions for installing software, using the associated software, and accessing the theme sheets will be included in the CD-ROM. Ultimately, three language options (English, Portuguese and French) will be available.

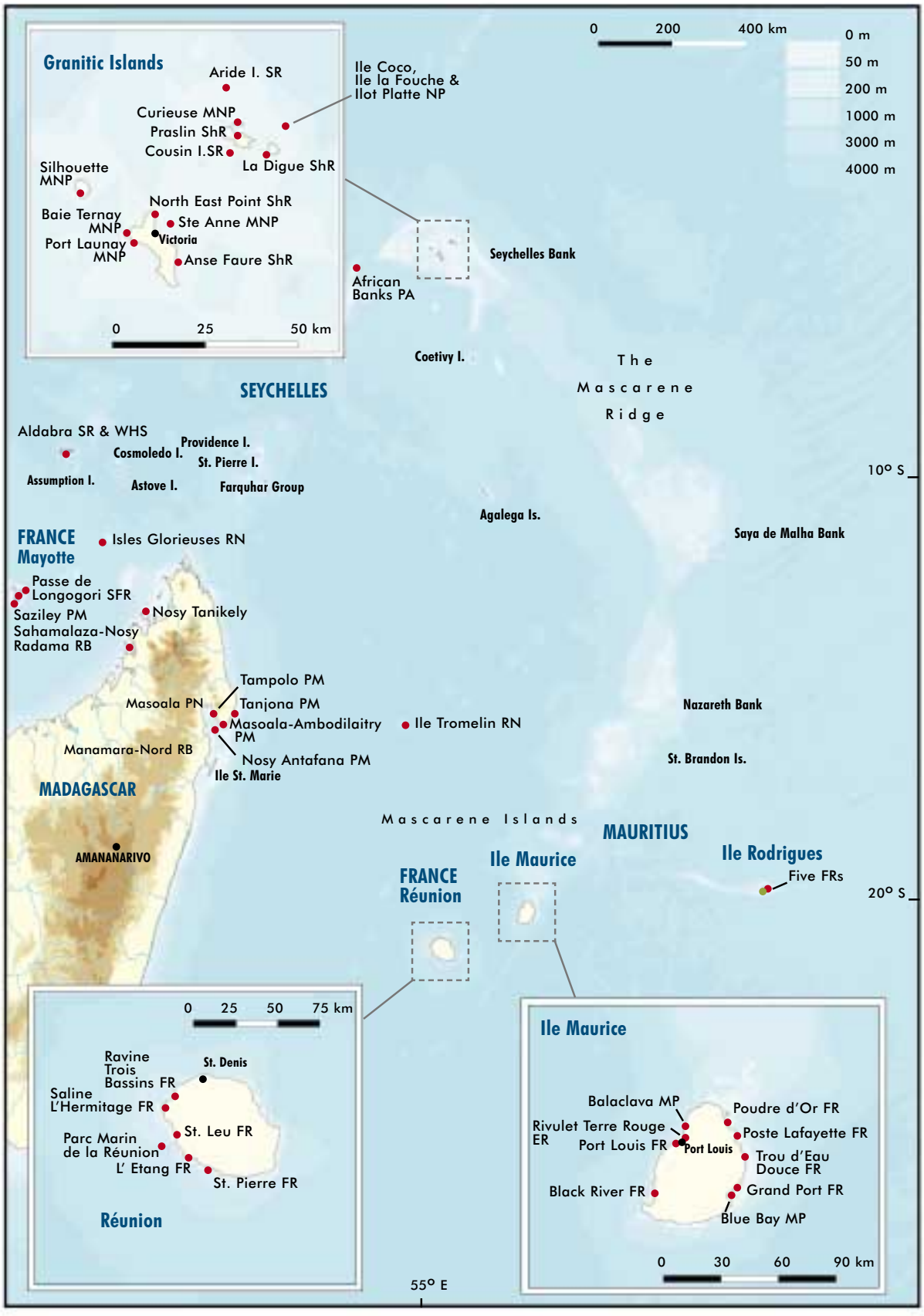
Website

The website (**www.wiomsa.org/toolkit.htm**) has been created to complement the printed Toolkit and the CD-ROM. All the theme sheets can be viewed or downloaded as pdf files. At a future date, information in the website will be in three languages namely, English, Portuguese and French. New material and updates will be posted to the website on a continuing basis.

See overleaf for explanation of abbreviations used for MPA names.

Marine Protected Areas of the Western Indian Ocean

Northern Madagascar, Mascarenes and Seychelles



Abbreviations for MPA names:

BR	Biosphere Reserve	MP	Marine Park	RN	Réserve Naturel
CA	Conservation Area	MPA	Marine Protected Area	RS	Ramsar Site
CMA	Collaborative Mngmt Area	MR	Marine Reserve	ReS	Reef Sanctuary
ER	Estuary Reserve	NP	National Park	SFR	Strict Fishing Reserve
FaR	Faunal Reserve	PA	Protected Area	ShR	Shell Reserve
FR	Fishing Reserve	PM	Parc Marin	SR	Special Reserve
MNP	Marine National Park	PN	Parc National	WHS	World Heritage Site
MNR	Marine National Reserve	R	Reserve	WP	Wetlands Park
		RB	Réserve de la Biosphère	ZP	Zone de Protection

The information below was as accurate as possible at the time of printing. Notice of any errors, changes to status or creation of new MPAs, should please be made to WIOMSA for incorporation into future editions. Included are proposed sites likely to be designated in the near future.

Some sites have both national and international designation. Where two dates are given, the MPA was gazetted twice, the second time changing name or size. Sheet A1 provides an explanation of IUCN categories. n/a = IUCN category not assigned. Sizes include terrestrial portion of MPAs.

Country	Marine Protected Area	Date estab.	IUCN category	Size sq km
Comores	**Moheli** Marine Park	2001	n/a	404.00
France	**Ilot d'Europa** Réserve Naturelle	1975	IV	..
Iles Eparses	**Iles Glorieuses** Réserve Naturelle	1975	IV	..
	Ilot de Bassas de India Réserve Naturelle	1975	IV	..
	Ile Tromelin Réserve Naturelle	1975	IV	..
France	**Passe de Longogori** Strict Fishing Reserve	1991	VI	13.80
Mayotte	**Saziley** Parc Marin	1991	II	25.90
	N'Gouja Zone de Protection	2001	-	2.00
France	Parc Marin de la **Réunion**	1997/98	VI	18.20
La Réunion	**L'Etang** Fishing Reserve	1992	VI	..
	Ravine Trois Bassins-Pointe de Bretagne Fishing Reserve	1978	VI	..
	St Leu Fishing Reserve	1992	VI	..
	Saline l'Hermitage (lagoon) Fishing Reserve	1992	VI	..
	Saline l'Hermitage (reef) Fishing Reserve	1992	VI	..
	St Pierre Fishing Reserve	1992	VI	..
Kenya	**Kiunga** Marine National Reserve	1979	VI	250.00
	within **Kiunga** Biosphere Reserve	1980	-	600.00
	Malindi Marine National Park	1968	II	6.30
	Watamu Marine National Park	1968	II	10.00
	Malindi-Watamu Marine National Reserve	1968	VI	245.00
	Malindi-Watamu Biosphere Reserve [partially covers the MNR]	1979	-	196.00
	Mombasa Marine National Park	1986	II	10.00
	Mombasa Marine National Reserve	1986	VI	200.00
	Kisite Marine National Park	1978	II	28.00
	Mpunguti Marine National Reserve	1978	VI	11.00
	Diani Marine National Reserve	1995	VI	75.00
Madagascar	**Nosy Atafana** Parc Marin	1989	II	10.00
	(within Réserve de la Biosphère du **Mananara-Nord**)	1990	-	1,400.00
	Masoala Parc National (includes 3 Parcs Marins):	1997	-	100.00
	Tampolo, **Masoala-Ambodilaitry** and **Tanjona**			
	Nosy Tanikely [no fishing zone]	1968/95	n/a	0.10
	Nosy Ve [community based marine management area]	1999	n/a	10.00
	Réserve de la Biosphère du **Sahamalaza-Nosy Radama**	2001	n/a	322.00
	Réserve de la Biosphère du **Tulear**	2003	n/a	..
Mauritius	**Balaclava** Marine Park	1997/2000	II	5.00
Ile Maurice	**Blue Bay** Marine Park	1997/2000	-	3.50
	Black River Fishing Reserve	1983/2000	IV	7.80
	Grand Port Fishing Reserve (Zones A & B)	1983/2000	IV	18.30
	Port Louis Fishing Reserve	1983/2000	IV	3.30
	Poste Lafayette Fishing Reserve	1983/2000	IV	6.00

Ile Maurice cont.	**Poudre d'Or** Fishing Reserve	1983/2000	IV	25.40
	Rivulet Terre Rouge Estuary Reserve	1999	-	..
	Trou d'Eau Douce Fishing Reserve	1983/2000	IV	5.70
Mauritius	Five Fishing Reserves proposed 1984 - 1998:		-	..
Ile Rodrigues	**Anse aux Anglais/Grande Baie** Reserve	..	-	1.20
	Carcasse and Grand Bassin Reserve	..	-	9.50
	Passe Demie and Islets Reserve	..	-	5.20
	Riviere Banane Reserve	..	-	0.30
Mozambique	**Bazaruto Archipelago** National Park	1971/2001	II	1,430.00
	Ilhas da Inhaca e dos Portugueses Faunal Reserve	1965	VI	20.00
	Quirimbas National Park	2002	-	7,500.00
Seychelles	**Aldabra** Special Reserve	1981	Ia	350.00
	Aldabra World Heritage Site	1982	-	350.00
	Aride Island Special Reserve	1973	Ia	0.70
	Baie Ternay Marine National Park	1979	II	0.80
	Cousin Island Special Reserve	1968/75	Ia	0.28
	Curieuse Marine National Park	1979	II	14.70
	Port Launay Marine National Park	1979	II	1.58
	Silhouette Marine National Park	1987	II	30.45
	Ste Anne Marine National Park	1973	II	14.23
	Ile Coco, Ile la Fouche & Ilot Platte Marine National Park	1997	-	0.01
	African Banks Protected Area	1987	-	8.20
	Anse Faure Shell Reserve	1987	n/a	1.08
	North East Point Shell Reserve	1987	n/a	2.99
	La Digue Shell Reserve	1987	n/a	1.58
	Praslin Shell Reserve	1987	n/a	1.74
South Africa	**Maputaland** Marine Protected Area	1986	n/a	408.00
	St Lucia Marine Protected Area	1979	n/a	414.00
	Greater St Lucia Wetlands Park	1895	II	2,587.00
	Greater St Lucia World Heritage Site	1999	-	2,396.00
	Trafalgar Marine Protected Area	1979	n/a	2.50
	Tongaland turtle beaches and coral reefs Ramsar Site	1986	-	395.00
	Aliwal Shoal Marine Protected Area	2004	n/a	126.00
Tanzania	**Mafia Island** Marine Park	1996	VI	822.00
mainland	**Mnazi Bay – Ruvuma Estuary** Marine Park	2000	-	650.00
	Dar es Salaam Marine Reserves	1975	II	26.00
	Bongoyo, **Fungu**, **Yasini**, **Mbudya**, **Pangavini**			
	Tanga Collaborative Management Areas			
	Boma-Mahandakini	2001	-	100.00
	Deepsea-Boma	1999	-	400.00
	Mwarongo-Sahare	1998/99	-	300.00
	Mtanga'ata	1996	-	150.00
	Boza-Sange	1996/2000	-	559.00
	Mkwaja-Sange	2001	-	405.00
	Maziwe Island Marine Reserve	1981	II	2.60
Tanzania	**Chumbe** Reef Sanctuary	1994	II	0.30
Zanzibar	**Menai Bay** Conservation Area	1997	VI	470.00
	Misali Island Conservation Area	1998	VI	22.00
	Mnemba Island Conservation Area	2002	VI	0.15

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

LEGALLY BINDING CONVENTIONS

Convention on Biological Diversity and the **Jakarta Mandate** 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 coastal management (ICM), sustainable use of living resources, MPAs, mariculture and alien species. **www.biodiv.org**

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. **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. **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. **www.un.org/depts/los**

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**

Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (Nairobi Convention) - One of the UNEP Regional Seas conventions, covering protection of the marine and coastal environment in the Eastern Africa Region. The Protocol on Protected Areas and Wild Fauna and Flora requires the establishment of a regional programme for the creation of a network of MPAs. **www.unep.org/easternafrica/**

African Convention on the Conservation of Nature and Natural Resources - Covers conservation and sustainable management of land, soil, water, and biodiversity. Requires parties to promote the establishment of community-based protected areas. **www.iucn.org/themes/wcpa/wpc2003/pdfs/outputs/africa/africa_pasconvention.pdf**

NON-BINDING PROGRAMMES AND INITIATIVES

World Summit on Sustainable Development 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 MPAs worldwide by 2012. **www.johannesburgsummit.org**

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'. **www.unesco.org/mab**

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**

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 MPAs. **www.icriforum.org**

International Coral Reef Action Network (ICRAN) - A global partnership of international organizations, NGOs, research and conservation organizations, that is part of ICRI and focuses on sustainable development of coral reef areas. **www.icran.org**

African Protected Areas Initiative (APAI) - A Pan-African process under the New Partnership for African Development (NEPAD) established to provide guidance on protected areas and promote implementation of the African Convention. The environment plan for NEPAD also includes a specific section on coastal and marine issues. **www.nepad.org**

WWF Eastern African Marine Ecoregion (EAME) **Programme** A partnership programme addressing large-scale conservation, MPAs and sustainable use of marine resources in mainland Eastern Africa. A complementary programme - **WWF Western Indian Ocean Marine Ecoregion** (WIOMER) **Programme** - is being established for the island states. **www.panda.org**

Conventions and programmes, not directly related to MPAs, but important for biodiveristy conservation

- **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.wcmc.org.uk/cmc**
- **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://unfcc.org**
- **Small Island Developing States** (SIDS). **www.sidsnet.org**

Using the Internet

The Internet is a vast, expanding, worldwide network, available to anyone with access to a computer, modem and telecommunications. It provides access to both email and the World Wide Web (**www** or 'the web'). This consists of many millions of screen pages of text, images and sound files, made available by individuals or organisations including governments, companies and NGOs. The information is made available on 'web pages' which are located at a specific addresses called a 'website'. **Websites** are viewed by a computer programme called a browser, of which of two popular ones are Internet Explorer and Netscape. Exploring the web is called web-surfing or surfing.

Every website has a unique address, known as a domain. The address generally starts with **www** and ends with certain letter combinations. Domains can be registered (owned) by governments, organizations 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 organizations, and **.ac** and **.edu** by academic and educational institutions. National governments, government agencies and ministries usually use **.gov** or **.gouv**. Sometimes an address ends with a suffix denoting its country such as **.tz** (Tanzania), **.ke** (Kenya), **.mu** (Mauritius) or **.za** (South Africa).

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. Any typing error will prevent the web browser from locating the website. Lower case letters are generally used for website addresses. Where **http://** is written in front of **www** in a website address, it signifies the protocol or language used by computers. Normally browsers will accept a website address starting with **www** only.

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 organized 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. 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:**www.leeds.ac.uk/civil/ceri/water/tphe/publicat/pdm/india/india.html.** These are short cuts that direct the browser to a specific page of the website producing the information, in this case, Leeds University in UK **www.leeds.ac.uk.**

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.

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 WIO. 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.

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

IUCN – The World Conservation Union

Most IUCN publications, including the IUCN/WCPA Best Practice Protected Area Guidelines Series and others specifically on MPAs are available from the IUCN Publications catalogue and can be viewed on the IUCN website (www.iucn.org). Publications specific to the WIO are available from the regional office in Nairobi.

IUCN Publications Services Unit, 219c Huntingdon Road, Cambridge CB3 ODL, UK. Fax: + 44 1223 277175; Email: books@iucn.org ; mail@iucn.org

IUCN Eastern Africa Regional Office, P.O. Box 68200, Nairobi, Kenya. Tel. + 254 20 890605/12; Fax. + 254 20 890615; Email: mail@iucnearo.org ; mail@iucn.org

WWF – World Wide Fund for Nature

WWF publications and resources can be obtained by contacting the following offices:

WWF Eastern Africa Regional Programme Office (WWF EARPO), 5th Floor of A.C.S. Plaza along Lenana Road, Nairobi, Kenya. Tel: + 254 20 577355; Fax: 577389; Email: eafrica@wwfearpo.org

WWF Madagascar & West Indian Ocean Programme Office (WWF MWIOPO), B.P. 738 Antananarivo 101, Madagascar. Tel: + 261 20 22348 85; Fax: 2234888; Email: rratsimbazafy@wwf.mg

WWF Tanzania Programme Office, Plot No. 350 Regent Estate, Mikocheni, Dar es Salaam, PO Box 63117, Dar es Salaam, Tanzania. Tel: + 255 22 27 00077; Fax: 2775535; Email: angusaru@wwftz.org

WIOMSA – Western Indian Ocean Marine Science Association

The manual produced by WIOMSA for the MPA manager training courses that are held in the WIO every two years complements the toolkit. The manual, other publications and the journal 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: 2233582; Email: secretary@wiomsa.org. Website: www.wiomsa.org

UNEP – United Nations Environment Programme

For information on UNEP publications contact:
United Nations Environment Programme: P.O. Box 30552, Nairobi, Kenya. Tel: + 254 20-621234; Fax: + 254 20 623927; Email: cpiinfo@unep.org Website: www.unep.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, Kortenaerkade 1, 2518 AX, The Hague, The Netherlands. Tel: + 3170 311 4460; Fax: 245 6648, Email: gpa@unep.nl Website: www.gpa.unep.org

Publications Specific to the Nairobi Convention: Contact – Nairobi Convention, P.O. Box 30552, Nairobi, Kenya.
Tel: + 254 20 623258; Fax: 624618;
Email: Nairobi.Convention@unep.org
Website: www.unep.org/eastafrica/

UNEP-World Conservation Monitoring Center, 219 Huntingdon Road, Cambridge CB3 0DL, United Kingdom.
Tel: + 44 01 22327731; Fax: 223277136;
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 1223 277427; Fax: 277237; Email: traffic@wcmc.org.uk

TRAFFIC East/Southern Africa, P.O. Box 63117, Dar es Salaam, Tanzania. Tel: + 255 22 2700077; Fax: 2775535; Email: traffictz@raha.com

SEACAM

Several very useful publications produced by the Secretariat for Eastern African Coastal Area Management (SEACAM) are listed in the theme sheets. The SEACAM office and website have unfortunately closed, but the main publications are available from www.coastalzones.gov.mz or Email: cdcoastal@teledata.mz attn: Mr. Hermes Pacule

TNC - The Nature Conservancy

Produces several publications on protected areas, particularly on topics relating to sustainable financing:

The Nature Conservancy, Worldwide Office, 4245 North Fairfax Drive, Arlington, VA 22203-1606, USA. Tel: + 1 703 8418170; Fax: 8414880; Email: publications@tnc.org
Website: www.tnc.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; Fax: 57052476;
Email: fi-library@fao.org or publications_sales@fao.org

World Fish Center (previously ICLARM)

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: 6265530;
Website: www.worldfishcenter.org
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: 7297610

AIMS - Australian Institute of Marine Science

Produces many reports and guides relating to the monitoring and management of tropical marine ecosystems.

Australian Institute of Marine Sciences, PMB No 3, Townsville Mail Centre, Townsville, Q 4810, Australia.
Email: bookshop@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 which can be ordered or viewed via their web site.

CRC Reef Research Centre, James Cook University, Townsville 4811, Australia. Website: www.reef.crc.org.au

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 web site or obtained in hard copy.

Great Barrier Reef Marine Park Authority, PO Box 1379, Townsville, Queensland 4810, Australia.
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: 7894670; Email: info@crc.uri.edu
Website: www.crc.uri.edu

Newsletters, general references and other useful sources

MPA News - 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 mpanews@u.washington.edu. The website www.mpanews.org allows automated searches by keyword through back issues of the newsletter.

CoastCare Fact Sheet - South Africa has its own 'marine' toolkit, which gives a wealth of information on topics relevant to the WIO in general, although with a South African angle: Attwood, C., Branch, M., Mann-Lang, J., Matthews, S., Glavovic, B. 2001. CoastCare Fact Sheet Series. Department of Environmental Affairs and Tourism, South Africa. Website: http://sacoast.wcape.gov.za

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

UN Atlas of the Oceans – an Internet portal that provides an information system for use by policymakers, 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

BACKGROUND TO THE PRODUCTION

The MPA Toolkit was commissioned by IUCN-EARO in August 2003, through two contracts, with Samaki Consultants and the Western Indian Ocean Marine Science Association (WIOMSA). Samaki Consultants was responsible for the design, research and editing of the theme sheets. WIOMSA, represented by Julius Francis, was responsible for overseeing website design, CD preparation, Toolkit promotion and translation.

Production of each theme sheet included research leading to the preparation of the first drafts that were then expanded and edited to incorporate comments from various reviewers. Under Samaki Consultants, Sue Wells led the preparation of the majority of the original draft theme sheets and was responsible for the coordination of both the extensive review process and all editing. Matt Richmond and Peter Llewellyn (both of Samaki Consultants) prepared most of the remaining theme sheet first drafts. Heidi Savelli Söderberg (assistant to WIOMSA) conducted research on websites.

Advice on format and content of the toolkit was provided by an Editorial team comprising 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), Sue Wells and Matt Richmond (Samaki Consultants), Helena Motta (WWF), Nirmal Shah (Nature Seychelles). The IUCN Technical Reviewers were Melita Samoilys, Julie Church, Dalmas Oyugi and Geoffrey Howard. The Toolkit concept was developed through prior contracts undertaken by Charlotte de Fontaubert, Joseph Tunje and Matt Richmond.

CARTOONS, GRAPHICS & PHOTOGRAPHS

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Many scientists, MPA practitioners and other experts gave freely of their time to provide valuable reviews of the theme sheet drafts resulting in the material included in the Toolkit. The Editorial team wholeheartedly thank all these individuals for their contributions. Colin Attwood (Dept Environmental Affairs and Tourism, South Africa) and Jude Bijoux (Seychelles Centre for Marine Research and Technology – Marine Parks Authority) are thanked for providing general information on South African and Seychelles MPAs respectively. UNEP-WCMC, Cambridge, kindly provided use of its information and facilities. The list that follows provides the names of individual contributors (contr.), being those who provided information and/or draft text, and of reviewers of the drafts (rev.) who provided comments on Toolkit theme sheets. For sheet titles see Contents or individual sheet.

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Types and categories of MPAs

A1

There are many 'types' of MPAs (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 an MPA 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.

MPA DEFINITIONS

IUCN defines a protected area 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 the basis of the UN List of Protected Areas, numbering over 100,000 protected areas. This is a subset of the larger World Database on Protected Areas (WDPA), managed by UNEP-WCMC.

An 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.*

MPA is thus a generic term for any marine area that is protected for the primary objective of biodiversity conservation, and includes protected areas differing in purpose, design, management approach, and name (e.g. marine reserve, sanctuary, marine park). The phrase 'reserved by law or other effective means' means that areas set up under traditional law or through voluntary agreements can be termed MPAs provided the mechanism is effective. Other definitions can be found in the literature, but the IUCN one tends to be the most widely accepted.

Note that MPAs in one country may have different objectives and be managed differently from those with the same name in another. Thus in Kenya, National Marine Parks prohibit extraction, and National Marine Reserves allow it; whereas in Tanzania, Marine Parks allow fishing and Marine Reserves are no-take areas (see sheet I1). Sometimes sites that are not perceived as meeting IUCN's definition of an MPA are considered by the stakeholders themselves as MPAs. These include some no-take fisheries management areas (e.g. in Tanga Region, Tanzania) where regulation of exploitation, rather than conservation is the primary objective, and some areas under integrated coastal management programmes which may be very similar to multiple-use MPAs. This does not affect the management of an area, but MPA practitioners should be aware of it.

IUCN PROTECTED AREA CATEGORIES

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

- a tool for promoting the development of a representative system of protected areas;
- 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 protected area. Categories IV and V are for protected areas 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 protected areas, using the IUCN guidelines.

MPAs can be difficult to categorise. They may be administered by a different agency from terrestrial protected areas, which may not be familiar with IUCN procedures (for example if it is a Fisheries Department). Furthermore, MPAs do not always appear to fit comfortably into the existing categories system, particularly multiple-use MPAs and no-take areas. In some cases (e.g. Australian marine reserves) different categories are applied to different zones. There are plans to revise the IUCN 1994 guidelines with greater attention being paid to MPAs (see further information at **www.cardiff.ac.ukk/cplan/sacl**).

IUCN categories (I-VI) with WIO examples (where they exist).

Ia.	Area managed mainly for science, or as a Strict Nature Reserve (Cousin I. Special Reserve, Seychelles).
Ib.	Area managed mainly for wilderness protection.
II.	Area managed mainly for ecosystem protection/recreation (all Marine National Parks in Kenya).
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 (Mauritius Fishing Reserves).
V.	Area managed mainly for land/seascape conservation and recreation.
VI.	Area managed mainly for sustainable use of natural ecosystems e.g. multiple-use protected area (Mafia Island Marine Park, Tanzania).

TRANSBOUNDARY MPAS

These are MPAs that 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. At present, there are no transboundary MPAs in the WIO, although there are plans for the border between Tanzania and Mozambique.

INTERNATIONAL DESIGNATIONS

Some MPAs have, in addition to their national designation, international status as a protected area. 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 MPA, 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 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 protected area is subject to a rigorous review procedure. At present there are only two marine WH Sites in the WIO: Aldabra in Seychelles and St Lucia in South Africa, but several MPAs potentially meet the criteria for nomination, for example in Mozambique.

Biosphere Reserves are established under UNESCO's Man and the Biosphere (MAB) Programme. They make up a network of protected areas 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 WIO with marine components include Kiunga and Malindi-Watamu in Kenya and Mananara-Nord in Madagascar. Details at **www.unesco.org/mab**
Ramsar Sites are established under the Ramsar Convention on Wetlands (**www.ramsar.org**), 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 protected area system. There are few coastal and marine Ramsar sites in the WIO, but several are being planned.

KEY POINTS FOR THE MPA

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

Sources of further information

Chape, S. *et al.* (compilers) 2003. *2003 United Nations List of Protected Areas*. IUCN, Gland, Switzerland and Cambridge, UK. **http://sea.unep-wcmc.org/wdbpa/unlist**

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MPA goals and objectives

A2

The goals and objectives of an MPA 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 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 MPA managers and personnel look critically at the goals and objectives of the MPA (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':

- Establish clear, concise objectives;
- Develop realistic plans for achieving these (see sheet C3);
- Monitor performance and achievement (see sheet G9);
- Take corrective (or adaptive) management.

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

GOALS

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

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

IUCN/WCPA-Marine has compiled generic goals (Pomeroy *et al.*, 2004), based on global survey of MPAs: five for biodiversity (e.g. 'individual species protected'); six for socio-economic issues (e.g. 'food security enhanced or maintained'; and five for governance (e.g. 'effective management structures and strategies maintained'). Examples of MPA goals in the WIO are:

Cousin Island Special Reserve Seychelles (called a vision): *To make Cousin the best marine and terrestrial small-island protected area in the world*, and:

Quirimbas National Park Mozambique (called a long-term objective): *To conserve the diversity, abundance and ecological integrity of all physical and biological resources in the park area, so that they may be enjoyed and used productively by present and future generations.*

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 MPA (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 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 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 MPA would be impractical if local communities depend on this area for food.

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

26 Biophysical objectives e.g. Focal species abundance increased or maintained;

21 Socio-economic Objectives e.g. Nutritional needs of coastal residents met or improved.

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

Cousin Island Special Reserve has eight objectives, five covering biodiversity and natural values, two covering socio-economic issues, and one covering governance:

1. To maintain viable populations of endemic land birds and internationally important breeding seabird populations on the island.
2. To maintain or establish threatened endemic plant species where appropriate, so long as this does not conflict with objective 1.
3. To maintain and enhance viable populations of the island's endemic terrestrial vertebrates and invertebrates.
4. To protect and maintain the integrity of the island's coastal and littoral habitats, especially the coral reef and its associated flora and fauna and the internationally important breeding populations of hawksbill turtle.
5. To understand and mitigate long-term and external influences.
6. To use the island's conservation features as a vehicle to raise and maintain education and public awareness.
7. To maintain a safe, effective and sustainable physical infrastructure for carrying out the reserve's management plan.
8. To administer and manage the reserve in a professional manner ensuring that all Nature Seychelles standards are maintained or exceeded

DEVELOPING GOALS AND OBJECTIVES

In order to ensure that a full understanding of the ecological and socio-economic values of an MPA is used in the development or revision of the goals and objectives, the process should be participatory and involve consultation with all stakeholder groups. Many of the objectives of MPAs in the WIO are worded more as goals, and would benefit from being made more specific (the example of Cousin Island illustrates objectives that are based on a good understanding of the values of the protected area). The generic objectives developed for MPAs by WCPA-Marine, and by Hockey & Branch (1997) for South African MPAs may be helpful when revising or developing those for other MPAs. 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 three years, income from MPA 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 is vulnerable to changes in the global economic situation). Further, such specific parameters may be difficult to measure (e.g. in the second example, there are no simple techniques for quantifying 'ecological knowledge of visitors'). Statements like this may be useful as targets to encourage good performance in an MPA, but objectives are best left open-ended (e.g. 'Income from MPA 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 MPA, and defined in more detail in the management plan. They should be assessed at intervals (preferably when the management plan is reviewed) to see if they need revision. 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 MPA 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 MPA

- ❑ **Ensure that MPA personnel and stakeholders have a good understanding of the current goals and objectives of the MPA.**
- ❑ **Consider whether it would be appropriate to reword them, 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.**
- ❑ **Ensure that monitoring programmes are in place or being developed to measure whether the MPA's objectives are being met.**

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Organisational structures

A3

MPAs 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). The differences relate mainly to the degree of stakeholder participation in the process and the location of the management authority and responsibility. 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 MPA. This is often illustrated in an organisational chart or organogram showing lines of authority and responsibility (see Cousin Island example below from the Seychelles). Each of the bodies on the chart should have a person in charge and clearly defined functions and powers, usually described in TOR for the body, or the job descriptions for the individuals involved.

MPA MANAGEMENT AUTHORITIES

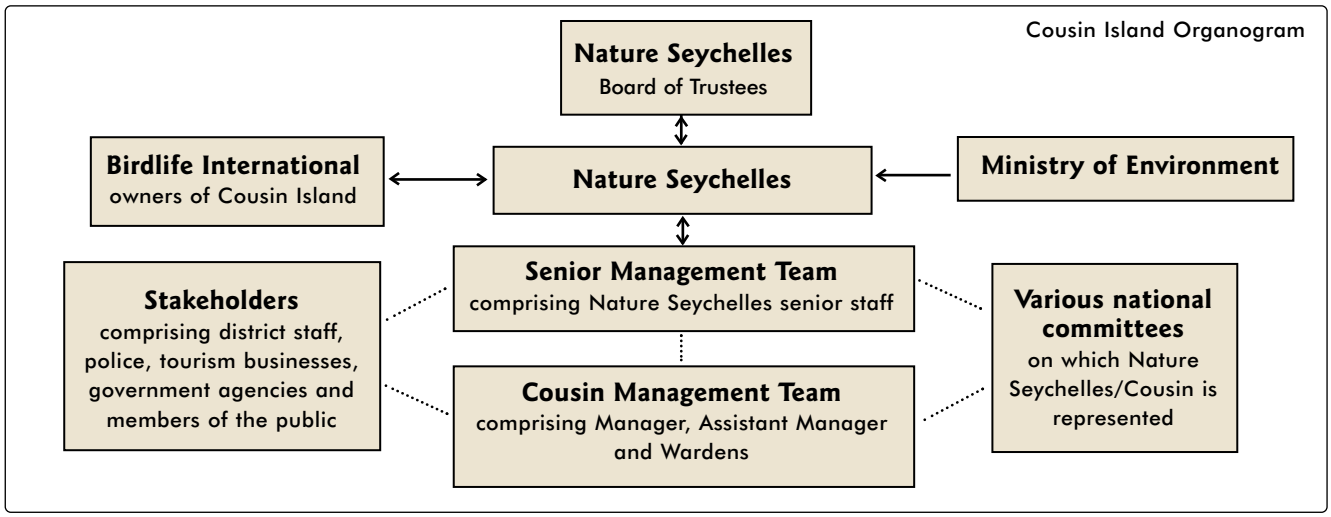
The organisational structure of an MPA varies according to the national political, legislative, cultural and socio-economic framework but even within a country, MPAs may have different arrangements. The government body responsible for MPAs is sometimes the same agency as for terrestrial protected areas, but sometimes several agencies may be able to establish MPAs. In Kenya, for example, all MPAs are the responsibility of Kenya Wildlife Service. By contrast, in Tanzania, the Marine Parks and Reserves Unit of the Department of Fisheries is responsible for Marine Parks and Reserves, and the Tanzania National Parks Agency is responsible for National Parks, even if the latter include marine habitat.

Fisheries Departments are often responsible for MPAs, but if they have no mandate to manage activities undertaken in the terrestrial areas where these impinge on the management of the MPA, 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. This will be an important issue for the MPA 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 MPA staff to fully understand the structure. The existence of a legally mandated MPA decision-making and management body, responsible for implementing the management plan, will lead to more professional management of the MPA. If it has 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 MPA 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 MPA MANAGEMENT

MPAs are increasingly being set up with the management authority delegated to, or in the hands of, 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. The Seychelles demonstrates a wide range of management arrangements. Two MPAs were set up and are managed by NGOs (Cousin Island, see below) and Aride Island Special Nature Reserves). The joint Seychelles Center for Marine Research and Technology and Marine Parks Authority (SCMRT – MPA) is responsible for the government-managed Marine National Parks. The Seychelles Fishing Authority (SFA) is responsible for Shell Reserves and the Island Development Company (IDC) for the African Banks Protected Area, but to date no active management arrangements have been implemented for these MPAs.



Some MPAs 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.

In some cases, the private sector is responsible for management. On Zanzibar, the management of Chumbe Reef Sanctuary is delegated to a private company (Chumbe Island Coral Park Ltd., see organogram below). 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. In Mozambique, Inhaca Faunal Reserve is managed by the Universidade Eduardo Mondlane, having been set up through the Marine Biological Station. Such delegated organisations are generally responsible for personnel, revenue collection, day-to-day management, environmental education and visitor management.

COMMITTEES AND BOARDS

Many or most MPAs 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. Members are usually appointed by the MPA administration 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 MPA to organise and convene meetings. Many meetings and interactions demand participatory and conflict resolution skills since they may involve divergent parties and viewpoints.

Many MPAs also have other committees for specific purposes. Village level advisory committees are very important in some MPAs, where communities play an important role in decision-making, as in some of the Tanzanian Marine Parks. For example, in Mnazi Bay-Ruvuma Estuary Marine Park, Village Environmental Committees play a key role. In other MPAs there may be committees and task forces for specific activities, such as the Scientific Committee for Aldabra Special Reserve and World Heritage Site. 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 MPA personnel, but other government personnel with 'powers of arrest' may have to be co-opted to arrest offenders. 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 MPA management and relationship to other stakeholders.

KEY POINTS FOR THE MPA

- ❑ **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 MPA statutes and legislation, and develop skills for effectively managing these.**
- ❑ **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.**

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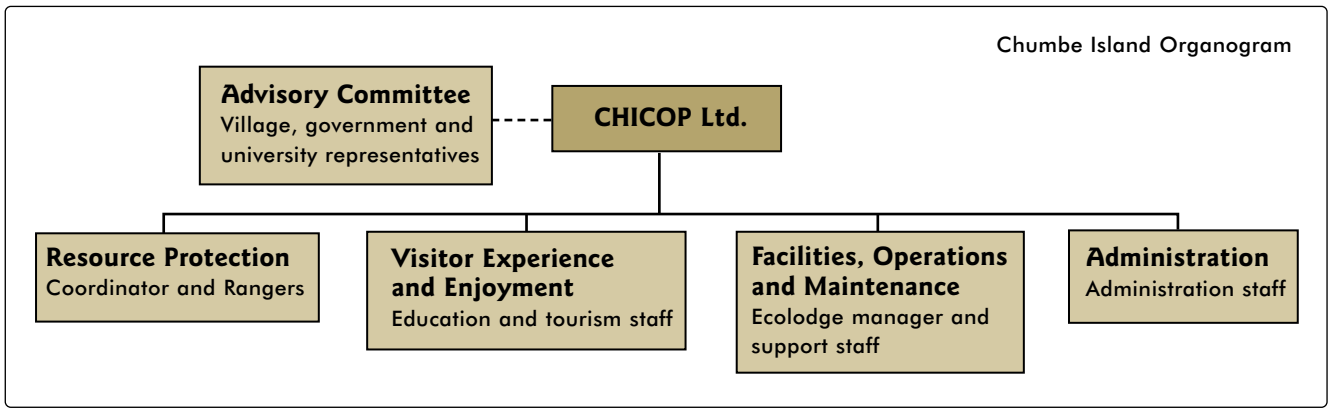

It is important that MPA personnel understand the legislation relevant to their work, including the laws and regulations specific to the MPA, other national legislation relevant to its management, and the international law that provides the overall context. The general regulatory framework of an MPA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

INTERNATIONAL LAW

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

- UN Convention on the Law of the Sea which 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;
- Convention on Biological Diversity, which requires that signatory states or 'Parties' establish protected areas;
- Nairobi Convention, which requires that signatory states in the WIO establish MPAs.

The treaties themselves do not enact or enforce legislation at the national level. Individual nations are responsible for this, which normally requires governments to pass enabling legislation in order to bringing the national law into line with what was agreed internationally.

NATIONAL LEGISLATION

Although MPAs can be set up without a legal foundation, these may not be sustainable as there will be no basis for court procedures if a prohibited activity takes place. In some countries, MPAs can be established under traditional or customary legislation (see sheet B4). This is rare in the WIO, one exception being Madagascar (see case study).

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.

Primary legislation

This refers to the overall legislative framework for a sector or issue, i.e. Acts, Statutes, Ordinances or Decrees. The primary legislation for protected areas prescribes their purposes and potential geographical scope, the principal restrictions and the general approach to management (e.g. requirements for involvement of stakeholders). It should allow for additional measures to be introduced to deal with unforeseen circumstances and for the development of regulations (e.g. for offences, penalties, and user fees).

Sometimes, terrestrial and marine protected areas are established under the same primary legislation (e.g. Kenya, where both terrestrial and marine National Parks and Reserves are gazetted under the Wildlife Conservation and Management 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 MPA needs. Elsewhere, MPAs are established under separate and more marine-oriented legislation (e.g. the Marine Parks and Reserves Act for mainland Tanzania). MPAs, particularly no-take zones, can often be declared under fisheries legislation. There may be several pieces of primary legislation allowing for MPA declaration, as in the Seychelles which has four.

Depending on the level of decentralisation in a country, legislation can often be passed at local level (e.g. District or village bye-laws), and it may be possible to establish MPAs in this way. For example, areas of reef have been closed to fishing in northern Tanzania through village bye-laws. Where local government agencies do not have jurisdiction seaward of the low water mark, locally managed MPAs will need central government support if legal backing is required.

Secondary or enabling legislation

This refers to the 'rules', 'regulations', or 'notifications' that are developed under the primary legislation and that allow for full enforcement. Secondary legislation can be used to define the boundaries and the specific activities allowed and prohibited within the MPA in general, or within different zones. It can also be used to delegate management to a government minister, a public authority, or to communities (e.g. under co-management

arrangements), and to set licences and other fees. Regulations should also address:

- Public rights to which people are ordinarily entitled e.g. rights of navigation, fishing and mangrove harvesting;
- Public activities that are generally tolerated but that usually have no legal basis e.g. use of the beach;
- Private rights e.g. ownership of the foreshore or private/communal fisheries.

The territorial sea-bed is usually state property, but the foreshore between high and low water marks and the adjacent coastal land can be privately owned, which can create difficulties. For example, MPAs may have no control over turtle nesting areas above 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.

OTHER LEGISLATION RELEVANT TO MPAs

Many other pieces of national legislation are relevant to an MPA and essential for its effective management (e.g. for fisheries, forestry and mangroves, shipping, waste disposal, mining, tourism, wildlife and E.I.A). Enforcing this can be difficult if the mandates of these government agencies take precedence over that for the MPA. Unless the primary legislation resolves this, such conflicts can undermine the effectiveness of the MPA. Harmonisation of MPA legislation with both primary and secondary fisheries legislation is particularly essential. An MPA manager must also have a good understanding of national legislation relating to employment (MPA personnel), the judiciary (powers of arrest and court procedures), and financial activities (management of the MPA's finances and fundraising).

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. The legislation should then be drawn up to permit implementation of the policy. Many countries are revising their policies relating to the environment and natural resources to reflect new thinking and the obligations of international agreements. It often takes longer to revise the legislation which means that national laws may lag behind the stated policy of the government.

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KEY POINTS FOR THE MPA

- ❑ **MPA staff should understand all relevant legislation; copies should be readily accessible and it should be described in the management plan.**
- ❑ **Help stakeholders and visitors to understand both the primary legislation and the regulations; disseminate information about it (interpreted in simple language) widely (e.g. in posters or leaflets); a good understanding will help to reduce violations.**
- ❑ **Assess the adequacy of the legislation and identify improvements that are needed; there is sometimes a delay between enacting the primary and secondary legislation which can make enforcement difficult, so if regulations are lacking, work with the management agency to help accelerate the process.**
- ❑ **Ensure that key personnel learn about the most relevant international agreements, so that they understand the role of the MPA in helping the country meet these.**

CASE STUDY

Legislation for MPAs in Madagascar

The two formal MPAs in Madagascar were created through decrees in 1989 and 1997, and are in accordance with guidelines issued by the national protected area agency ANGAP in 1992. The new Code des Aires Protegées recognises that protected areas must address research, education and economic development as well as conservation, and use the participatory approach, in fulfilment of the obligations under the international conventions to which Madagascar is a party. Legislation to apply the Code to MPAs is being finalised, and will specify how MPAs should be established and managed, whether they be under ANGAP or other entities. The Gestion Locale Securisée (GELOSE) of 1996 allows for delegation of the management of natural resources to local communities, and is being used at MPAs where villages play an important role in management.

Madagascar also has customary law that can be used for designating local protected areas. A *dina*, or social convention, can be developed by communities according to their needs and enforced by themselves. Six villages near Toliara have set up a *dina* that is being successfully used to protect Nosy Ve Island and its surrounding reefs. Access to the MPA and its surrounding reefs, and exploitation of marine resources, are controlled through this. A *dina* must not contradict the official legislation, and once officially approved it tends to be respected.

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Integrated coastal management

A5

Integrated coastal management (ICM) is, like MPAs, an important tool for management of coastal and marine resources. It has been adopted in many countries worldwide. This sheet explains how MPAs are more effective as part of an ICM framework and why ICM programmes should include MPAs.

All MPAs 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 MPA as those taking place within its boundaries. The tight connections between MPAs and adjacent land and water, through currents, migratory species, larval dispersal, nutrient exchange and other processes, require that MPAs are incorporated within an overall coastal management regime for the country.

The recommended global approach to MPAs, 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 MPAs or no-take zones (see sheet 11) protecting critical biodiversity areas;
- A larger network of multiple-use MPAs maintaining vital ecosystem functions and processes;
- An overall national MPA system embedded within a national ICM programme.

ICM and MPAs are sometimes perceived incorrectly as alternative approaches but both are essential for effective management of the oceans. ICM provides the framework for management of the coastal and marine environment, with MPAs as the key component for protecting biodiversity and maintaining ecological processes. ICM focuses primarily on managing coastal development, while MPAs focus on biodiversity conservation issues.

A 1993 Ministerial Meeting in Arusha marked the beginning of serious political commitment to ICM in the WIO. South Africa, Tanzania (see case study) and Mozambique now have national programmes underway, and South Africa has a legislative framework. Local level ICM activities are underway in many countries, such as the Mecufi Coastal Zone Management Project in Mozambique and several District-level initiatives in Tanzania. All address the need to incorporate MPAs into general management of the coastal zone. Global guidelines on integrating MPAs and ICM are also in preparation.

M. Richmond

Disharges of sediment-laden water, such as this plume adjacent to Dar es Salaam Marine Reserves in Tanzania, can have a major impact on MPAs.

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 MPA management agencies or of the MPAs 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 MPA and over which the MPA 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 MPA;
- 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 MPA legislation and sectors such as fisheries or forestry, and can help to promote effective implementation of EIA recommendations.

THE ROLE OF MPAS IN ICM

MPAs, and preferably a national MPA 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. MPA 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.

Some large multiple-use MPAs are very similar to ICM programmes, in that they allow for different uses of marine and coastal resources within an area, and the involvement of large numbers of stakeholders in the management process. Such MPAs may be able to help catalyse the development of an ICM programme in the area. Where programmes are already in place, the MPA needs to become one of the ICM 'stakeholders' and should share information and experiences.

M.Richmond

Many conservation areas are close to port facilities, such as Tanga, Tanzania, and managers must keep abreast of development and expansion plans."

KEY POINTS FOR THE MPA

- ❑ **Ensure that the links between the MPA and the surrounding environment are fully understood by all MPA personnel and stakeholders.**
- ❑ **Participate in local ICM initiatives and in national programmes where these exist.**
- ❑ **Ensure that the MPA management plan addresses coastal management issues in the broadest sense, and that there is clear understanding of the role that the MPA plays in sustainable coastal development.**

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Sharing the Experience – coastal management in a rapidly changing world. CD-ROM containing c 200 publications generated by the Coastal Resources Management Program (CRMP), Coastal Resources Center, Univ. Rhode Island. Contact: **communications@crc.uri.edu**

Global Web Service on ICM - **www.icm.noaa.gov** – service provided by a partnership of international organisations including UNESCO, World Bank, and UNEP-GPA, to give advice and news on ICM.

CASE STUDY

MPAs and ICM in Tanzania

A National Integrated Coastal Environment Management Strategy was adopted in 2002. There are seven 'strategies', of which Strategy 3 concerns conservation of biodiversity. It recognises MPAs as an effective tool and proposes that the existing institutional arrangements for establishing and managing MPAs and other protected areas should be used. Since responsibility for natural resource management has been decentralised in Tanzania, District ICM Action Plans are proposed as the main mechanism for implementing ICM on the ground. These plans are expected to identify locally important critical coastal areas and areas of high biodiversity and specify actions that provide for their conservation, restoration and sustainable use.

The national ICM strategy is not yet being fully implemented but mechanisms are being tested at local level. Pangani District in northern Tanzania is developing a District ICM Action Plan that is integrated with a collaborative fisheries management plan, implemented jointly by the District and local communities. The fisheries management plan includes reefs that are closed to fishing (identified and enforced by the villages that use the fishing grounds). In one case, a closed area is a formal MPA, Maziwe Marine Reserve, designated under the Marine Parks and Reserves Act. The Marine Parks and Reserves Unit (MPRU) is technically responsible for management of Marine Reserves and has delegated management of Maziwe to the District and villagers. The District Fisheries Officer has been designated as an Honorary Ranger.

Integration of MPAs and ICM at the national level needs further effort. At present, ICM activities are carried out through the Tanzania Coastal Management Partnership (a joint initiative of the National Environment Management Council, University of Rhode Island and US-AID). Ultimately a coordinating body is to be established, as well as inter-agency working groups that will draw members from key disciplines and sectors to provide the main source of technical input. Working groups for mariculture and tourism are already established. At present there is no formal mechanism for coordination with MPRU, but this would be needed once the strategy is implemented.

Environmental impact assessment

A6

An Environmental Impact Assessment (EIA) is an essential tool for identifying the environmental, social and economic impact of a project in advance, so that damage can be prevented or mitigating action taken. MPA managers must be aware of EIA requirements, which are often mandatory, for developments both within and outside the MPA 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 both 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. MPA managers need to understand the principles of EIA and may need to actively engage in an EIA; they should make use of the extensive literature and the many training opportunities.

An EIA is normally funded by the developer and carried out by consultants or a government agency, using a multi-disciplinary 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 to the full project) and any associated delays, but the benefits of a well-conducted EIA far outweigh any inconveniences.

Several WIO countries including South Africa, Mauritius, Mozambique, Tanzania and Seychelles, have legal requirements or general procedures for EIA. Tanzania has EIA requirements for developments in National Parks, and is establishing guidelines for EIA specifically in MPAs; Madagascar is developing EIA requirements for ecotourism activities in protected areas.

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

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 socio-economic 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.

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 MPA

- ❑ **Make sure that EIA requirements for developments within the MPA, 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 MPA that might have a negative impact, and lobby for EIAs to be carried out where required.**
- ❑ **Ensure that expert advice is obtained if the MPA is involved in any EIA activities.**

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Eastern Africa Association for Impact Assessment (EAAIA), Wasaa Conservation Centre, P.O. Box 68200-00200, Nairobi, Kenya. Tel: 254 20 890605-12; e-mail: eaaia@iucnearo.org, issa@epiq.or.tz

CASE STUDY

Using EIAs to reduce damage in an MPA in the Seychelles

Building land is scarce in the Seychelles, which led to the East Coast Reclamation Project on Mahe, carried out in three phases in 1985, 1991 and 2001-2003. Despite an EIA for Phase I, reefs in St Anne Marine National Park, which lies 5km off Mahe, suffered severe stress from sedimentation, although there was some recovery. The Phase II EIA led to greater use of filter cloth to limit silt transport and deposition, and the slopes of the reclaimed areas were stabilised with rock armouring, resulting in less siltation stress. In 1996, Environment Protection (Impact Assessment) Regulations came into force, which laid out specific procedures, making EIAs mandatory for all developments affecting protected or ecologically sensitive areas. Phase III of the project involved an area of 343.5 ha, and required over 15 million m^3 of coral fill, extracted from the channel between Mahe and the Marine Park. A Class I EIA was therefore undertaken in 1998 by the Government, with an independent team of 12 local experts from various disciplines. Standard methods were used, and the lessons learned from Phases I and II were incorporated.

The EIA pointed out that the Marine Park would be highly vulnerable to further sedimentation and made recommendations for mitigation of ecological and socio-economic impacts during all stages of the reclamation. During the public review, concerns of the Marine Parks Authority were addressed, such as the need for silt screens around the dredger cutter-head, and monitoring of sediment levels during operations. A clause was added to the dredger's contract for work to be halted if sediment levels rose above 10 mg/l near the Park boundaries. Following approval of the EIA, the Marine Parks Authority was appointed to monitor the implementation of the EIA recommendations and the environment management plan.

This case study illustrates some of the problems that can arise:

- There was little public review of the EIA reports. This is often the case, given their technical nature, but it may also may reflect a lack of community involvement, or a lack of willingness by the government to make information accessible.
- Adequate time must be allocated so that all the key issues are covered: in this case, no studies on currents were done although modelling was undertaken using past data.
- The Phase III reclamation work took place shortly after mass coral bleaching which devastated the reefs in the Marine Park; the results of the monitoring programme are thus difficult to interpret, but the reefs are now slowly recovering.
- Ensuring that the proponent complies with the recommendations of an EIA is not always easy; in this case the scope and extent of the development was modified after the project was approved.

S. Wells

Dredger in action near St Anne Marine Park, Seychelles.

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Participatory techniques

B1

A participatory (collaborative management) 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 relating to this topic. This sheet provides some general guidance on the key tools that can be used.

The success of an MPA 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. MPA 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 MPAs, a passive level of participation may be appropriate, but MPA managers should aim for as interactive a role as possible. 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 MPA, 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 MPA staff, and even those living far from the MPA (e.g. migrant fishers and overseas visitors).

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

- Who will be affected?
- 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 TECHNIQUES

Most MPAs in the WIO 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.

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); 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; 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; useful for identifying social and environmental issues (e.g. livelihood issues, evidence of environmental degradation). Valuable for managers' induction phase and for participatory monitoring. Often helps 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.

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 the MPA, or introduction of a new fishery (see sheet B3).

J. Rubens

Participatory techniques in use in Mafia Island Marine Park.

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.

Participatory Monitoring and Evaluation - Involvement of stakeholders in monitoring of the physical, organisational and management aspects (see sheets in section G).

KEY POINTS FOR THE MPA

- **Arrange for training in participatory techniques for MPA 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 MPA staff and to encourage stakeholders to participate.**
- **Build an attitude of respect for stakeholders' knowledge.**

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www.planotes.org. IIED PLA Network, IIED, 3 Endsleigh Street, London WC1H0DD, UK - PLA notes and participatory methodology series free to Southern subscribers.

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 a Marine Park in Tanzania

The process of building full stakeholder participation into the management of Mnazi Bay – Ruvuma Estuary Marine Park is ongoing, having started before the park's creation. By the mid-1990s it was known that the area was of high biodiversity value but under serious threat. A local NGO called Shirikisho, with the support of other NGOs and local government, initiated efforts with local communities to stop dynamite fishing. In 1998 this was achieved with support from national enforcement agencies. A multiple-use marine park was proposed, as the national legislation requires that stakeholder institutions be set up to assist with management. In 1999, government, local community leaders, private sector representatives and NGOs, strengthened by the successful stakeholder-based initiative already in place, reached unanimous agreement to adopt this approach, and the Marine Park was gazetted in 2000.

The first step in ensuring full participation was the formation of an Advisory Committee that includes representatives of local government, NGOs, private sector and local communities. This committee provides the park managers with advice, and helps to integrate park activities into the wider setting of Mtwara District. Village Liaison Committees (VLCs) (comprising eight members with at least three women) have been set up in each of the 10 main villages in the Park. The VLC elections were supervised by the park staff to ensure that they were democratic and that there would be gender representation. In addition, two communities outside the Marine Park requested they form VLCs due to their historical dependence on the park's resources. The Park now works with 12 VLCs in activities such as enforcement patrols, scientific research and awareness raising. As the process to develop the general management plan begins, the VLCs will work towards ensuring that community interests are taken care of and they are involved in decision making.

Conflict resolution

B2

Conflict is common in MPA situations where there are many interests. If not addressed adequately, conflict will undermine the management of the MPA. Managers are generally wise to face conflict with and among user groups and to work for a solution, for 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 MPA, most often connected to resource allocation and to the need to rationalise the MPA's biodiversity objectives with its sustainable livelihood objectives. 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);
- 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' MPA authorities);
- Political and/or legal (e.g. allowing entry to and use of an area by certain stakeholder groups but not others).

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. 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 MPA, and that where MPA 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, as demonstrated in the case study from Madagascar.

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

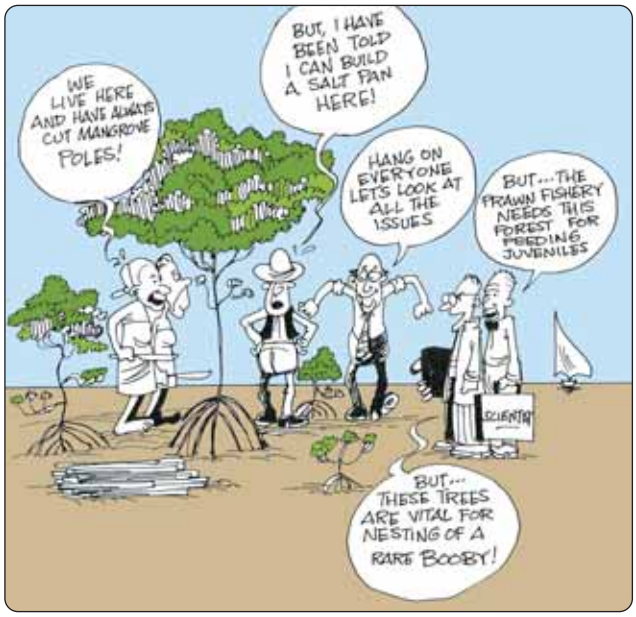
- Negotiation;
- Mediation;
- Arbitration;
- Community conferencing.

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 MPA. In some cases, the MPA itself may be part of the conflict, and the manager or other MPA personnel may have to negotiate with another party. To some extent, negotiation is like bargaining in a shop or market to reach an agreed price for a purchase. To be successful requires certain skills and practice, and a manager should seek training in negotiating skills before embarking on conflict resolution.

RESOLVING CONFLICTS

Some of the main steps involved in confict resolution are as follows:

1. Check that all parties involved are ready to participate and willing to cooperate;
2. Ensure that the proposed meeting time and place is agreeable to all parties;
3. At the beginning of the meeting, ask each party to explain clearly what they want and why;
4. Identify areas of agreement;
5. Identify additional information required for all parties to understand the claims of others (if necessary, stop the process in order to obtain the information);
6. Identify the areas of disagreement;
7. Agree on a common overall goal for the negotiation – e.g. the MPA providing benefits for the stakeholders;
8. Help the parties compile a list of possible options to meet the goal;
9. List criteria against which each option should be measured – e.g. urgency, feasibility, economic returns;
10. Evaluate each option against these criteria;
11. Develop an agreement on one or more of the options that is satisfactory for all parties;
12. Decide on the processes, responsibilities and time-frames for implementation of the agreement;
13. Write up the decisions made and ask the parties to sign the agreement.



KEY POINTS FOR THE MPA

- ❑ **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 criticize 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 minimize 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.**

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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

Resolving a conflict with stakeholders in Masoala National Park

Masoala National Park was created in 1997 and includes three marine parks: Tampolo, Masoala-Ambodilaitry, and Tanjona. Until donor funding became available in September 2000, the marine parks existed only on paper: there were no regular patrols, the boundaries were unknown by the local population, and there was no agreement with local people over the fishing activities that were to be allowed. This situation led to a negative reaction, particularly from local fishers living around Tanjona marine park. This culminated in the establishment of a local fishers' association at Antsabobe aimed at countering marine park objectives and activities. The partnership between ANGAP (National Association for Protected Areas Management) and the Wildlife Conservation Society, with funding from WWF, permitted the implementation of the basic management systems. These included regular patrols, collaboration with local fishers' associations over access to marine resources, comprehensive regular monitoring, boundary marking, small scale development projects in the fishing communities, and education programs to explain the importance of marine ecosystems and the need for protection. However, the situation worsened and negotiation became impossible between the local fishers and marine park staff, until eventually two fishers were arrested for contravening marine park regulations.

This triggered a change in their approach and they decided to negotiate and ask for help. The marine park staff organized a small workshop to break down all misunderstandings between them and the local fishers about the management of the marine park. After the workshop, a field visit with snorkelling was organized with representatives of the fishers, focusing on the core (closed) area where improvements in the condition of the coral reef and biomass of the reef fish population could be seen. The workshop and field visit helped the fishers to understand the positive impact that the marine park could bring both to marine biodiversity and to their own livelihoods. The same approach was applied in the other two marine parks and also seems to have had a major impact on the behaviour of the local communities. However, although there has been a big reduction in destructive practices in all three marine parks, there is room for improvement in various aspects of management, particularly to ensure that there is more local participation.

This illustrates a number of aspects of conflict resolution and shows how activities such as field visits can bring people together. It also demonstrates that conflict resolution is a long-term process, in that although there has been improvement, the problems are not entirely over yet.

Gender and MPAs

B3

In the WIO, the role of women in coastal management tends to be overlooked, although women may play key roles as stakeholders, resource users and in management. 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, religion 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 WIO countries recognise gender and the participation of women in development processes as central for sustainable development, and are signatory to international agreements on gender equality.

Due to their different roles, MPAs affect women and men differently whether or not they are consulted or involved, and both men and women inevitably have an impact on MPA implementation and management. Recognition of gender differences and their integration into MPA planning increases the chance of both women and men participating in and benefiting from an MPA, which in turn contributes to its success.

Gender affects MPA establishment and management 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 MPA 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 the WIO region, they often gather invertebrates and small fish 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. 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.
- Mariculture – although large-scale, intensive aquaculture (e.g. shrimp farming) tends to be dominated by men, women are often involved in the more extensive, less technological forms of mariculture in Eastern Africa, most notably seaweed farming.

Women are also involved in other activities that may be affected by MPA management activities, such as gathering of mangrove products and making handicrafts. They may also play a crucial role in aspects of community involvement in MPA management and are often very effective in planning and consultation. At Mafia Island Marine Park, in Tanzania, women have been included in the Park's planning since its establishment, for example as leaders of planning committees.

MPA STAFF

Protected area staff are often male, and this bias may be particularly strong in MPAs, since in many cultures women are not encouraged to learn to swim and do not have experience of boats. However, women are increasingly playing key roles; for example in Kenya, there is a female Marine Park Warden and several female rangers. 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. 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.

S. Wells

In Kisite Marine National Park, the warden has a good relationship with the women in the local communities that use the Park's resources.

KEY POINTS FOR THE MPA

- ❑ **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 MPA 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.**

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CASE STUDY

Quirimbas National Park: a gender sensitive approach to MPA establishment

Aida Safire is a co-founder of ASSOCIAÇÃO KARIBO, an association of friends and residents of Ibo Island in northern Mozambique that promotes small projects on fishing, goat production, and other micro-enterprises. Its work with fishers made Aida and her colleagues appreciate that donor programs that provide fishing gear would not solve the problem of overfishing. The establishment of the Quirimbas National Park would be more effective, as legal protection would allow fish stocks to recover and would protect marine habitats.

The Association consulted with each of the 40 villages to be affected by the Park to determine the state of the resource base and what could be done to improve it. Aida often spoke to the women alone as, in the absence of the men, they tended to speak their minds more openly. All villages ultimately supported the park through signed agreements, and the results of the community consultations were used in the management plan. In particular it was agreed that there should be no-take areas so that fish stocks could recover. The zoning plan, the community agreements, and the proposed management plan were submitted to the Council of Ministers, and the National Park was declared in June 2002. Aida is now working to help implement the marine sanctuaries, four of which have been organized since the Park's inception. Two of these were not included in the original management plan but are the result of requests from local communities. She also works with groups of volunteer rangers who police these areas. In 2003, Aida Safire was a co-winner of the National Geographic Society/Howard Buffett Award for leadership in the creation of the Quirimbas National Park.

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 MPA.

Fishing communities have their own knowledge about fish stocks and other marine 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 MPA also have relevant knowledge. Women have knowledge of trends in local community structure and household characteristics. Government agencies and local businesses may have information on socio-economic 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.

Local communities may have their own names and classifications (or 'taxonomy') for resources, places (particularly significant sites such as fish spawning aggregation sites, fishing grounds and landing 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. 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 MPA 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 MPA management (see case study).

Such customs are rare in the WIO and it seems likely that traditional tenure was not as well developed here as in the Pacific. Nevertheless, it is useful for MPA 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 MPA authority. Knowledge of such approaches in other parts of the world can also help to guide community involvement in a more modern setting.

M. Richmond

Misali Island off Pemba, Tanzania, has strong religious significance among many local Islamic fishers.

One example in the WIO is Menai Bay on Zanzibar, Tanzania. At Kisimkazi village, a traditional management system involved seasonal closures of fishing areas, particularly for octopus, with controls on fishing gear and use of the area by visiting fishers. The system collapsed with increased pressure from fishers using the area, but government support has allowed the system to return improved.

In southern Kenya, traditional systems have recently been acknowledged as being relevant to natural resource management. The Digo people inhabit the coastal strip down to northern Tanzania and have a complex set of beliefs in spirits associated with natural resources and places which is overseen by community leaders or elders, who pass down their knowledge to their sons. The spirits require offerings (*sadaka*) which are generally made at sacred sites: the *kaya* in the coastal forests, and *mzimu* at sea. Significant fishing events (for example, unusual decreases or increases in catches) are still a reason for elders to convene a meeting and sometimes for *sadakas* to be made. The elders are currently playing an important role

in initiatives undertaken in collaboration with the Fisheries Department, NGOs and other government agencies, to introduce and enforce regulations banning damaging fishing methods and to increase the use of local knowledge in management. This has been particularly important in Diani, where a Marine National Reserve was gazetted in 1995 but never implemented because of opposition from local communities. New initiatives that respect the indigenous people of the area and their traditions may prove to be more effective.

KEY POINTS FOR THE MPA

- ❑ **Find out whether local people in or adjacent to the MPA 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 at 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 MPA 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

Using religious beliefs to promote effective MPA management - Misali Island, Zanzibar

The participation and support of local Muslim elders has been sought in the management of Misali Island Conservation Area, a small MPA off the west coast of Pemba Island, comprising a closed sanctuary area and a larger area open to traditional forms of fishing by local communities. Many Islamic teachings and concepts are relevant to marine conservation such as the recognition that animals should reproduce before they are killed for human use, the duty to treat all creatures well, and the guardian or stewardship role of humans in protecting the environment. Preserving the balance of marine and terrestrial ecosystems helps to achieve the *mizaan*, or the principle of balance on which all creation is based.

Under the Misali Ethics Project (jointly undertaken by local government departments, the Misali Island Conservation Association, and CARE Tanzania, with funding from the MacArthur Foundation), religious leaders and teachers in the mosques and *madrassa* schools associated with Misali Island were provided with educational materials including posters, calendars, a film and a short manual explaining how the guidance in the Holy Qu'ran is relevant to day-to-day decision making by fishers. The Islamic messages were used to promote conservation, with religious leaders assisting through their sermons and teachings.

A baseline study at the beginning of the project showed that only 34% of fishers thought that Islam related to their use of the marine environment. An assessment at the end found that 66% could now relate their religious beliefs to marine resource use behaviours, and that some fishers were practising at least one or two specific conservation measures. It was also found that this increased understanding had spread beyond the villages directly involved in the project. As a result of this pilot programme, the initiative is now being scaled up to address a broader population on Pemba Island.

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Mapping and surveying

C1

Identifying the locations of the habitats, species and resources of an MPA, 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 MPA and preparing a map.

A map of the MPA has a wide range of uses. It improves the quality of leaflets, posters, souvenirs, and other materials for visitors; it enhances reports; it assists with research and monitoring; and it helps to make boundaries and zonation schemes clear to MPA users. 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 MPA. Modern tools, such as Geographical Information Systems (GIS), 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.

SURVEYS AND ASSESSMENTS

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 (Global Positioning System), 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, 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.

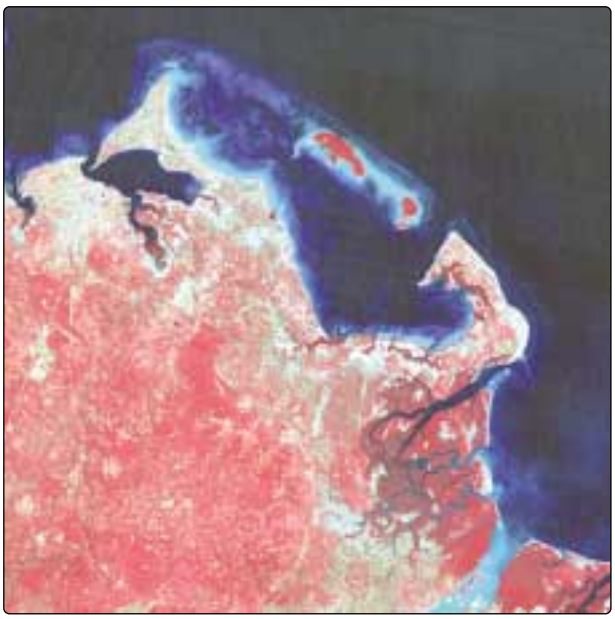
Satellite or remote sensing images may be very useful and relatively cheap. SPOT and LANDSAT satellite images can be obtained from the relevant supply companies for a fee, but their use requires equipment and professional training. Thus, if planning to use them for MPA surveys and mapping, it is best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

Information can also be collected from local communities and is very useful for improving detail on a map, e.g. determining water currents, seasonal changes in water turbidity or whether certain areas dry out at low tides. 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 though 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.



Courtesy of Tanzania Coastal Management Partnership

This satellite image of the Mnazi Bay-Ruvuma Estuary Marine Park area, Tanzania, was used when preparing a map for this MPA.

The following characteristics affect the use of maps:

Scale - The size of the MPA, the scale required and the size of the printed map (and thus the paper to be used) must be chosen on the basis of 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 1cm on the map represents 500m in reality. Maps of 1:50,000 (used to show buildings, roads, etc) are considered large-scale compared to those of 1:1,000,000, which are considered small-scale and are used for whole countries or oceans.

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. They can be in the form of latitude and longitude (as used on charts) or UTM units (frequently used by government cartographers). Most GPS and GIS can convert between these two, and other settings.

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

GIS is a program 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 overlain onto data on fishing activity, permitting analysis of any spatial relationships between the two parameters. GIS is thus far more than a mapping tool, but 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 MPAs are advised to collaborate with relevant institutions. MPA staff will be able to operate the system, once trained, provided there is expert supervision and appropriate maintenance.

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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.

CASE STUDY

Mnazi Bay - Ruvuma Estuary Marine Park (MBREMP) GIS and maps

Gazetted in 2000, one of the first requirements of MBREMP was a good map to guide development of the management plan and monitoring programmes. With funding from the Global Environment Facility (GEF) and the Government of France, and technical support from IUCN, a geographical database and GIS are being established. Baseline information on biodiversity (mangroves, coral reefs and intertidal areas) and socio-economic issues was collected by survey teams, in cooperation with MBREMP staff. GPS readings were taken at each site surveyed. Data on infrastructure (e.g. roads) and other physical characteristics, like bathymetry, were also collected. Additional data (e.g. topography and mangrove distribution) were obtained by digitising existing maps and interpreting aerial photographs and satellite images (see overleaf).

For the design of the database and GIS, MBREMP is working with a local unit, the GIS Information Centre (GISic) of the Agricultural Research Institute Naliendele. The database is designed so that it can be extended over time, used for long-term monitoring, and takes into account the financial, technical and staff limitations. To ensure long term maintenance of the information system, Park staff are being trained in geographical skills, including databases, GIS, the use of GPS and mapping.

KEY POINTS FOR THE MPA

- ❑ **Ensure that the necessary maps for the MPA are produced and available in printed or digital form as appropriate.**
- ❑ **Use a team approach for preparing maps, involving local stakeholders and technical institutions; involve relevant MPA 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).**

MPA design and zonation

C2

Careful attention to design is often over-ridden by social, political and economic issues when establishing an MPA. As a result some MPAs 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 MPA is established.

Design aspects include size and shape, location, position of boundaries, zoning, ecological representation, and links or connectivity with other MPAs. There are also practical considerations in terms of ease of management (e.g. whether the MPA is adjacent to sources of threats such as urban areas or major fishing grounds) and access.

BOUNDARY LOCATION

The location of MPA boundaries should be based on 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. If the original designation was driven by socio-economic-political factors (e.g. interests of the stakeholders, immediate availability of an area), key ecological sites may lie outside the boundaries of the MPA 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. increasing shipping traffic has led to a proposal to extend the ship exclusion zone around Aldabra World Heritage Site.

Stakeholders must be closely involved in establishing or changing boundaries. In Menai Bay Conservation Area, Zanzibar, for example, consultations were held with fishers and village leaders to identify guiding features on which the boundaries could be based. A draft map was then prepared with key boundary points identified by GPS and this was ground truthed by government officers, MPA management personnel, fishers and scientists.

Clearly marking and maintaining the boundaries of an MPA is often difficult particularly in deep waters and/or strong currents but, if this is not done, confusion and conflict may arise. 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.

SIZE

For ecological reasons, MPAs should be as large as possible because of the open nature of marine ecosystems. Mozambique has recently increased the size of Bazaruto Archipelago National Park from 600 to 1,430 km^2 to provide greater protection for the dugong. Large MPAs 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 MPAs are often more acceptable to local communities and therefore easier to implement. Small MPAs are effective conservation tools for many marine resources, depending on their location, connectivity to other MPAs, and how well adjacent areas are managed.

ZONING

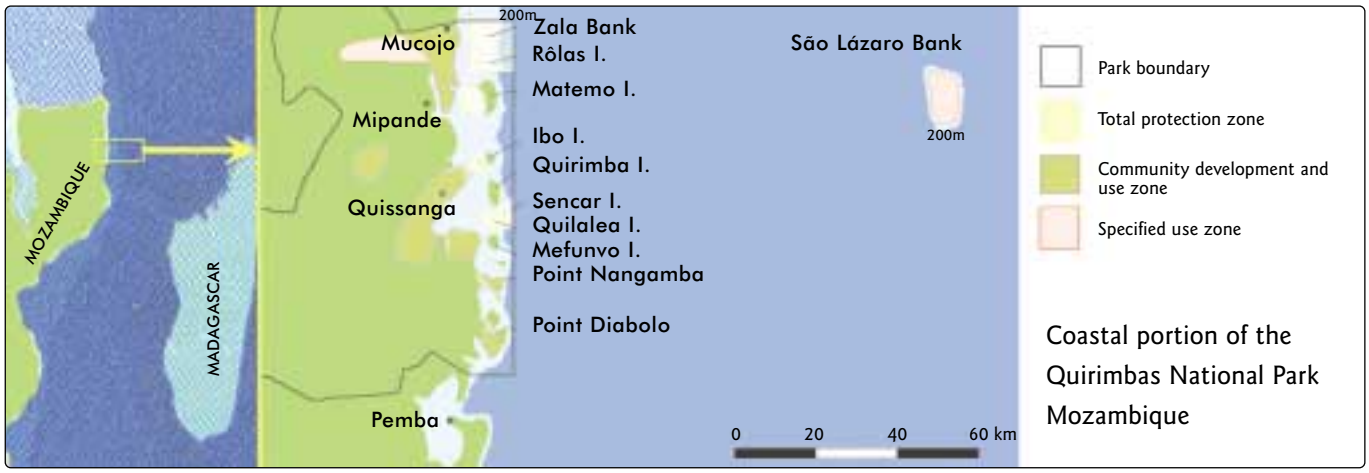
Zoning is a key management tool for multiple-use MPAs. It allows areas to be set aside for particular activities such as protection of key habitats or nursery areas and breeding sites, research, education, anchoring, fishing and tourism. Zoning helps to reduce or eliminate conflict between different users of the MPA, to improve the quality of activities such as tourism, and to facilitate compliance.

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 may be part of the management plan or a separate document, and in some cases the zone types are laid out in the MPA legislation. 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 MPA, it is essential that zones are clearly marked once agreed and approved.

CONNECTIVITY

Connections with other MPAs and other ecologically important areas should be considered. An MPA 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 the WIO, 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). MPA design should also take into account any existing framework of integrated coastal management (see sheet A5).



KEY POINTS FOR THE MPA

- ❑ **Consider carrying out an assessment of the design of the MPA, to understand any shortcomings and to make recommendations for improvement; make any necessary changes that are feasible.**
- ❑ **For boundaries, avoid ambiguous language like 'approximate low water', and use the most detailed charts or maps available to ensure the greatest level of accuracy.**
- ❑ **Reference fixed features that will not move over time e.g. rocky headlands rather than sandy headlands or buildings.**
- ❑ **Changes in the design and zonation of an MPA must be discussed with stakeholders as their agreement and support will improve compliance.**

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CASE STUDY

Zonation scheme in Quirimbas National Park, Mozambique

Quirimbas National Park covers some 6,000 km^2 of land and 1,500 km^2 of marine, intertidal and island habitat (see map above). The zoning scheme has to take into account the large area, varied depth ranges, large human population (about 55,000 people depend on the Park's resources), diversity of habitats and species and a range of uses including fishing and tourism. It can be modified provided that the area and habitat diversity within the Total Protection Zones are maintained at, or increased above, the initial levels. The zoning is prescribed as follows under the MPA legislation:

Total Protection Zones - All exploitation is prohibited but regulated tourism and scientific research are permitted. These zones are being established in collaboration with local communities and tourist operators, who may be responsible for their management. Four have been defined to date:

- the islands of Quilalea and Sencar with their surrounding waters - to be managed by the tourism company operating on the islands, in collaboration with the communities;
- a 20km^2 stand of mangroves adjacent to Ibo Island;
- seagrass beds adjacent to Matemo Island;
- Rôlas Island and Zala Bank - an exposed, and little used, reef and associated small island.

Specified Use Zones - Areas that warrant full protection but where this is not possible. The only marine example is the São Lázaro Bank, a seamount which is to be managed for sportfishing and SCUBA diving. Lying 80km from shore the bank is not used by artisanal fishers.

Community Development and Use Zones - The remaining areas of the Park are designated to allow for sustainable use exclusively by local residents. Regulations are to be developed with the communities.

Buffer Zone - A 10km wide strip all round the Park within which all developments must receive Park approval and be subject to the same environmental considerations as those within the Park.

Management plans C3

Each MPA 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 MPAs should have one. It 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 MPA 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 MPA's 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 MPA to be met?' Objective-oriented management is pro-active 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. For example, in Tanzania, the Marine Parks and Reserves Act requires that a Management Plan be developed within six months of a Marine Park or Reserve being gazetted. Management agencies should aim to promote a common approach and format for the Plans for all MPAs under their mandate, in order to harmonise objectives, facilitate comparison between sites, and streamline planning and reviewing procedures. However, each MPA is unique and its Management Plan must be designed specifically to address its own needs. Where an MPA has an international or other specific designation (e.g. World Heritage Site), the Plan should address this and may require a certain format.

Management Plan for Moheli Marine Park in the Union des Comores.

Some Management Plans have the status of legal documents, in which case failure to manage an MPA 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 MPA, 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 were prepared without the participation of all those involved in implementation, and if they were 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. 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 MPA is set up, and will usually take at least a year to ensure adequate consultation. MPA 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 MPA.
- 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 and acceptable mechanisms for enforcement and compliance.
- Determine financing mechanisms, bearing in mind the need for benefit and revenue sharing with stakeholders.
- Establish monitoring and evaluation protocols, including a process for periodic review and revision.
- Prepare the draft Plan, and submit it for public consultation and review.

- Incorporate comments and publish final Plan (preferably both as a hard copy and electronically)
- Submit plan for approval (the mechanism for this varies between countries) and disseminate it.

Where an MPA does not have sufficient capacity or expertise to prepare a Plan, it may be useful to hire a consultant. Such a person must work closely with MPA 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 stategic and operational elements of the MPA and clearly link them, be flexible enough to cater for unforeseen events and interpret national policies in relation to the MPA, 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 socio-economic 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 prepare a summary for broader dissemination.

KEY POINTS FOR THE MPA

- ❑ **Ensure that all staff are familiar with and use the Management Plan, and understand its status (as a legal document or general guidance).**
- ❑ **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.**
- ❑ **Obtain copies of management plans for other MPAs, both within your country and from other countries for comparison.**

Sources of further information

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CASE STUDY

Management Plan for Moheli Marine Park, Union des Comores

The decree that established Moheli Marine Park requires that a management plan be prepared. This was done with support from a UNDP/GEF project and technical assistance from IUCN. The process took two years and involved all stakeholders, particularly the 10 villages involved in collaborative management of the Park. The process started with a training workshop organised by the park personnel and 'eco-gardes' (village-based rangers). The objectives were developed through consultations in the villages and working groups were set up to develop certain sections of the plan. All aspects of the plan were developed in consultation including gathering baseline information, defining the zoning plan, and developing the regulations and co-management agreements. The management plan is for five years and will be used to develop annual work plans and more detailed operational plans. It was approved by the Management Committee of the MPA. The contents are as follows:

- Ecological and socio-economic characteristics and values;
- Threats to the environment and its resources;
- Objectives and strategies to be adopted to ensure conservation, sustainable use of natural resources, and the sustainable development of revenue generating activities;
- Management inputs (management structure, budget and financial resources, equipment);
- Zonation scheme, regulations, rights of access to zones and co-management agreements;
- Five year action plan for each objective.

Logical framework approach

C4

Good planning is a key element of successful MPA 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 MPA 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 which may vary (particularly from donor to donor), but in general the principles underpinning the approaches are the same. An effective MPA manager will need to be familiar with some of these terms and approaches, especially if s/he 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 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.

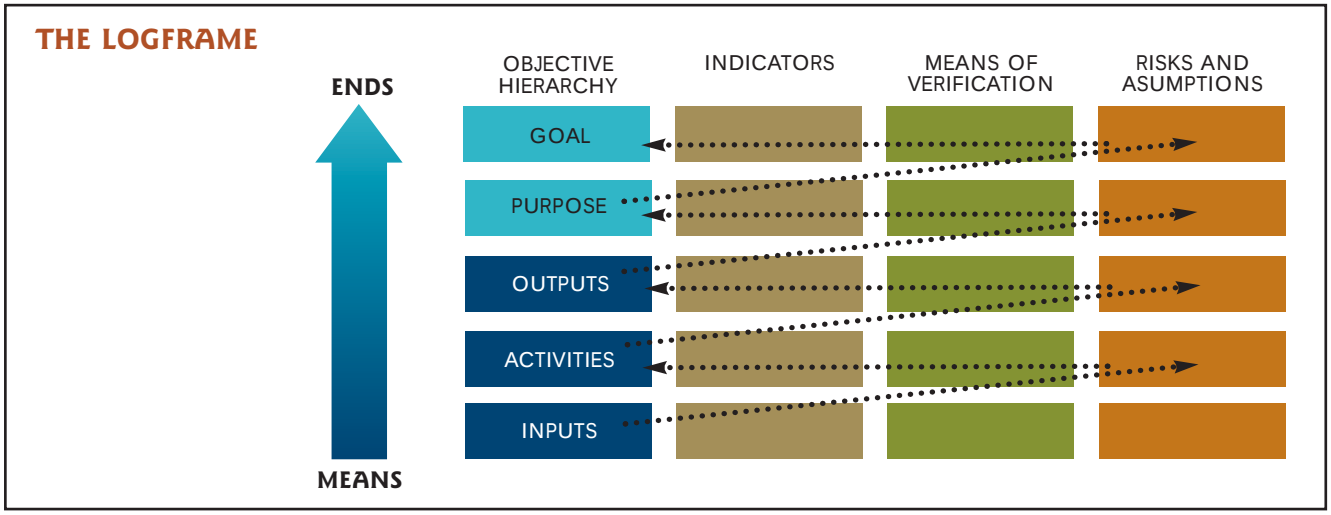
THE LOGFRAME

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 done and what will be achieved (the 'means to the ends'), and it 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 time-frame 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, 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 MPA management, what requires collaboration with others, and what is beyond the influence of the MPA 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.

Logframes are generally used for projects of limited duration with a set budget. An MPA is a permanent institution and, although potentially feasible, it is not usual for an MPA 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 MPA itself. However, the principles used are useful to consider in any form of planning.

The following two examples illustrate how logframes may be used in MPA development. Mnazi Bay-Ruvuma Estuary Marine Park, in Tanzania, has funding through a 5-year UNDP/GEF project to support a broad range of activities, such as baseline assessments and preparation of a management plan, involved in setting up the MPA. A project logframe guides implementation of these project activities, but the Park has separate goals and objectives. Moheli Marine Park, in the Comores, was also set up through a UNDP/GEF project, but in this case it was one component of a much larger biodiversity project and was one 'Result' of the logframe. It is thus important not to confuse the logframe of a project with the managemnbt plan itself, and vice versa.

KEY POINTS FOR THE MPA

- ❑ **If a logframe is required by a donor or for a particular project, get advice on how to prepare it.**
- ❑ **If a logframe is not required, use a more simple planning approach, but follow similar principles (e.g. use a participatory approach, identify clear measurable objectives and define carefully what is required to achieve them, and ensure that there is a monitoring programme to measure success).**

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Donor guidelines are available as follows:

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www.ausaid.gov.au/ausguide

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.

Progress and donor reports

C5

Most MPAs 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 MPA 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 inter-linked. Progress reports are essential to measure achievements, to focus activities and improve subsequent work plans, to encourage new funding, and to provide a historical record and thus be available for future reference, particularly if impacts of the work are to be assessed. MPAs 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 MPAs 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. Don't spend so much time on figures that the content of the text suffers. As the WIOMSA training manual, says: '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. Many donors as well as other report 'users' will have a lot of documents to read, and 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).

Title and cover - The cover page should clearly show the title and date of the report, and often it should give details such as 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).

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 last 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 where there have been deviations from what was planned, this 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. 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? Analysis of contribution to the longer-term goals will usually not be done 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?

Obstacles encountered and solutions identified - Obstacles and problems may have origins within the MPA 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 MPA 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 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.

KEY POINTS FOR THE MPA

- ❑ **Ensure that MPA 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 and electronic form and are accessible for future reference; associated correspondence should also be filed.**

Sources of further information

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Personnel D1

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

The personnel of an MPA 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 MPA. 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 MPAs in the WIO is highly variable and can range from one or two to over 50. MPA staff are usually 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, MPA 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 MPA and the greater the number of visitors (e.g. involved in recreational or commercial activities), the higher the staff levels. The work force can be increased by using seasonal staff or volunteers, as well as consultants or contract staff.

S.Wells

The Warden of Kisite Marine Park, Kenya discussing issues with stakeholders.

In large MPAs, 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 WIO MPAs, and this responsibility often falls to the senior manager and/or the overall management agency (whether government or NGO). A good manager will be in touch with and approachable by employees and will be aware when there are problems relating to performance, job satisfaction or working relationships.

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 MPA. 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;
- Attempt to employ staff on as equal terms as possible, whilst recognising that employees rights and benefits may vary according to whether they are permanent or temporary, full-time or part-time, and 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. 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. 'MPA 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 MPA.

PERFORMANCE APPRAISALS

An annual performance appraisal for 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 which might involve participation in workshops and meetings, and increasing responsibility. WIOMSA's training course for MPA managers which takes place every two years is one useful option for increasing staff skills.

S.Wells

Visitor engaging with staff in Curieuse Marine Park, Seychelles.

KEY POINTS FOR THE MPA

- ❑ **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.**
- ❑ **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 local labour law, statutory minimum pay and conditions of employment, 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.**

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

It is often necessary to contract out important but short-term or highly skilled activities, if the MPA does not have sufficient capacity within its own staff. This can benefit the MPA 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 MPAs or projects, as well as having skills not available amongst the MPA staff.

Consultants and other short term experts are relatively expensive in comparison to full time MPA staff. In order for the MPA to get full value from them, it is essential that their role is clear, both to them and to the MPA staff. If not, there may be conflicting expectations and misunderstandings among MPA 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 MPA agency.

PREPARING TERMS OF REFERENCE (TOR)

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 their 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, 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, 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 MPA 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 also that she/he is sympathetic to the approach being taken. A selection of CV's 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, which could be a member of the MPA 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 made available if the consultant does not speak the language.

Can he really understand everything after only a few days?

PREPARATION OF A CONTRACT

Whereas the TOR provide 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 MPA 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 which is adapted for individual contracts. If not, one should be developed for use by the MPA, and it is advisable to seek advice from a legal expert. Contracts should specify the following;

- Timing of the consultancy and reporting schedule, including timescale for submission of and comments on draft reports;
- Fees, payment schedules, and arrangements for other expenses incurred by the consultants or employee (such as travel, accomodation, 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*.

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 MPA, are clearly defined. The TOR are usually appended to the contract, and 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 WIO countries and with tasks related to MPA management, where unexpected delays may occur due to events such as equipment purchase being delayed, unsuitable weather for fieldwork and changes to the overall MPA work plan. 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, should receive a full briefing, and be given all the necessary documentation. When the consultant needs to ask questions or obtain further information, MPA staff should be ready and willing to assist. To get full value from a consultant, priority needs to be given to providing the necessary MPA 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 'end product' of most consultant's work is their report. A consultant's report should be judged by its quality and usefulness to the MPA, rather than by its size.

A few questions to be asked before paying the consultant are:

- Has the consultant provided more answers than questions?
- Does the report clearly analyse the problem(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 his/her overall TOR?
- Has the agreed information and support been provided by the MPA to the consultant?

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

KEY POINTS FOR THE MPA

- ❑ **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.**
- ❑ **Obtain samples of TORs and consultancy contracts from other MPAs, as a guide, before developing these documents for the first time.**
- ❑ **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 MPA receives a good product.**

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. 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. **www.seacam.mz**

Partnerships and volunteers

D3

MPAs 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 gives information on how to find such assistance.

MPAs 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 MPAs 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-MPA staff include:

- Ecological and socio-economic survey and assessment work of all kinds (e.g. surveys of coral reefs, bird counts, collecting data on questionnaires). Often partner institutions and research expeditions bring in knowledge of methods that the MPA personnel may be unaware of.
- Research on specific topics. 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, and so short-term visitors are generally not the ideal people to assist with this. However, groups or individuals that return to the MPA regularly, or that are based locally can play important roles (see case study on Kiunga).
- 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 clean-ups (see sheet K4) and other general maintenance work around the MPA 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 MPA 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 MPA, perhaps in terms of funding, technical expertise, or training activities. For example, the organisations Coral Reef Conservation Project (CRCP) and Coral Reef Degradation in the Indian Ocean (CORDIO) assist with monitoring activities in several MPAs in the region, which saves these sites money (see sheet G11).

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 many WIO countries, but nevertheless is growing, particularly among young people. There are several categories of individuals who may volunteer to work in an MPA, these include:

- Members of the local community, who may be benefiting from the MPA 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 MPA.
- Overseas volunteers, provided either through one of the bilateral-aid national volunteer programmes or through international programmes such as the UN.
- Overseas volunteers available through programmes run by NGOs or commercially-organised operations; these often work in certain locations over a 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.

S. Wells

International and local community volunteers monitoring a turtle nest in Kiunga Marine National Reserve.

Individuals participating in one of the 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 MPA 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 of time. 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.

KEY POINTS FOR THE MPA

- ❑ **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 MPAs 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 MPA and their interests may not be directly complementary MPA objectives.**
- ❑ **Make sure that MPA personnel are fully involved and take part in the activities carried out by partner organisations or volunteers, so that they learn from the experience.**

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

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

Local volunteers in Kiunga Marine National Reserve (KMNR), Kenya

Since 1999, KMNR has involved local and foreign volunteers in its work programmes. Each volunteer has brought her/his skills to KMNR, and in turn has gone away with a better understanding of the challenges faced in managing an MPA. To broaden the involvement of the local youth members in the KMNR, a volunteer programme was initiated to assist with turtle monitoring activities, aimed at:

- Increasing awareness of youth through practical involvement with KMNR;
- Increasing participation of those who have limited job opportunities;
- Reducing the number of turtles killed in nets, by involving youth in conservation and thus discouraging them from poaching;
- Providing youth with some prestige and discouraging them from joining the beach seining and gill-net fishing fleets that cause so much damage.

Six local youths were recruited from the main fishing villages within KMNR, using the following criteria:

- Good knowledge of the KMNR area and basic understanding of marine turtles;
- Good communication and networking skills;
- Fourth form leaver with basic written skills.

Their main task is to assist with management and conservation measures at the Rubu Island outpost in collaboration with the KMNR Turtle team. Each volunteer is allocated specific tasks, and at the end is asked to complete a form to provide feedback on his accumulated experience, and recommendations for programme improvement. This initiative has so far only involved males, as culturally it would be unacceptable to have young girls working in the field in a mixed sex group, but there is potential to involve girls in activities that take place in the more immediate village environment.

Ten international volunteers have also played a crucial role in the development of the KMNR marine turtle initiative. They have brought skills and experience from similar programmes in Sri Lanka, Australia, the US and the Philippines, and have also assisted in the development of a marine turtle database, in training and in improving analytical and writing skills. National interns have also worked for KMNR and subsequently joined the WWF technical team that supports the Reserve.

Safety and emergency procedures

D4

The sea is inherently a dangerous environment. Injuries resulting from being in or on the sea are the most likely, but not the only, emergency incidents in an MPA. 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

MPAs 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 MPA staff and other stakeholders who will take responsibility for the logistics, communications and actions in case involved. Other MPA 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 MPA budget and should ideally include emergency or disaster cover. The inclusion of third party liability helps protect the MPA 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. The MPA 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.

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 MPA.

- **Green alert -** A tropical low or cyclone within 500 n.mi; MPA 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 MPA is within 120 n.mi of a cyclone, or forecasts place it in the likely path or re-curvature area within the next 12 hours; all vessels must abandon their work and transfer crews to safe locations.

Medical Evacuation (medivac) - Required in cases of severe injury or sickness; air transport to a medical treatment centre is usually required and the MPA should have all the information at hand to arrange this.

DANGERS AT SEA

Weather - Changes in weather should be monitored and, where possible, forecasts should be obtained before going to sea. If the MPA has access to internet or radio weather forecasts, storm alerts should be communicated to the local communities.

Vessel seaworthiness - Unfavourable sea conditions and poor seamanship often result in the swamping and sinking of small boats. An MPA 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. For small boats, safety and seaworthiness are normally the responsibility of the vessel operator and/or owner.

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 MPA and should be mandatory on MPA boats. Flares, radios, and survival supplies (including water) are recommended.

Search and rescue man-over-board - The MPA 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 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-over-board procedures should be well practised.

Swimming - Fishers and MPA personnel often cannot swim, and most deaths at sea are caused by drowning. An MPA can organise swimming lessons for all those who regularly use the MPA. 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 MPA

- Good communications are essential (see sheet F7) and should cover the entire MPA.
- Daily time and travel plans, with check-in times by radio, helps to keep track of field staff and detect safety issues.
- 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 Coast Guard
  - Airports
  - Airline and charter companies
  - Weather station
  - Air ambulance
  - Re-compression facilities
  - Doctor
  - Hospital
  - Fire brigade
  - Pollution specialists
  - MPA Warden
- Maps and charts should be detailed enough to identify the location of an incident and any wider geographical implications.
- A co-ordinator 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 MPA 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 MPA staff should learn first aid. Oxygen is often needed in diving accidents and may be available from SCUBA diving operators. A stretcher should be included among emergency equipment.

M. Richmond

Life jackets are essential for activities involving children as seen here on snorkelling trips to Chumbe Island Coral Park.

CASE STUDY

Contingency planning and emergency preparedness in MPAs in Seychelles

In Seychelles, some MPAs have taken contingency planning and emergency preparedness seriously. In addition to the recommendations listed above, they are addressing the following:

Emergency-mindedness - In contingency planning it is important to think ahead and try to 'disaster-proof' the MPA. In Seychelles, this includes keeping boats and engines in top condition, with multiple 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. On Cousin Island, the use of kerosene cookers by personnel was seen to be a potential hazard and was phased out.

Insurance - MPAs in Seychelles have various forms of insurance cover including third party liability (including guest personal effects), staff disability or death, damage to buildings and boat hulls, and cover on engines and mooring buoys. The insurance also protects the MPA management from litigation in cases where public or staff liability is in question.

Emergency landing/meeting points - If an area for emergency/medivac helicopter landing is necessary, it should be constructed in collaboration with the civil aviation authorities and regularly maintained. In Seychelles, at least three MPAs have helicopter landing pads, as well as special tools and equipment in case of a helicopter accident. Emergency meeting points have also been designated and clearly posted.

Disaster Fund - In 2002, a freak storm damaged protected areas on Praslin Island and surrounding islands. Cousin was the only MPA severely affected, and was closed for three weeks leading to loss of revenue. Substantial expenses were incurred in clearing hundreds of fallen trees, repairing infrastructure and rehabilitating ecosystems. A small emergency fund was used to cover these costs and thus intervention was swift. It would be wise for other MPAs to set up such a fund.

Sources of further information

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

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.

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).

Financial planning E1

MPA managers face a major challenge in managing funds efficiently and developing a sustainable financing basis for the MPA. Good financial planning (comparing expected costs with the projected income) 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.

Recent studies have shown that the greatest recurrent cost for MPAs is wages, followed by operational expenses (e.g. fuel and maintenance) and compliance (especially if the MPA is large). Monitoring, general administration, visitors, education and attendance at meetings and events also generate significant expenses. Few MPAs in the WIO 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 MPA is provided by central or local government as management of marine and coastal resources is seen as a public service. However, few governments in the WIO are able to provide such support and most MPAs 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) describe over 30 mechanisms for funding marine biodiversity conservation, many of which are suitable for MPAs, 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 MPA management plan. Business plans are used in the private sector to attract investors, inform stakeholders and improve management, and thus are relevant to MPAs. The plan is usually for 5-10 years 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 MPA, 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. It also guides fundraising efforts but, unlike a budget, it will be subject to change, given its longer duration. Quirimbas National Park in Mozambique, and Masoala National Park in Madagascar (see case study) have prepared business plans.

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 MPA, 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).

The 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. Managing a newly gazetted MPA is expensive, requiring funds for equipment and infrastructure, baseline assessments, training and research, which may best be met through a donor. Subsequent management costs are lower, involving recurrent operational and administrative support, patrolling, maintenance of equipment, monitoring, community outreach and education. Government subventions, Trust Funds and revenue from user fees 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. 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 MPA; 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 MPA.

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. There are two kinds of costs:

- **Management or programmatic activities** (e.g. surveys, monitoring, patrolling). In well-established MPAs, figures for on-going 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 MPA 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.

KEY POINTS FOR THE MPA

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

Sources of further information

Boyd, C. & Inamdar, A. 2001. *Sustainable Financing of Coastal Management Activities in Eastern Africa.* Report to SEACAM. **www.synergy-global.net/documents/Sustainable-Financing.pdf**

Conservation Finance Alliance 2003. *The Conservation Finance Guide*. Prepared by Nature Conservancy (TNC). Available on CD-ROM and at: **www.guide.conservationfinance.org.** Includes:

TNC 2001. *Long-term Financial Planning for Parks and Protected Areas*. The Nature Conservancy. 40pp.

The following are available direct from TNC:

Mcleod, P., Leon, P. & Esquivias, P. 2001. *Integrated Strategic and Financial Planning for Non-governmental Organisations*. Vol. 3, Resources for Success Series, TNC /US-AID. 64pp.

Morris, B. 2002. *Transforming Coral Reef Conservation in the 21st Century: Achieving financially sustainable networks of marine protected areas*. Report to TNC.

Humphrey, S. 2003. 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, The 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.

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**

CASE STUDY

Business plans for Madagascar's protected areas

Madagascar, with assistance from the GEF, World Bank, US-AID 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 km^2) and comprises seven different units, three of which are marine parks covering 100 km^2. 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 was 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. Over 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

MPAs receive income from various funding sources. The efficient management of this is vitally important both for effective management of the MPA 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 MPA 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 MPA 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 relating to one particular component of a project without consultation, and between different components within a certain percentage (e.g. 5-10%), but generally approval 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 MPA 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 MPA, 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, and so 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 instalments, 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 long financial accounting period) is not always the same as the calendar year; for the MPA 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 MPAs could have identical balance sheets but for one the financial situation might be improving, and for the other it could be declining. An income statement, showing 'financial activity' over a period of time 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 MPA 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, 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 MPA 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 instalments 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 MPA 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), in-kind support from the tourism industry, sharing resources (e.g. technical expertise) among MPAs, and organising for 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 MPA 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 of time, 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 MPA finances as a whole, emphasising the need for separate accounts for project funds.

KEY POINTS FOR THE MPA

- ❑ **Ensure that staff understand that good financial management is a pre-requisite for effective overall management of an MPA.**
- ❑ **Set up the standard accounting practices of the MPAs 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.**
- ❑ **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.**

Sources of further information

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User fees and direct revenue

E3

Revenue generated directly by the MPA 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 MPA. There are a range of 'goods and services' that can be 'sold'. This sheet describes some of these 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 MPA (see sheet J2), for example, by charging more where sensitive ecosystems are involved and/or where mass tourism use is being discouraged.

MPAs 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 MPA. 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 MPA if they think that revenue is being misused. Where revenue is shared between an MPA and local communities, the % 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 MPA, and in other cases they go to a central agency. There can be good justifications for both systems. Where some MPAs have more visitors than others (due to accessibility or attractiveness to tourists), a centralised system allows revenue to be shared across the system.

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 MPA. Where there is a lack of harmonisation between licensing arrangements and MPA regulations (e.g. fishing licences may be issued for areas that are closed to fishing under MPA rules), close co-operation is required between the agency responsible for licensing and the MPA itself. MPA managers can raise the issue, and a suitable management arrangement could be developed, perhaps with a revenue-sharing arrangement between the MPA and government agency.

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 (e.g. as in the Dar es Salaam Marine Reserves in Tanzania), transport to the MPA, access points and launch ramps, or accommodation. Concessions encourage private investment in the MPA, can help to attract visitors and, if managed appropriately, can provide employment for local people, but they should not compete with private services provided by local communities who depend on MPA resources. A concession should be granted and renewed only if the activity meets appropriate environmental conditions and does not contradict the objectives of the MPA.

M. Richmond

In Tanzania, park fees contribute towards management costs of MPAs, as they do for the many world renowned terrestrial national parks.

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 MPA, 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 MPA. Special appeals or the establishment of a programme for supporters to provide regular donations, such as a 'Friends programme' may be appropriate for some MPAs, 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 in an MPA, where there is no single entry point, and in general, revenue collection tends to be poor in WIO countries. 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 MPA, or boat operators taking visitors to the reef, may be able to issue tickets and remit the funds to the MPA. Whatever revenue collection system is adopted, it should be carefully monitored, and penalties imposed if it is not adhered to.

KEY POINTS FOR THE MPA

- ❑ **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 MPA.**
- ❑ **If an MPA has to introduce new fees or revise existing ones, obtain expert advice and consult widely with stakeholders.**
- ❑ **If the MPA runs a shop, ensure that this provides a good selection of well-displayed, labelled and priced goods, does not over-invest in stock which deteriorates, and sells environmentally sound souvenirs.**

Sources of further information

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The International Ecotourism Society **www.ecotourism.org** - publications available on revenue generation from ecotourism.

CASE STUDY

Examples of revenue generation in WIO MPAs

There are no detailed studies assessing the success of different revenue generating systems in the WIO but many of the systems described above are in use.

In the Seychelles, the Marine Parks Authority generates revenue through entrance tickets, boat-mooring fees, filming fees, sales of coco-de-mer and tortoises (both of which are sustainably harvested in some protected areas), and hiring of picnic facilities. User fees cover about 70% of the management costs, and over half comes from just two of the five parks which thus subsidise the running of the others. A willingness-to-pay survey showed that 96% of tourists were willing to pay a fee and 74% were willing to pay at least the current fee or possibly more. However, when the fee was raised, it did not increase revenue as SCUBA divers moved to sites outside the MPAs.

Kenya has a two tiered system for Marine Parks, with lower entrance fees for residents and citizens. In addition, annual passes can be purchased and there are separate fees for overnight stays and use of boats in the Parks. The newly renovated accommodation and meeting facilities at Malindi Marine Park have been estimated to have the potential to generate about 20% of the operating costs of this MPA. However, revenue from fees from the Marine Parks currently goes to the central KWS authority.

Mainland Tanzania also has a tiered fee system. Furthermore, visiting fishers and traders are charged for use of a Marine Park, which helps to limit their number, thus benefiting resident users and providing some compensation for other use restrictions. The fees are retained by the MPA for management costs, but a proportion will be shared with local communities once implementation mechanisms are in place.

Kenya Wildlife Service. **www.kws.org** - information on fees for Kenya's MPAs.

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 MPA, and allowing management to concentrate on conservation and other key activities. 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 a lot of 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. MPA network or national protected area system);
- there is commitment from government and others to support the fund and participate in its work;
- there are appropriate national legal and financial practices and supporting institutions, to provide the confidence for raising the initial capital.

As yet, there are no fully effective ETFs in the WIO supporting MPAs, although the Comores and Madagascar (see case study) have experience in developing these for biodiversity conservation in general, and mainland Tanzania is in the initial stages of establishing one specifically for MPAs. 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$0.7-1 million annually (depending on the market and types of investments) over an unlimited amount of time. 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 MPA.

Sinking funds - The entire principal and investment income is disbursed over a fixed period of time (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 have experience serving on boards, and often bringing 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 WIO 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 US, 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 MPA).

KEY POINTS FOR THE MPA

- ❑ **Setting up an ETF is not something that an individual MPA manager should consider, but MPA personnel can play a major role in any assessments as to whether this might be an appropriate mechanism for the MPA 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, MPA managers can assist by helping to develop alliances with businesses, government agencies, NGOs, donors and others to stimulate interest.**

Sources of further information

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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 Program 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 programs which reach these regions. One part of the Foundation's endowment fund is earmarked for the creation of new protected areas, including MPAs.

Donor proposals E5

Most MPAs in the WIO will need external funding and there are many potential donors. Funding organizations 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. 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 organizations.

A long period may elapse 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 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 channeled 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, and be submitted through the parent ministry or government agency of the MPA. Local embassies and websites can provide details, and embassies may provide small grants for which there are simpler application and reporting procedures.

Multilateral organizations - Grants and loans from these (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 three areas: protection of biodiversity, pollution control and protection of international waters. GEF project proposals are prepared jointly by the country (which must be a party to the Convention on Biological Diversity) and either World Bank, UNDP or UNEP. There is also a GEF Small Grants Programme supporting NGOs and smaller projects.

International organizations - NGOs such as IUCN, 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 channeled 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 SEA Trust, the Pew Charitable Foundation, and Packard Foundation, that support MPAs. They generally offer direct grants and are less likely to have a fixed programme, but they may have particular areas of interests or priorities. Most foundations prefer to fund particular projects or activities, rather than operational costs.

Academic and research institutions - These may support MPAs through research grants for management-oriented studies. This is likely to be most successful if the MPA 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 is an opportunity 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 MPA (e.g. Chumbe Reef Sanctuary in Zanzibar) 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 MPA 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 POINTS FOR THE MPA

- ❑ **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 MPA 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 MPA.**
- ❑ **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 MPA management agency and other responsible bodies.**
- ❑ **Check whether visitors to the MPA have contacts with relevant organizations or 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 MPA, which could be used against it.**
- ❑ **Consider appointing one MPA 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.**
- ❑ **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**

UNEP 2000. *Project Formulation, Approval, Monitoring and Evaluation Manual*. Programme Coordination and Management Unit, UNEP, Nairobi, Kenya. **www.unep.org/Project_Manual/**

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).

Seashores of Eastern Africa Trust (SEA Trust) **www.seatrust.com** - a WIO grant-giving foundation

GEF: **www.gefweb.org**

ELEMENTS OF A FUNDING PROPOSAL

Title, proposed length of project, contact person with contact details.
Summary, emphasizing importance of the project and results to be achieved.
Background information giving a description of the status, trends and issues relating 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$, 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

MPAs 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 MPA 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 MPA management.

Marine ecosystems have many benefits that provide an important economic justification for establishing MPAs, 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$5-7 billion a year. Being able to demonstrate to local communities, donors, governments and other stakeholders that an MPA has significant economic benefit from 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 MPA is useful to:

- Demonstrate and quantify its economic value in terms of raw materials, protection of natural and human systems, 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 ship wreck; 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 MPA are more equally shared, e.g. income generating activities for local communities who have insufficiently benefited from the MPA, disincentives for damaging activities through taxes or bonds, and funding from groups who benefit from an MPA at little or no cost, such as user fees for tourists and visitors.

Quantifying the economic value of an MPA 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. 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 MPA 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.

2. Identify the total economic cost incurred in establishing and running the MPA, 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.

"Who pays for the damage to the reef...and how much?"

3. Quantify the values and costs listed in (1) and (2) above, to obtain the economic value of the MPA; 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 MPA and thus what economic incentives or other benefit mechanisms are needed; for example, tourism operators may benefit more from an MPA than fishing communities if the latter can no longer fish in the area.

KEY POINTS FOR THE MPA

- ❑ **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 minimizing costs.**
- ❑ **MPA 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 MPA, and the recommendations should be followed up.**

Sources of further information

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Cesar, H., Burke, L. & Pet-Soede, L. 2003. *Economics of Worldwide Coral Reef Degradation*. WWF-Netherlands and ICRAN. 24pp. Available from WWF Netherlands, Postbus 7, 3700 AA, Zeist, Netherlands and **www.icran.org**.

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IUCN/WCPA 1998. *Economic Values of Protected Areas: Guidelines for Protected Area Managers*. WCPA Task Force on Economic Benefits of Protected Areas with the IUCN Economics Service Unit, Gland, Switzerland and Cambridge, UK. 52pp.

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Spurgeon, J.P.G. 1993. The economic valuation of coral reefs. *Mar. Poll. Bull.* **24** (11): 529-536.

Spurgeon, J.P.G. 2001. *Valuation of coral reefs: the next 10 years*. Paper presented at International Consultative Workshop on Economic Valuation and Policy Priorities for Sustainable Management of Coral Reefs. ICLARM, Penang Malaysia, December 2001. **www.icriforum.org/docs/Valuation_CR.pdf**

Special issue of *MPA News*, Aug 2000. **http://depts.washington.edu/mpanews/MPA11.htm**

IUCN Business Unit **http://biodiversityeconomics.org**

IUCN/WCPA Sustainable Financing for Protected Areas: **www.iucn.org/themes/wcpa/theme/finance/finance.html**

CASE STUDY

An economic valuation of an MPA in Kenya

Kisite Marine National Park and Mpunguti Marine National Reserve, administered by the Kenya Wildlife Service (KWS), are together an important tourist destination, and also contribute to fisheries. Exploitation is banned in the Marine Park while fishing using traditional methods is permitted in the Marine Reserve. An economic valuation was carried out, with the support of IUCN and with funding from BMZ-the German Federal Ministry for Economic Cooperation and Development, to help identify how the financial and management problems faced by the MPA could be addressed.

It was found that, in 1999, the Marine Park and Reserve was generating income in excess of US$1.6 million a year in net revenues from tourism, and a further US$39,000 from fisheries. These returns are far in excess of the estimated management and opportunity costs associated with the park of some US$190,000 a year. If other economic benefits of the MPA, such as its contribution to shoreline protection, marine productivity, wildlife habitat and nursery, cultural and aesthetic values, had also been factored in, its economic benefits would have been even greater.

The valuation was also able to demonstrate that some groups (primarily the commercial tourism operators) receive the main economic benefits from the MPA, but others (the local fishing communities who had reduced fishing opportunities, and the local KWS office which had to manage the area although the entrance fee proceeds are managed centrally by KWS) bear the costs. Once this had been shown, activities were initiated to rectify the imbalance, focusing particularly on increasing benefits to local communities. These included constructing a mangrove boardwalk that is managed by the village womens' group (see sheet J8), and helping local boat operators to improve their services to tourists (e.g. preparation of an information leaflet and code of conduct, and assistance with obtaining appropriate insurance). These activities have led to a marked increase in support for the MPA by the local communities.

Emerton, L. & Tessema, Y. 2001. *Economic Constraints to the Management of Marine Protected Areas: the case of Kisite Marine National Park and Mpunguti Marine National Reserve, Kenya*. IUCN Eastern Africa Programme, Nairobi, Kenya. 26pp.

MPA buildings

F1

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

An MPA needs some or all of the following building and facilities:

- Offices, library, documentation centre, meeting rooms and laboratory;
- Staff and visitor accommodation;
- Restaurant, kitchen, snack bar, picnic area;
- Visitor centre, 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.

When planning buildings, compromises will have to be made between cost, availability of materials, aesthetic, environmental considerations, and functionality. Lighting, power and energy needs (see sheet F2) need careful thought. Other factors to consider include the following, 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 favour separating them however 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 these are suitable for the MPA'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 WIO region. Natural finishes or eco-friendly labeled products should be considered where possible.

S. Wells

View from the Chumbe Island lighthouse showing the eco-bungalows within the forest reserve.

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 maximize 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 alot of supply.

WATER AND SANITATION

Freshwater is often a scarce resource in MPAs. 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. Ground-water aquifers can be accessed relatively inexpensively, if not deep, but must not be over-used, as in coastal situations this often leads to salt water intrusion. Check 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 1,000 mm 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).

KEY POINTS FOR THE MPA

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

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

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http://energy.sourcesguide.com - worldwide souces on energy and related building design.

www.greenbuilder.com - advice on environmentally appropriate and sustainable building technologies.

www.cat.org.uk - consultants on appropriate technology buildings, energy and water and sanitation.

www.fscoax.org and www.fsc-uk.demon.co.uk - Forest Stewardship Council, for information on sustainable timber.

CASE STUDY

Environmentally sound buildings at Chumbe Reef Sanctuary, Zanzibar

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 uses 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 lower building costs and minimized environmental impact.

There is no natural source of freshwater so rainwater is collected in tanks under each eco-bungalows, 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 channeled 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

MPAs need power for a range of activities and provide an opportunity to demonstrate alternative, environmentally sound energy sources. Where an MPA 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 an MPA manager will wish to invest in 'renewable' energy sources.

The management of an MPA 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 MPAs 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 MPA 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 MPA in the WIO region 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.

S. Wells

Solar panels used to generate electricity on Cousin Island in the Seychelles.

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, fluorescent lights are four times more efficient 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 MPA 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 the WIO region, seasonal 'trade' 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, are used in an MPA as the components of these 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

The WIO region is blessed with reliable and plentiful sunshine, and solar energy is the logical choice for most MPA 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 array of water pipes under a glass cover which 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 which 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

Whilst 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 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 volt or 24 volt if linked together. For small-scale uses, like radios, power can be drawn directly from the batteries. For larger uses, like 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 MPA

- **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 MPAs.**

Sources of further information

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CASE STUDY

Lessons Learned from Solar Energy Systems in the Seychelles

Diesel generators have served the electricity needs of protected areas in Seychelles for many years, because of noise and pollution, a few MPAs have opted for solid state solar panels. Cousin Special Reserve, Aride Special Reserve and Curieuse Marine Park, for example, have introduced modern integrated systems recently. The high cost of the equipment (which had to be imported) meant that external funding was sought, from the Italian Government and from the Dutch Trust Fund for Seychelles for Curieuse and Cousin respectively. As the MPA 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 MPAs 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 lights and inverters, and the difficulty of procuring spare parts in Seychelles, emphasise the need for proper design and installation, by personnel suitably experienced in renewable energy systems.

M. Richmond

Solar cooker in use for boiling water.

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 MPA 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 MPA 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 MPA 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 following facilities:

COMPUTERS AND ASSOCIATED EQUIPMENT

Whilst 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 MPA 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 anti-virus and firewall software;
- Unauthorised users: use passwords and other blocking methods.

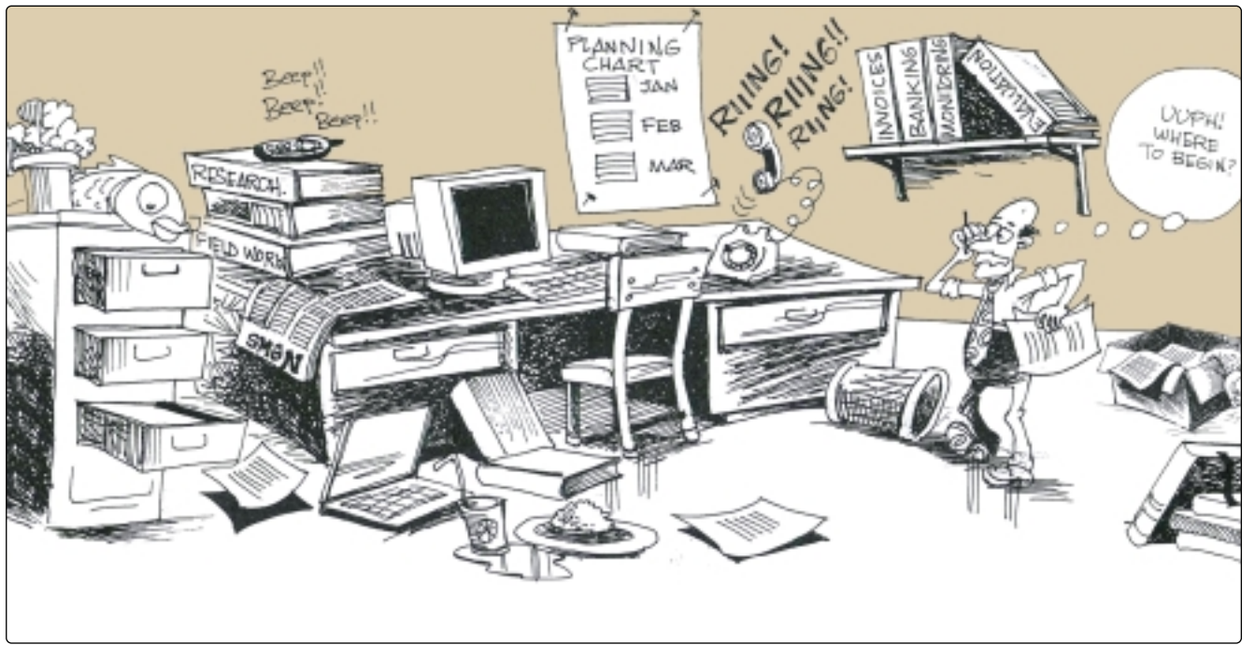
Make sure that staff who use computers have adequate training for the work they are expected to do. Support staff should be appropriately trained in preparing documents, managing e-mail, and maintaining general correspondence.

DOCUMENTATION AREA

The MPA 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 MPA, as well as more general field guides, 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 MPA, and a notice board is often useful to display key information (e.g. meetings, staff leave and absences, staff travel, visitors, events in the MPA such as sightings of rare species). A calendar of key dates and events in the year is also useful.



MEETINGS AND PRESENTATIONS

The office is likely to be where most meetings take place and an area should be made available for this. 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 set up and encouraged to promote communication and information sharing between MPA staff and between the MPA 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. Overstocking is to be avoided as supplies may have a limited shelf life, especially in hot or humid conditions. Equally, understocking 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 purchase and maintenance of equipment in general; broken computers, and photocopiers can seriously hinder the technical and management work of the MPA and hinder it from 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 MPA provides a good working atmosphere, where information sharing and networking can flourish. Some simple ways to encourage this include:

- E-mails, 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 MPA.

KEY POINTS FOR THE MPA

- ❑ **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 MPA 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 MPAs, and others who may have authority over or be supporting the MPA.**
- ❑ **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 MPA 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. and 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, The 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 & maintenance F4

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

Many equipment purchases are 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.

The types of equipment likely to be required in an MPA 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, field monitoring and meteorological equipment;
- 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 MPA management. They can be further explained as follows:

Availability - enough suitable equipment is ready and available 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, two to five years for a vehicle, longer for 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.

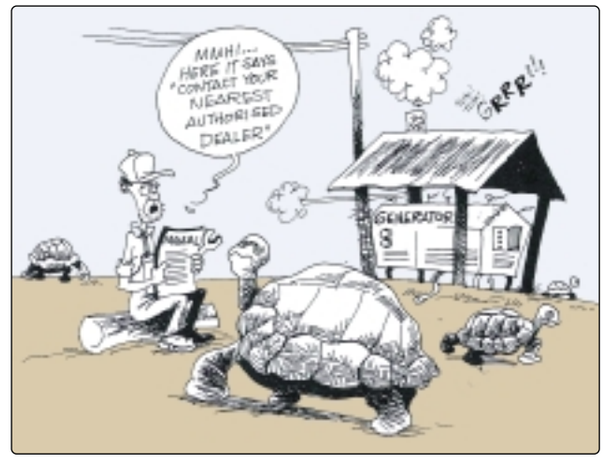
Consider the level of sophistication that is appropriate for the MPA, particularly if access to technical support, advice and troubleshooting may be difficult. It is best to avoid being tempted by suppliers offering equipment with attractive features that are not needed. Where relevant, try and balance 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? Seek advice from other MPA managers and learn from their experiences.

Think about standardizing 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 MPA? 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 MPA 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 sale, 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 MPA. The last thing any one wishes to see is it being dropped off the back of the MPA 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 MPA 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 MPA is available in most WIO countries. Some training will lead to nationally recognised qualifications. Training areas to consider include:

- Vehicle drivers and mechanics;
- Boat operations and maintenance;
- Radio operators 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.

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 MPAs 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 MPA 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, furnishing and even supplies are part of the assets of the MPA 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. All equipment and furnishings should be labeled in a permanent manner. A good storekeeper is recommended to maintain stocks and spares.

KEY POINTS FOR THE MPA

- ❑ **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.**
- ❑ **Assign individuals (i.e. 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 MPA buildings).**

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 for manufacturers of equipment needed by the MPA.

Boats and engines F5

All MPAs 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 MPA, 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, but a boat for personnel transport should have seating and preferably shade. 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 this.

S. Wells

Launching a fibreglass boat bought for the Moheli Marine Park in the Comores (note two engines).

BOAT MATERIALS

Materials commonly used to build the main structure (the hull), are wood (including marine ply), rubber, fibreglass, ferrocement, aluminium and steel, some of which can be combined, e.g. fibreglass hulls with rubber sponsons (called semi-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 to ensure a long service life. The material used also influences the maintenance schedule and the need for spares; wooden hulls (e.g. dhows) 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 usually 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 long distances in the open ocean and has a single outboard, a small backup should be carried. Manufacturers of outboard engines include Yamaha, Mariner, Evinrude, Honda and increasingly Suzuki. Agents for these are present in most WIO countries and should stock spare parts.

Larger, heavier boats usually have inboard diesel engines which are efficient in fuel consumption but slower. Common names are Yanmar, Lister-Petter, Volvo-Penta and Mitsubishi, but there are fewer back-up agents in the WIO. The operator must fully understand the engine which may be more complex to run than outboards (e.g. complicated electrical systems and some are turbo powered). For shallow waters, where propellers are regularly damaged or cause damage to marine life, 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.

S. Wells

Inflatable boat being used for educational activities.

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.
- 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 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 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 MPA

- ❑ **Boats are a major investment, so think carefully and consult colleagues and other MPAs 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 MPA from maintenance and support facilities.**
- ❑ **Ensure 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 MPA's 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 MPA boats and have key spares available (e.g. propeller pins, propellers, fuel filters).**

CASE STUDY

Boats in Aldabra Special Reserve and World Heritage Site - Lessons Learned

Aldabra is one of the remotest and largest MPAs in the region. Numerous activities, ranging from research and monitoring, to tourism and education, are undertaken from the combined management base and research station. Acquiring and maintaining appropriate vessels is a major preoccupation for the management agency, the Seychelles Island Foundation (SIF).

Boat transport is needed for:

- Transferring visitors, personnel and cargo to shore from vessels that have to anchor outside the reef;
- Patrols in the lagoon (many shallow areas but also deep channels with extremely fast tidal currents) and the open waters (deep and often rough);
- Monitoring and research;
- Visits by tourists and school children;
- Occassional transfer of people to and from the nearest airstrip, on Assumption, about 30 km away;
- Rescue and emergency evacuations;
- Subsistence fishing.

SIF has several boats including a very large zodiac, a fibreglass catamaran and small tenders. Strong aluminium heavy-duty hulls (although fibreglass is easier to repair if damaged) are used as the boats are regularly beached. One of the most successful boats is the 'Bumboat' (see Toolkit folder cover) which has been used for over 35 years and continues to transport stores to and from the supply ship, visitors and researchers around the atoll, and is even used for medical evacuations to the airstrip. With a heavy aluminium hull including a solid 30mm keel, it is powered by an 85 HP outboard engine. SIF has a policy of replacing all outboards every two years, as this means lower maintenance costs and a higher re-sale value, but this is not always possible. Older style engines (although not as environmentally friendly as 4-stroke engines) tend to be used, as the boatmen and mechanics are familiar with these and can maintain them in the remote location.

All the boats receive careful operation and regular maintenance, as spares and fuel are only available through the supply boat that visits every two months. The Warden ensures that daily operations (laid out in an operations manual) are carefully followed, and each boat is allocated to a particular boatman. The mechanic and head boatman are recruited with basic skills (e.g. graduates from the national School of Maritime Studies) and sent for further training in engine maintenance, navigation skills and sometimes diving. SIF pays for this, which adds to the MPA's costs, but is considered essential.

Sources of further information

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

Use a search engine to find websites for manufacturers of engines, boats and accessories.

Vehicles F6

Vehicles, like boats, represent a necessary and large investment for the MPA. The purchase of appropriate vehicles, that can meet clearly defined requirements, will make a valuable contribution to the management of the MPA, 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 MPAs 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, motor cycles and even bicycles. Before investing in new or additional vehicles, the MPA should first consider what requirements it has for land transport, both inside and outside the MPA. 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, and the MPA 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 MPA vehicle is a potential item for sponsorship.

MANUFACTURER AND MODEL

Manufacturers of 4x4 vehicles, commonly in use throughout the WIO, include Toyota, Land Rover, Jeep, Mitsubishi, Nissan, Suzuki and Mercedes. 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 motor cycles, it should be readily obvious, from the nearest large town, what makes are locally available and easy to support and maintain.

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 MPA, 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.

ENGINE

Engine size, performance and range will be determined by the requirements within the MPA. 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 MPA, then it is the wrong choice. A heavy duty 4x4, that operates daily within in the MPA 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 MPA 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.

M. Richmond

Maintaining vehicles in difficult conditions with inadequate availability of spare parts can be a challenging task.

ACCESSORIES

Boat trailers and the corresponding tow bars are a common requirement of MPA 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'.

MPA vehicles may need to be equipped with auxiliary equipment such as radios (and relevant antenna) and search lights. A complete tool kit, tow rope, jump leads, and other items such as flares, torches, first aid kit, fire extinguisher should also be considered, 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 airfilter extension pipe, diving bottle holders, spot lights, glass fibre covers for pickups, secure storage bins and 12V cool boxes. Within the WIO region, South Africa has probably the greatest choice of suppliers.

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.

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 and 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 MPA 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 MPA for major servicing of certain components, but in general the MPA should have a trained mechanic, competent in the general maintenance of all MPA vehicles. The MPA should identify and list key workshop tools required, i.e. ramp where work can be carried out underneath the car, good lighting and security, and puncture repair kits.

VEHICLE USE

MPA 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 MPA workshops, recording the date, kilometres and details of all servicing of the vehicle.

KEY POINTS FOR THE MPA

- ❑ **Develop a set of land transport needs for the MPA, 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 MPA vehicles, but use the vehicle primarily for its correct purpose; do not over load or over use.**
- ❑ **Encourage a 'maintenance' rather than 'repair' culture amongst MPA 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

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

Use a search engine on the internet to explore websites for manufacturers of vehicles and accessories.

Radio and telecommunication F7

Good communications are vitally important both within an MPA and between the MPA staff and stakeholders, and others outside the boundaries. Radio, telephone and internet are the primary forms of communication available to MPAs. Key principles in their selection and use are outlined in this sheet.

MPAs need good communication links with:

- MPA 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 MPA;
- Visiting vessels (e.g. yachts, commercial shipping or fishing vessels);
- Oil spill task force and/or emergency response contacts;
- Other MPAs, 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.

Commercial Wave Bands	Wavelength	Frequency
VLF - Maritime navigation signals.	10-100km	3-30KHz
LF - Navigational aids.	1-10km	30-300KHz
MF - AM radio, maritime radio.	100-1,000m	300KHz–3MHz
HF - Short wave (SW) radio, radiophone, weatherfax.	10-100m	3-30MHz
VHF - FM radio, navigational aids, TVs, walkie-talkie 2-way radios; most short-range services, e.g. aviation, shipping, police.	1-10m	30-300MHz
UHF - Cell phones, GPS, TVs.	10cm – 1m	300MHz-3GHz
SHF - Microwaves, space and satellite communications	1-10cm	3-30GHz
EHF - Radars and radio astronomy	1mm – 1cm	30-300GHz

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 off-shore 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 MPAs. 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.

M. Richmond

HF radios can be a vital link for remote MAPs or isolated communities such as this villlage in the Rufiji Delta, Tanzania, where electricity and phone lines do not reach.

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.

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 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.

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.

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 are expensive (user charges typically US$ 1 per minute; purchase costs is between US$ 500-1,000). 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), now available in most WIO cities, are companies that provide connections to the Internet and host email addresses. Connections to the Internet can be made by:

- **Fixed land telephone lines -** The cheapest option.
- **Mobile phone -** More expensive, and so not very suitable for Internet browsing. Weak mobile signals can sometimes be boosted locally within the MPA.
- **Short wave HF radio -** Suitable for email messages but not for large attached files or Internet access. This is particularly useful in remote locations due to the long range of short wave.
- **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.

Sources of further information

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

Gale, J.M 1992. *Marine SSB operation*. Fernhurst Books, Brighton, UK. 96pp.

Companies providing wireless and telecommunications services and relevant equipment: **www.icom.com; www.motorola.com; www.multisource.co.za; www.kenwood.com; www.globalcoms.co.za**

www.icom.com - commercial company giving information on creating websites and getting on-line

KEY POINTS FOR THE MPA

- ❑ **Establish a communications system that adequately covers the MPA 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 unit used on boats, and try to purchase marine models.**

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 MPA to the patrol base in Kizimkazi. The seven 'base' radios include several in villages, some powered by car batteries connected to solar panel, 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 violation of park regulations to Kizimkazi. Radio posts were strategically posted in villages with clear views of entry points to the MPA 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 learned 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 MPA. 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 & snorkelling equipment

F8

Diving or snorkelling provide those working in or visiting MPAs 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.

MPA 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 minimal skills and training, and just three main pieces of equipment: mask, fins and snorkel.

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, and NAUI. The equipment includes mask, fins and snorkel, as well as all the additional components to allow the diver to spend time underwater at depth. Most MPA activities will only require shallow-water diving, that is dives of around forty 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 MPAs far from any re-compression chamber, as is the case in most WIO MPAs. More advanced forms of diving, as practised by commercial or salvage divers, involve different mixtures of gas, and depths and duration of dives are much longer. Re-compression 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, glow sticks and a goody bag.

A slate (plastic sheet), and pencil (attached) are useful for both snorkelling and diving, and are essential if data are being collected.

Prices of individual items vary throughout the region. The only country in the WIO that manufactures diving equipment is South Africa; other sources are Australia, USA, Italy, France and other European countries. The following are details of the more expensive and technical equipment.

Cylinders or bottles - There are two sorts: 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 and (become positively buoyant underwater when almost empty) 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.

M. Richmond

Underwater cameras are increasingly becoming an important tool for coral reef research.

Regulators - There is now a vast range of regulator models, from at least five 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. 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. Furthermore, both the warranty and insurance may be void if uncertified people have opened or serviced regulators.

Compressor - The MPA may have its own compressor for filling bottles, or may have to use the services of a local dive operator. 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 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 users' 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 MPA (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 MPAs 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, 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 MPA 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 MPA. Although using official dealers for maintenance and repairs may appear expensive in the short term, it is more cost-effective in the long run, 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. In many diving accidents, the victim should be given oxygen as soon as possible after the accident, ideally on site. Small oxygen bottles can be purchased from commerical diving centres and should be a standard part of emergency kit in MPAs where diving is carried out. 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 Diver Alert Network (DAN) have specialist insurance for divers.

KEY POINTS FOR THE MPA

- **Develop close co-operation 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 MPA has a strict policy on diving practices, particularly safety aspects.**
- **Ensure that any necessary insurance has been taken out.**
- **Make sure that all MPA personnel are aware of first aid and emergency procedures that would be needed in case of a diving accident.**

Sources of further information

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.com** or **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 on: **www.daneurope.org/**

Moorings and buoys F9

Buoys are used for a variety of purposes in an MPA, 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 MPAs.

The main uses for buoys in an MPA are for:

- Marking navigation channels, and the boundary and zones of the MPA;
- 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.

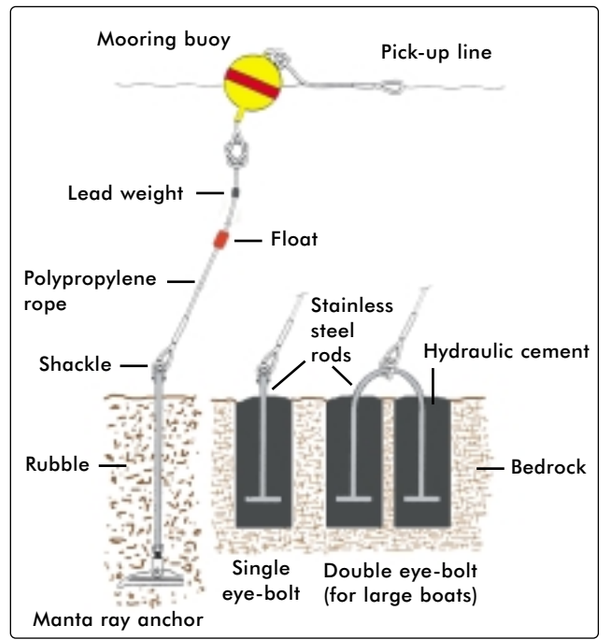
Moorings are particularly important in an MPA to protect the seabed from anchor damage, especially in coral areas, and to reduce overcrowding (e.g. at popular dive sites where anchoring is prohibited and the number of buoys can be limited). Fishers may use the moorings as well as tourist boats and competition 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, wave and wind factors).

HALAS MOORING SYSTEM

Halas embedment moorings are strongly recommended for MPAs, and were designed specifically to prevent environmental damage whilst providing robust and safe mooring (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 encourge 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 meters 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.



Variations of the Halas mooring system.

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 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$200-2000, with labour, boat use and fuel costs on top. Maintenance costs can also be expensive. In many WIO countries, donors have funded installation costs. Some MPAs in the Caribbean have set up 'Adopt a Mooring Buoy' programmes to raise funds, and dive operations often contribute financially or in kind. In the Seychelles, the MPAs themselves help to cover costs (see case study).

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 MPA 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 MPA

- ❑ **Provide information on positions of buoys (particularly MPA 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 MPA user fees.**
- ❑ **Carefully examine insurance and legal liability issues for mooring buoy use; ensure that the MPA 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'.**

Sources of further information

Breda van, A. & Gjerde, K.M. 1992. *The use of mooring buoys as a management tool.* Centre for Marine Conservation, Washington DC. 56pp.

Environmental Moorings International: **www.reefmoorings.com**

Gjerde, K.M. 1991. *Mooring buoys and legal liability.* Centre for Marine Conservation, Environmental Solutions International and The World Conservation Union. 12pp.

Marine Conservation Society Seychelles (MCSS) moorings project: **www.mcss.sc/moorings.htm**

International Association of Lighthouses: **www.iala-aism.org** - information on the IALA Maritime Buoyage System.

PADI International Project Aware: document on Mooring Buoy Program Planning: **www.projectaware.org**

CASE STUDY

The Seychelles mooring buoy programme

The Marine Conservation Society Seychelles (MCSS), with assistance from other organisations, is installing a national mooring buoy system in and adjacent to MPAs. 100 moorings and buoys (the Halas type) were purchased with donor funding from the Netherlands. An installation training course was carried out by John Halas for about 12 staff from the Marine Parks Authority, the Marine Unit of the Department of Environment, and the MCSS.

Yellow mooring buoys are designated for large boats and white for smaller boats. The programme has resulted in some useful lessons learned and modifications to the design. The Seychelles is the first place where Halas embedment moorings are being used for large vessels (35m length, GRT up to 250 tonnes). On Aldabra, the hard limestone substrate required modification to the installation technique, and the difficult diving conditions due to depth and strong currents required Nitrox diving.

Following initial installation, a public and stakeholder workshop was held to develop a framework for further installations and maintenance. A Mooring Stakeholder Steering Committee, comprising agency and MPA representatives, was established to oversee the long-term process. The Marine Parks Authority and the NGOs running the MPAs at Aldabra, Aride and Cousin maintain the moorings. Under a memorandum of understanding with the MCSS, the MPAs are responsible for routine maintenance with MCSS responsible for six monthly inspections and other essential maintenance. Entrance and overnight mooring fees fund maintenance and sometimes installation.

The port and coastguard authorities were worried about liability if an accident occurred to a vessel moored to a buoy. Reassurance was provided through information about the situation in other countries and by obtaining insurance. The buoys are now serving their immediate purpose, providing a much-needed service in many areas used by tourist boats and yachts.

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 principle reasons for developing an M&E programme are to (1) Assess the status of the key values (biodiversity and socio-economic aspects) of the MPA; and (2) Determine whether management is having its intended impact and is effective (see sheet G9). Because M&E terminology, methods and approaches can be confu-sing, thus it is useful to distinguish the following terms:

Monitoring - A continuous systematic process of collecting and analyzing information, through the use of indicators. Ecosystem and biodiversity health (see sheet H5) and the well-being of local communities dependent on the MPA 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 MPA are being met. Individual projects may be evaluated, or the management effectiveness of the MPA as a whole may be assessed. 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 MPA is first established.

Most MPAs in the WIO have monitoring activities underway, including 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 socio-economic 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 MPAs have integrated M&E programmes, and many 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 MPA 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 MPA 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 socio-economic 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' which measure changes in the system (e.g. coral abundance as a measure of coral health), and 'process indicators' which 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 MPA.

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 judgements) is 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 species. 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), socio-economic and governance indicators that can be used to help develop monitoring programmes in MPAs (see Pomeroy *et al.*, 2004).

IMPLEMENTING M&E PROGRAMMES

Given the complexity of M&E, a general plan should be developed for the MPA 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. for 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, MPA 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 MPA and used for management decisions. Involvement of stakeholders such as local communities and tourism operators can raise awareness about the MPA and provide useful information and feedback.

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 MPA

- ❑ **Where budgets allow, appoint someone to oversee all components of the M&E plan.**
- ❑ **Monitoring activities should be set up as soon as an MPA 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 MPA 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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(see also sheets G9 and G10)

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Compliance and enforcement

G2

An MPA is only effective if stakeholders and users comply with the legislation that has been put in place to support management. The MPA 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 MPA to ensure that the regulations are being respected.

Patrolling or surveillance refers to physical observation of the MPA 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 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 MPA, that might have an adverse impact on it, are monitored.

Patrolling to check on compliance involves ensuring that regulations are understood, discussing infractions with offenders, issuing a warning where required, and arrest and prosecution if compliance cannot be achieved in any other way. The process should be laid out in the MPA management plan and regulations.

Most MPAs operate as a partnership between national and local government agencies, local communities and sometimes the private sector. To promote voluntary compliance, MPA 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 that roles and responsibilities are fully understood.

Some MPA legislation comes under the mandate of other government agencies, not of the MPA itself. For example, the Fisheries Department may be responsible for enforcing fisheries legislation, the Forest Department for enforcing mangrove use regulations, and the Tourism Department for issuing licences to tourism operators. The MPA personnel responsible for compliance must therefore fully understand the wider national legal framework, and consult with police, coastguard, navy and other agencies as appropriate. Information obtained during surveillance of an MPA may be useful to other management agencies, and the latter may be able to provide information valuable to the MPA.

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 MPA. There may already be national standards for surveillance activities, and for training in surveillance techniques, and other MPAs in the country may have established programmes. Coordination with such groups can help to improve overall standards and efficiency.

RESPONSIBLE PERSONNEL

Most MPAs have rangers or enforcement officers who are responsible for daily patrols, on foot or by boat. These are often salaried MPA personnel but sometimes staff from other agencies are seconded for this purpose. For example, in northern Tanzania, the Honorary Ranger for Maziwe Marine Reserve, is the local District fisheries officer, and enforcement of the collaborative fisheries management areas is assisted by naval personnel seconded to the Districts. In other places, community representatives provide their services voluntarily, for an honorarium, or are paid by the MPA (see case study).

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 MPA 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.

M. Vely

Park 'ecogardes' in Moheli Marine Park, Comores.

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. Although some government protected area personnel may automatically receive military training, it is important for enforcement staff to avoid agression; training should include advice on appropriate behaviour for this task.

EQUIPMENT

The appropriate equipment for surveillance will be determined by the physical characteristics of the MPA (e.g. shape, size, habitat types, 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);
- Hand-held GPS;
- Standardized report forms, notebook and pens;
- 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 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 hand held 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 MPAs to provide early warning against intruders and permit MCS enforcement staff to intercept the vessels.

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FAO Document Repository: **http://www.fao.org/DOCREP**

CASE STUDY

Moheli Marine Park, Comores - community involvement to promote compliance

Moheli Marine Park was established through individual co-management agreements with each of the 10 villages bordering the Park and the government. The Park manager is a government appointee, but the rangers, known as 'ecogardes' come from the villages. Each village environmental association selects an ecogarde, jointly with the local environment department officer on Moheli Island, on the basis of their educational achievements, their previous involvement in environmental activities and their availability. Their tasks are defined in the legislation that created the Marine Park and include monitoring, surveillance, education and awareness-raising. They are supervised by the MPA manager and receive a salary from the Park. They make daily patrols, each covering the part of the park over which their village has particular responsibility.

Although not armed, they must report infringements of legislation to the police who then take action; in case of any contest, their statements take precedence. They have however felt at risk of violence on occasions, particularly from turtle poachers, and there are discussions about possibly arming them. The UNDP/GEF project that helped with the establishment of the Park, with technical assistance from IUCN, enabled all the ecogardes to receive basic training in terrestrial and marine ecology, navigation, first aid and other management related issues. Some have also had specific training in ornithology and turtle protection and monitoring. The ecogardes provide a key link between the MPA authority and the local communities and visitors and tourists, and have proved a very effective mechanism for improving compliance.

KEY POINTS FOR THE MPA

Given that safety, security and legality are so important, 'Standard Operating Procedures' must be developed (see website for SADC/EU MCS Project). 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? Is this available 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? Are there support staff at the operations base?**
- ❑ **Telecommunications - Are the telecommunications functioning properly?**
- ❑ **Dual-tasking - Are there any other functions the surveillance activity can perform during the patrol, such as research? 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.**

Monitoring coral reefs

G3

A vast literature exists on coral reef monitoring, often making selection of an appropriate method for use in an MPA a daunting task. This sheet provides some guidance on the methods available 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 or area cover of species present. More detailed methods involve measuring ecological processes, such as coral recruitment, or fish herbivory and predation (see case study).

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 intervals so that observations can be made of overall reef condition or populations of visible species (e.g. COTs and turtles). Swimming surveys can be used for smaller distances. ReefCheck 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 and learnt in one day. ReefCheck methods are being incorporated into several MPA monitoring programmes in the WIO, following training workshops, supported by UNEP. In La Réunion, ReefCheck methods are combined with more detailed scientific procedures.

Detailed benthic monitoring - Line transects or quadrats are most commonly used, and require more time in the water and more complex analysis than the rapid surveys, but photography and video can be used for data collection. 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 and the amount of each substrate type encountered under it, is recorded. Transects must be laid systematically and objectively, generally parallel to the reef edge, or stratified according to local habitat features. They may be permanently placed or random depending on the sampling design. Several replicate transects (>5 recommended) should be laid at each site so that average % cover can be calculated. Specific measurement of coral condition and colour will be necessary if bleaching is occurring (see sheet H7). Changes in reef rugosity (or topography) can also be recorded, by laying a chain along part or all of the transect.

Reef fish diversity and abundance - This is usually monitored using Underwater Visual Census (UVC) methods, provided there is sufficient water clarity. UVC is usually carried out using a 50m belt transect with divers recording the fish observed at a set distance on either side of the transect. Stationary point counts are equally effective, and are particularly useful for very heterogeneous environments or where there are isolated structures (e.g. a large *Porites* coral head). Other methods are capture with traps, baited lines and set nets, and application of rotenone or other poisons, but these should not be used for regular monitoring or in an MPA.

Invertebrate diversity and abundance - Mobile invertebrates, such as octopus, lobster and many echinoderms, can be monitored using transects. 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 MPA. Professional guidance should be sought, particularly for sampling design (location and number of replicate transects) as this must be correct if the results are to be valid. An MPA may wish to set up an independent programme, but it is best to collaborate. Some countries, such as Mozambique, are developing nationally coordinated reef monitoring programmes; in others, MPAs have their own programmes but share data at the national level. There are three regional programmes:

- Indian Ocean – Reef Network (IO-RN): based in La Réunion, coordinates monitoring and a database (COREMO) for the island states.
- Coral Reef Degradation in the Indian Ocean (CORDIO): focuses on regional assessments, including socio-economic monitoring.
- Coral Reef Conservation Project (CRCP): supported by the Wildlife Conservation Society, works in Kenya and Tanzania (see case study).

IO-RN and CORDIO are the regional nodes for the Global Coral Reef Monitoring Network (GCRMN) which promotes the methods described in English *et al.* (1997); a similar francophone manual is available in Conand *et al.* (1998). A summary of GCRMN and ReefCheck methods is available on the C-NAV CD-ROM.

Senior researcher laying out a coral reef transect line in Kenya.

T. McClanahan

KEY POINTS FOR THE MPA

- 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 CORDIO and IUCN for information on techniques in common use in the WIO.
- Ensure that data collectors, particularly non-professionals, are adequately trained, and undertake regular inter-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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ReefCheck methods and instruction manual available from: **www.reefcheck.org**

C-NAV Coral Navigator - a CD-ROM on GCRMN and ReefCheck methods, available from AIMS Bookshop Science Communications, Townsville, Qld 4810, Australia.

Coral Health and Monitoring Programme (CHAMP): **www.coral.noaa.gov/methods.html** – lists a variety of resources for reef monitoring.

Hawaii Coral Reef Monitoring Program (CRAMP): **http://cramp.wcc.hawaii.edu/overview/3._methods/** - provides an analysis of advantages and disadvantages of different methods.

CORDIO – Coral Reef Degradation in the Indian Ocean: **www.cordio.org**

COREMO database for Indian Ocean Commission members; contact: **jpquod.arvam@wanadoo.fr**

CASE STUDY

Coral reef monitoring in MPAs in Kenya

Since 1987, the Kenya Wildlife Service (KWS) and the CRCP have been jointly monitoring five of the six MPAs in Kenya (Malindi, Watamu, Mombasa, Diani and Kisite). Sites have been selected to allow comparison between fully protected areas (marine parks) and partially protected areas (marine reserves). The annual monitoring program has several components including:

1. Benthic substrate cover (i.e. live coral, soft coral, fleshy algae, sand, algal turf, seagrass), measured using the LIT method (nine 10m transects/site, two sites/location).
2. Topographic complexity of the substrate.
3. Predation of sea urchins, measured by tethering *Echinometra mathaei* and counting the numbers eaten over a 24-hour period.
4. Herbivory by fish and urchins, measured through observations of blades of *Thalassia hemprichi*, secured onto a transect line for a 24 hour period.
5. Fish diversity, through counts along a 100m belt transect, with classification by family and size classes; a more detailed method is used for individual species in nine common fish families.

Results show that areas closed to fishing (marine parks) have higher coral cover and coralline algae, lower cover of fleshy algae, and larger, more numerous and more diverse fish populations than areas open to fishing, with the longest established closed areas having higher abundance of fish and higher coral cover. Predation of sea urchins is also greater in parks where there are more red-lined trigger fish *Balistapus undulatus*. The data from Mombasa Marine Park and Reserve show a trend in recovery of reefs after establishment of the MPA, but the 1997/98 El Niño bleaching event lead to dramatic decreases of coral cover due to mortality in all MPAs with the parks showing the greater effects. This demonstrates the value of long-term consistent monitoring as many of these trends have management implications.

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Monitoring mangroves & seagrasses

G4

Mangroves and seagrass beds are important habitats in many MPAs in the WIO, and it is important that their health is monitored. This sheet introduces available techniques and encourages MPA managers to develop monitoring programmes.

Many mangrove management and restoration programmes are underway in the WIO (see sheet H9), but there is little monitoring of mangroves or seagrasses. MPAs 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 should be collected (e.g. weather, state of the tide, water quality) at the same time (see sheet G5) and baseline maps and assessments are essential (see sheet C1).

MANGROVES

There are ten easily recognisable species in the WIO. Monitoring methods are described in English *et al*. (1997), but a comprehensive programme may be beyond the scope of many MPAs. Priority parameters should therefore be selected, and collaboration sought with local forest departments for personnel and equipment. The main parameters for monitoring mangroves are:

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.

J. Rubens

Measuring mangrove tree girth, as part of a monitoring programme in Mafia Island Marine Park, Tanzania.

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 10 cm.
- 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 determine mangrove health and other information needed for management (see case study).

SEAGRASSES

There are 13 seagrass species in the WIO. 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. A SeagrassNet monitoring site has been set up in Tanzania by the University of Dar es Salaam. 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 50 cm, divided into 25 sectors) are used to calculate % 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 % 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.

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.

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 MPAs 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 MPA

- ❑ **MPAs should develop monitoring programmes for mangroves and seagrass beds, choosing methods that reflect the needs of the MPA, 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 **www.glomis.com** - contains a global mangrove bibliography.

World Seagrass Association - **www.worldseagrass.org** - a Global Network of scientists and coastal managers committed to research, protection and management of seagrasses.

SeagrassNet - **www.seagrassnet.org** - a global programme to monitor and document the status of seagrasses.

CRC Reef Research Centre - **www.reef.crc.org.au** – information on monitoring including SeagrassWatch (community-based programme).

CASE STUDY

The Mangrove Management Project (MMP) in Tanzania

The national MMP was initiated in Tanzania in 1988 to promote mangrove conservation and sustainable utilisation. All mangrove forests in Tanzania are classified as Forest Reserves and zoned for different uses, with some areas strictly protected. To assess the impact of the MMP, changes in overall mangrove coverage were estimated by comparing Landsat TM images for the years 1988-1990, with Landsat-7 ETM+ images for the year 2000. Field observations and ground verification were undertaken with District natural resource and mangrove officers. The results showed that there has been little change over the last 10 years, with some Districts showing a slight increase (e.g. Tanga, Muheza, and Mtwara, where the MMP has been very active and has promoted restoration efforts) and others a decrease (e.g. Rufiji District).

National trends in mangrove cover do not, however, necessarily reflect trends in mangrove health, and in Tanzania there is evidence that the latter has declined. Monitoring mangrove forest quality at the local level is thus equally important for management, but is not yet being undertaken widely, even in MPAs. Short term monitoring activities have been carried out at a few sites to follow the effectiveness of restoration programmes. For example, at Mbweni Mangrove Forest, a restoration initiative was monitored for eight months with assistance of the village women's group, and the results showed that it was successful. However, monitoring of natural stands is as important, and MPAs could take the lead in developing appropriate simple long-term methods.

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 MPA 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 MPA 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 MPA (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 pollutant levels. 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

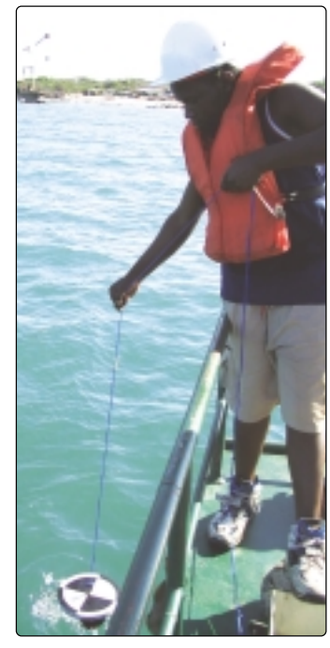
A marine-rated mercury thermometer in a protective casing should be used and recordings taken just below the surface (30cm) and at other depths depending on other data collection programmes and the presence of a thermocline or stratification. Retrievable temperature loggers are very useful for obtaining long-term data sets (see case study).

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).



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Using a Secchi disk.

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 a series of pipes, closed at one end, that are attached vertically to the substrate and are collected after a fixed period of time. 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 MPA, 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 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 MPA

- **It may not be essential to monitor all physical parameters, and priorities should be set according to the needs and capacity of the MPA; water temperature, visibility and salinity are among the more important.**
- **Assign specific MPA 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 MPA 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.**
- **Ensure that data are logged promptly and accurately, and are analysed quickly so that if there are changes that may affect the MPA, expert advice can be sought quickly.**

Sources of further information

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UNEP/IAEA/IOC 1991. Standard chemical methods for marine environmental monitoring. *Reference Methods for Marine Pollution Studies*. No. 50. UNEP, Nairobi.

United States Virgin Islands Coastal Zone Management Program 2001. *Coastal Water Quality Monitoring Manual: Parameters and Techniques*. Department of Planning and Natural Resources, Division of Coastal Zone Management, National Oceanic Atmospheric Administration, Washington D.C., USA. **www.ocrm.nos.noaa.gov/PDF/USVI_Monitoring_Manual.pdf**

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

Automatic underwater temperature recording - a new technology for the WIO

The extensive coral bleaching in 1998 made MPA managers and scientists in the WIO appreciate the importance of understanding trends in seawater temperatures. A programme to install automatic temperature data loggers was therefore initiated by CORDIO, in partnership with scientists and MPAs. Those being installed in the WIO are small self-contained, battery-powered waterproof units that are tied to holes or projections on the reef. They are generally hidden to prevent theft and dislodgement by curious fish. A sketch map, noting obvious markers (such as a subsurface buoy or prominent coral heads) helps relocation. Most of the loggers have been placed in shallow lagoons and at 5-10m depth on fore reef slopes, with a few in deeper waters to monitor cooler waters and different habitats.

Before deployment, the data logger is connected to a personal computer and progammed with the parameters that are to be measured (e.g. temperature on an hourly basis). After a certain time (several months or a year), it is retrieved from the reef, and the data is off loaded and analysed. Some data loggers have a 'data shuttle' that can be used to retrieve the data *in situ*, so that the loggers stay in place for continuous recording. Data loggers cost about US$100 each, and the software and hardware, which can be used for many individual loggers, about US$300.

Many of the loggers are installed in MPAs and are managed by MPA staff. The longest *in situ* temperature records are from Kenya, La Réunion and Mayotte, which started records in 1998. By 2002 even remote islands such as Europa and Aldabra had temperature loggers. When matched with sea surface temperature data from satellites and other long term records, the WIO data allows prediction of local warming trends, and will enable MPA personnel and scientists to be better prepared for bleaching events.

Further information from CORDIO (cordio@cordio.info).

Socio-economic monitoring

G6

Few MPAs 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, socio-economic monitoring is essential to demonstrate the value of an MPA and provide information for management. This sheet outlines the main principles involved.

Most MPAs in the WIO have objectives that relate to social, cultural and economic issues, particularly in terms of improving livelihoods of local communities and providing economic benefits nationally. Without a socio-economic monitoring programme, it is difficult to demonstrate whether these objectives are being achieved. Socio-economic monitoring also provides information that:

- helps managers understand how people interact with the MPA 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).

Socio-economic monitoring should be carried out in parallel with ecological monitoring because of the close links between the environment and its users. For example, monitoring of fish populations underwater should be linked to fishery data collection, as this will help determine the causes of changes in catch size or composition.

SOCIO-ECONOMIC INDICATORS

Finding reliable and realistic indicators for socio-economic issues is difficult. First, the main 'parameters', or areas of interest, must be identified. The ten most commonly used are as follows (Bunce *et al*., 2003). Note that not all of these are relevant to every MPA, and they should be carefully selected to reflect MPA 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, use rights.

Stakeholder characteristics - e.g. household characteristics (such as age, gender, education level, religion, literacy, food consumption, incomes).

Gender issues.

Stakeholder perceptions - e.g. perceptions and level of understanding of MPA 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.

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 habitat.

The parameters allow the selection of indicators. For example, 'stakeholder characteristics' is likely to be relevant to many MPAs, 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 MPAs 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, numbers of fishers and traders. 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).

J. Rubens

Designing a socio-economic monitoring programme requires a good understanding of the local use of the area, thus consultation and discussion are essential.

DESIGNING A PROGRAMME

As with all monitoring programmes, clear objectives are needed, 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; MPA 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 socio-economic 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.

KEY POINTS FOR THE MPA

- ❑ **Obtain expert advice when developing a socio-economic 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 MPA.**
- ❑ **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.**
- ❑ **Where possible, use stakeholders, including local communities and local and national government representatives, in data collection activities.**

Sources of further information

Bunce, L. & Pomeroy, B. 2003. *Socioeconomic Monitoring Guidelines for Coastal Managers in South-east Asia: SOCMON SEA*. GCRMN and IUCN/WCPA, NOAA, Washington D.C. 82pp. **http://ipo.nos.noaa.gov/coralgrantsdocs/SocMonSEAsia.doc**

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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**

National social science strategy for MPAs in the USA: **www.mpa.gov** – details priorities for social science research in relation to planning, management and evaluation of MPAs.

CASE STUDY

Socio-economic monitoring in Tanzania and Kenya

CORDIO's Socio-Economic Monitoring Project (SEMP) started in 2001 with funding from the Finnish Foreign Ministry, and aims to develop indicators and a method for monitoring socio-economic aspects of marine resource management at community and local government levels. Although not developed specifically for use in MPAs, three of the four pilot sites are MPAs or marine management areas: Diani (a National Marine Reserve but never implemented because of opposition from stakeholders) in Kenya, and Mnazi Bay-Ruvuma Estuary Marine Park (a multiple-use MPA) and Tanga Region (six collaborative fishery management programmes), both in Tanzania.

Parameters and indicators were selected to ensure that costs were within the expected budgets, that the monitoring would not take up too much time for MPA staff or community members, and that data would be easy to collect. The indicators had to have been tested elsewhere, so that their usefulness was known. The following three were selected:

Resource use patterns - to determine trends in pressure on coastal resources; the indicators are how, where and when resources are used.

Livelihood strategies - to determine dependence on coastal resources; the indicators are the % of households involved in each activity.

Attitudes and relations - to provide information for management interventions, predict future problems and identify zoning needs; the indicators are conflicts and relations among user groups.

Monitoring teams, comprising community members and local government staff, were trained by technical advisors to conduct interviews and focus group sessions, and to manage data collection. Training notes and guide sheets are provided so that in the long term external technical assistance will not be necessary, although this should be accessible if needed. The frequency of data collection varies with the indicator, from 3-5 years (livelihood strategies) to seasonal (resource use patterns and conflict analysis) and remains constant unless an event occurs that accelerates change (e.g. a natural disaster or a major development, such as hotel construction). The data will be stored in a database and analy-sed at CORDIO, but sites are expected to develop their own capacity for this. Computer skills are lacking at the sites but if long-term technical support can be made available by government agencies or NGOs, this gap could be filled.

Although termed monitoring, the pilot phase is a baseline assessment for each site. The initial results have provided data on the numbers of households dependent on fishing, fish selling, glass-bottom boat and other tourism activities, and thus an indication of marine resource dependence. In Diani, for example, some villages depend significantly more on marine activities than others. Very few households have family members employed in tourism although this is the biggest single industry. While these patterns were generally known before, the assessment gives up-to-date quantified data that will help determine appropriate management interventions.

Fisheries monitoring

G7

Monitoring of fisheries in and adjacent to an MPA is essential to determine the impact of fishing on the biodiversity within the MPA, and also 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 MPA. 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 MPA is thus essential to:

- determine the extent to which fishing is having an impact on stocks (or populations), species, and biodiversity within the MPA;
- detect changes (trends) in the fishery and their causes;
- estimate the contribution of fish to food security and the economy, and how the MPA 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 MPA should be undertaken. This identifies the number and types of vessels, gears, fishers (including migratory fishers and their seaonal 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 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, but if both CPUE data and independent survey data on fishery populations (see Sheet G3) are used, it should be possible to assess the impacts of the MPA on a fishery.

To determine whether an MPA 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 MPA), and the number of people using MPA 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 dug-out canoes are grouped with larger sailing 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

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Fisheries monitoring can benefit from the involvement of local fishers, shown here weighing fish catches.

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 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 MPA may be landed some distance away and since fishing outside the MPA 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 MPA.

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):

- on-board 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 MPA 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, gears 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 MPA

- ❑ **In developing a fishery monitoring programme, ensure adequate training of those involved, aim to cover as many exploited species as possible, but set the priorities according to the MPA objectives.**
- ❑ **Use local fishers to help collect data where appropriate; examples include Kiunga (Kenya), Tanga (Tanzania), and projects underway through CORDIO and CRCP.**
- ❑ **Establish a good relationship with the local Fisheries Department and involve it and local communities in designing and implementing the programme.**
- ❑ **If the MPA is closed to fishing (see sheet I1), information on the adjacent fisheries may still be important; access to this will require cooperation with the relevant organisations.**

Sources of further information

FAO 2002. *Sample-Based Fishery Surveys - A Technical Handbook.* FAO Fisheries Tech. Paper 425, Rome.

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FAO Fisheries Website **http://www.fao.org/fi**

FAO Document Repository **http://www.fao.org/DOCREP**

FAO International Standard Statistical Classifications: Aquatic Animals and Plants (ISSCAAP); Fishing Gears (ISSCFG); Fishery Vessels (ISSCFV)

Information management

G8

Large quantities of data are generated in an MPA, 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 MPA provide a vital source of information by which the effectiveness of the MPA can be assessed and the best management decisions taken. 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. 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 easy to set up and view and analysis is easy on a one-off basis, but the regular analysis and reporting required in most MPAs 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 Oracle, 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 MPA over a 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 following procedures are involved in management of electronic data:

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 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.

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 or harmonised with international or regional databases, such as COREMO II and III (developed by the Indian Ocean Commission), CORDIO, the WIO Fisheries

Database (developed with assistance from IUCN), ReefBase and FishBase). CORDIO has developed databases for coral reef, fisheries catch and socio-economic 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.

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 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 6 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 re-writeable) and stored in a central office, with the original raw datasheets and the print out 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 MPA

- ❑ **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 needed are put into the budget for the MPA.**
- ❑ **Ensure that information on visitor numbers, ticket revenues, sightings of rare or endemic species, and other management or occasional events is collected and stored, as well as 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.**

Sources of further information

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Wilkinson, C., *et al*. 2003. *Monitoring Coral Reef Marine Protected Areas: a practical guide on how monitoring can support effective management of MPAs.* Australian Institute of Marine Sciences and IUCN, Switzerland. 68pp.

Reefbase: **www.reefbase.org**

Fishbase: **www.fishbase.org**

WIO Fisheries Database **www.wiofish.org**

CORDIO **www.cordio.org**

Assessing management success

G9

Managers need to know how successful or 'effective' their MPA 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 to 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 MPA's 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 MPAs, and helps when setting priorities and developing funding proposals.

Where assessments have been undertaken, managers have gained valuable insights into what works well, as well as any shortcomings. The Convention on Biological Diversity has recommended that countries should assess management effectiveness of at least 30% of their protected areas by the year 2010.

GENERAL PRINCIPLES

IUCN/WCPA has developed a 'framework methodology' comprising six components (see diagram) relating to the three key elements of the protected area management cycle. The key elements are:
Design: What is the *context* in which the MPA 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:

- The aim is to improve management and generate positive change, not compete with other MPAs;
- 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, socio-economic, 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 MPA's monitoring and reporting system (see sheet C3), thus developing an adaptive management approach.

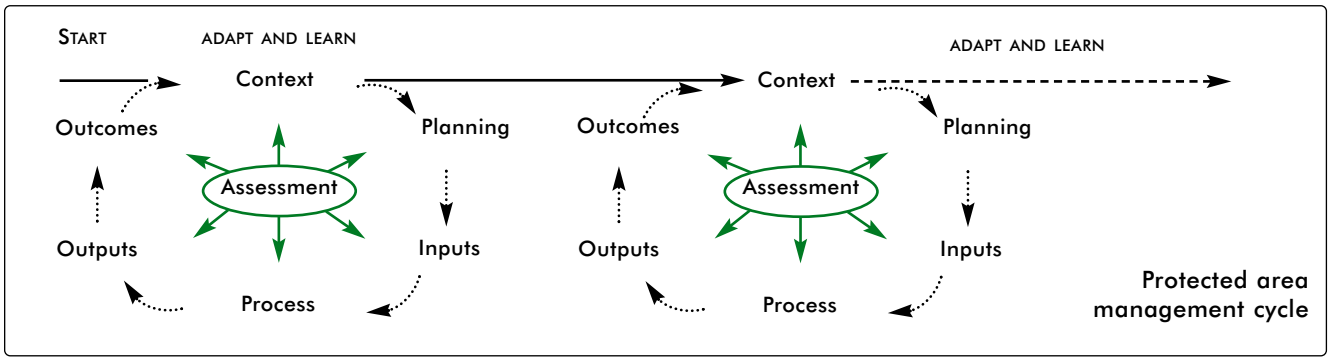
ASSESSMENT METHODS

There are several methods and common steps include:

- Developing a plan for the assessment;
- Analysing the biophysical and socio-economic 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, socio-economic 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.

The first assessment of an MPA 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 following methods 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 MPAs (Pomeroy *et*



al., 2004). This has been piloted at 17 sites worldwide, including Mafia Island Marine Park. For this method, the MPA 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, including Aldabra (see case study) and St Lucia (South Africa). 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 MPAs in the WIO, and piloted in eight sites. A small 'implementation team', comprising MPA 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 MPAs, this provides a simpler method, focusing on the Process component of the management cycle. If repeated at intervals, it will help to track progress. The scorecard is completed by MPA staff, and makes use of immediately available information and staff knowledge, and should take a maximum of half a day to complete.

KEY POINTS FOR THE MPA

- ❑ **Carry out an assessment of management effectiveness; if financial and human capacity is limited, one of the simple methods can be tried.**
- ❑ **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.**

Sources of further information

(see also sheet G1)

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TNC 2000. *The Five-S Framework for Site Conservation: a practitioners handbook for site conservation planning and measuring conservation success*. TNC, Arlington, Virginia. **http://nature.org/summit/files/five_s_eng.pdf**

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**

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 relating 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 prioritized 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 of the 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.

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 MPA 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 MPA.

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 MPAs (see sheet G10), 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 for evaluations and reviews, but may request assistance in preparing these, 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 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 were neither clear nor measurable and if there were 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 experiences 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 stakeholders.

Preferably a participatory approach is used, with widespread consultation among partners, stakeholders and project beneficiaries. 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 MPA

- ❑ **Ensure that all MPA 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 MPA.**
- ❑ **Try and encourage MPA 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 MPA management in general.**

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.

UNDP/GEF *Information Kit on Monitoring and Evaluation:* **www.undp.org**

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 evaluations of a coastal management programme in Tanzania

Since it started in 1994, the Tanga Coastal Zone Conservation and Development Programme (funded by Development Cooperation Ireland and with technical assistance from IUCN) has had to adapt to many changes, including the Local Government Reform Programme (LGRP) which decentralised decision making powers from the Region to Districts. An adaptive management approach was therefore adopted, which required a good understanding of the impacts of the Programme itself and of the political, social and economic context.

Much of the information required to support planning and decision-making came from the mid-term reviews and final evaluations undertaken during each of the three phases of the Programme. These were not only invaluable in guiding planning and improving management, but were also extremely useful in generating shared understanding amongst the Programme partners, motivating stakeholder groups and enhancing public and political support.

Examples of information and recommendations generated include:

Achievements - Confirmation that the Programme had helped to change the behaviour of key stakeholders, which in turn contributed to positive impacts on the environment (e.g. improved coral cover).

Strengths and weaknesses - Observations that while the Programme was successfully increasing support and capacity for collaborative coastal management, efforts to introduce alternative income generating activities were not so successful. It was thus recommended that the Programme should focus on fisheries issues.

Relevance - Given decentralisation, the evaluations recommended increased capacity building at District level, reaffirmed that the approach of participatory management and involvement of stakeholders was appropriate, and recommended greater focus on developing mechanisms to ensure long term sustainability.

The Programme also learnt crucial lessons about conducting evaluations efficiently so that they generate useful and accurate information. For example:

- Sufficient resources (people, time, money) must be available, to guarantee the quality and usefulness of the final product;
- TOR need to be clear and comprehensive;
- The evaluation team should have good technical knowledge of the programme area as well as good evaluation skills;
- The team must be given time to understand a programme and develop their methodology with the evaluation managers before the evaluation starts;
- All partners must understand their roles and responsibilities in an evaluation.

Appropriate research, on both biological and socio-economic issues, is essential for long-term effective management of an MPA, and many MPAs in the region have the promotion of science or research as one of their objectives. This sheet provides guidance on how an MPA 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 MPAs typically involve collaboration between managers, staff and scientists at all stages: formulating management policy and interventions; designing the MPA; 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 MPA 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 MPA may well be a potentially attractive 'field laboratory' for scientific or other research. Having research teams, including PhD students, in the MPA can put it on the scientific map, bring publicity, expose MPA staff to wider experience and knowledge and bring in modest amounts of income to support running costs.

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 MPA at no cost. Scientists are also often willing to help train MPA 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 MPA

Some MPA 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. Some MPAs (for example Aldabra Special Reserve in Seychelles) have a formal scientific Advisory Board that meets on a regular basis to review research underway in or needed by the MPA and to set research priorities.

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 afield. A correlation has been found between the presence of at least basic research facilities and the amount of research done in a protected area. The MPA 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.

The MPA 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 MPA. This will help to avoid duplication of studies, will ensure that new research builds on the results of previous research, and will help to ensure that the results of research are fed into the MPA decision-making, planning and management process. The managers will need to understand the limitations of the research results and this can be achieved through regular discussions and feedback sessions with the scientists.

M. Samoilys

Village monitoring team in Tanga, Tanzania, preparing to conduct coral monitoring on shallow reefs.

KEY POINTS FOR THE MPA

- 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 MPA personnel and the external agencies.
- If funding is available, appoint a Research or Science Officer to the MPA 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 MPA.
- Develop a code of conduct for researchers so that they fully understand how they are expected to behave in an MPA and what the regulations are.
- Ensure that visiting researchers and students work closely with the MPA 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 MPA 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 MPA, preferably stored electronically and perhaps made available on the MPA's website (if it has one) and establish a library to host information relevant to the MPA.
- 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

GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). 1996. *The contributions of science to coastal zone management*. Reports and Studies GESAMP 61, FAO, Rome, Italy. 66pp.

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Thorsell, J.W. 1992. Guidelines for managing research in protected areas. p. 175-180. *In*: Willison, J.H.M., *et al.* (eds.) *Science and Management of Protected Areas*. Proc. Int. Conf. on Science and Management of Protected Areas (SAMPA 1). Nova Scotia, Canada. Elsevier.

CASE STUDY

Inhaca Marine Biological Station and Ilhas Inhaca e dos Portugueses Faunal Reserve

Few MPAs in the WIO have as close a relationship with research as the Ilhas Inhaca e dos Portugueses Faunal Reserve. It was established in 1965 and has a long history of research through the biological station that was set up on the island in 1951. This protected area, comprising several separate components (mangrove, coral reef, coastal forest), is managed by the Faculty of Sciences of the Universidade Eduardo Mondlane, through the Marine Biological Station. Diving is allowed in the marine part of the Reserve but no fishing or aquatic sports. The Director of the Biological Station is the manager of the protected area, the station staff are responsible for day-to-day management of the Reserve, and the University employs 12 guards. Management activities include patrolling the turtle nesting beaches (Loggerheads and Leatherbacks), monitoring the nests and erasing the tracks made by the nesting females.

The station comprises laboratories, a museum for visitors and scientists and accommodation, and receives numerous national and international students who undertake field courses there, as well as many scientists. Research activities within the coral reef component of the Reserve have increased dramatically since 2000, producing much relevant information for management, and including the establishment of two permanent coral reef monitoring stations.

The advantage of such close links with the academic community is that it results in much more consistent research. The area includes some of the best studied reefs in Mozambique with records going back to 1935, and some of the most comprehenisve taxonomic studies have been carried out here. Much of this work will be used in development of the management plan that is to be undertaken shortly. However, it can mean that the protected areas is overlooked in government initiatives to support MPAs, which in recent years has tended to happen at Inhaca, although the government will now be assisting with the preparation of a management plan. The research staff also lack experience in some aspects of management, notably in terms of participatory approaches, and understanding of some of the key socio-economic issues such as the need to provide alternative livelihoods for those who can no longer use the Reserve area. This led to considerable conflict with local people which is now being addressed, as scientists and managers (in this case the government protected area agency) increasingly understand the importance of working together.

Threatened marine species

H1

Biodiversity protection is a primary objective of MPAs 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. MPAs 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 WIO region is still poor, but there are at least 11,000 macrofaunal species (creatures larger than 1-2 mm) of which 10-20% are endemic (i.e. do not occur anywhere else). Little is known about specific centres of endemism within the region, although one example is the area along southern Mozambique and the coast of KwaZulu Natal in South Africa which has several unique coral and fish species.

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 this time (see sheets H2, H3, 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 programme Reefcheck 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 overfishing; they have been fished out of most shallow reefs worldwide. Spiny lobsters have also declined dramatically on coral reefs all over the world. The Coconut crab now occurs only on small islands and generally only in protected areas (e.g. Misali, Chumbe, Aldabra and Mafia).

THE IUCN RED LIST

Every year, IUCN publishes the global Red List of threatened species on-line. Species are classified into the following eight categories 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. WIO examples are Coelacanth, Southern Bluefin tuna, Hawksbill and Leatherback turtles.

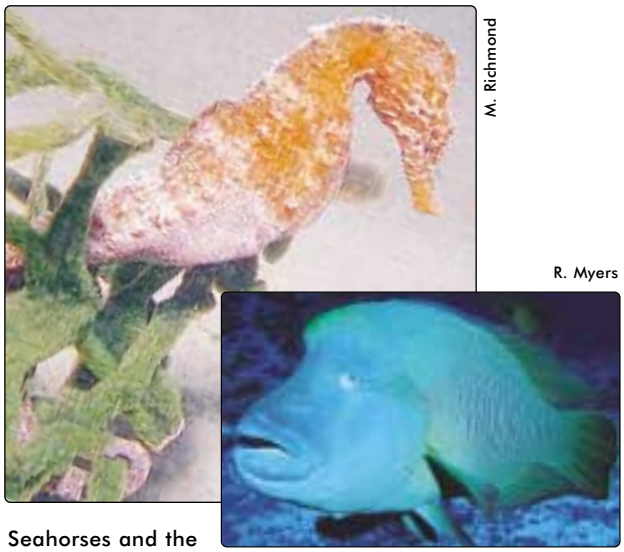
Endangered (EN) - A taxon that is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future as defined by the criteria. WIO examples are Loggerhead, Green and Olive Ridley turtles, several species of saw fish and the Blue whale.

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. WIO examples are dugong, Humphead wrasse, Whale shark, Humpback whale, several shark species including Grey Nurse shark and Great White shark.

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. WIO examples include many shark and whale species.

Data Deficient (DD) - A taxon for which there is insufficient recent information for assessing threat or a lot of uncertainty about data for widespread but declining species. WIO 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.



M. Richmond

R. Myers

Seahorses and the Humpheaded wrasse are threatened in parts of the WIO.

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 are being added to the Red List including swordfish, sawfish, all tuna species except Yellowfin and Skipjack, sharks (38 in the WIO), groupers, seahorses, manta rays and the coelacanth. Very few marine invertebrates are on the IUCN Red List, with the exception of six species of Giant clam. This dearth of information and general lack of awareness of the vulnerability of many marine species has been taken up by a campaign called 'Shatter the Myth', headed by IUCN's Species Survival Commision.

The Red List is used to help establish conservation priorities at 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).

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.

Marine species on the 2003 IUCN Red List

	Global	WIO
Whales, dolphins	65	29
Marine otters	7	0
Seals	4	0
Manatees/dugong	4	1
Seabirds	155	17*
Marine turtles	7	5
Marine fish	375	105
Molluscs	93	7
Coelenterates (corals, sea fans, anemones)	3	0

* known to be an underestimate

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Shatter the Myth: **www.iucn.org/themes/ssc**

S. Wells

The Coconut crab (*Birgus latro*) is rare in the Pacific and Asia and survives in the WIO on remote islands.

KEY POINTS FOR THE MPA

- **It is essential to know whether there are any nationally or globally threatened species within the MPA, so check species lists against the Red List and any national lists that exist.**
- **All threatened species in an MPA should be monitored; manuals on specific methods are available and regional/global monitoring programmes have been developed for many species; MPA staff should find out about these and participate.**
- **Some species may need special techniques for their study and management, and in this case, outside appropriate expertise should be obtained if possible, and MPA personnel should receive relevant training.**
- **There are often global or regional networks and working groups on threatened species, and MPA staff should check their websites, subscribe to newsletters and email groups, and participate in monitoring programmes.**
- **Protection of breeding and nesting sites of threatened species (e.g. turtles and certain seabirds) that occur within an MPA 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.**

Marine turtles H2

Many MPAs 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 occur in the WIO. 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 I of CITES which means that international trade in live specimens or their products, such as carapaces and oil, is prohibited.

J. Rubens

Green turtle released from fishing nets on Zanzibar.

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.

The major threats to marine turtles in the WIO 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, shell, oil, and other products (traditional medicines, cooking fat);
- Disturbance of nesting turtles by beach lighting, boats and water-sports offshore, dogs, other predators and people on the beach;
- Incidental capture and drowning in shrimp trawls, gill-nets and other fishing gears.

KEY POINTS FOR THE MPA

- ❑ **Identify turtle species, nesting beaches, feeding areas, and seasons involved, within the MPA.**
- ❑ **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).**
- ❑ **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 MPA 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 (there are plans to standardise tag numbering in the WIO region). 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 gill-nets where these result in accidental capture of turtles.**
- ❑ **Raise awareness about turtles in MPA 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 adult.**
- ❑ **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).

Two regional agreements require parties to carry out conservation and management actions for turtles:

Nairobi Convention 1985 - All five species are listed as 'protected migratory species' in the Protocol on Protected Areas and Wild Flora and Fauna in the Eastern Africa Region. Olive Ridley, Loggerhead and Leatherback are classified as species of wild fauna requiring special protection. The Green and Hawksbill are classified as harvestable species of wild fauna requiring protection and states are required to produce management plans for their exploitation, although none have yet done so.

Convention on the Conservation of Migratory Species of Wild Animals (CMS) - This includes a regional agreement (Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and S E Asia (IOSEA)) which has been signed by Comores, Kenya, Madagascar, Mauritius, Seychelles, and Tanzania.

Most countries in the WIO now have national legislation protecting turtles. MPAs play a vitally important role as they include many of the key nesting beaches and feeding areas, although not all.

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IUCN/SSC Marine Turtle Specialist Group: **http://www.iucn-mtsg.org** WIO Regional Contact points are Jeanne Mortimer **jmort@nersp.nerdc.ufl.edu**; and George Hughes **ghughes@kznncs.org.za**

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): **http://www.coral.org**

Wider Caribbean Sea Turtle Conservation Network (WIDECAST): **http://www.widecast.org**

Indian Ocean – South-East Asian Marine Turtle Memorandum of Understanding (IOSEA MoU): **http://www.ioseaturtles.org/**

Mozambique Marine Turtle Working Group: **marineturtlemz@hotmail.com**

Watamu Turtle Watch, PO Box 125, Watamu, Kenya: **wtwkenya@swiftmalindi.com,**

KESCOM (Kenya Sea Turtle Conservation Committee): **kescoms@yahoo.com**

CASE STUDY

Mafia Island Marine Turtle Conservation Programme, Tanzania

A community-based turtle conservation programme was initiated on Mafia Island, Tanzania in collaboration with Mafia Island Marine Park, Mafia District Council and local communities in January 2001. Threats to turtles on Mafia included poaching of eggs and nesting females, capture in gill-nets and fence traps, disturbance from seasonal fisher camps, predation by monitor lizards and beach erosion.

The main nesting sites and foraging grounds were identified through interviews and site visits. Locally chosen turtle monitors were recruited and trained to patrol the main nesting beaches, relocate nests when necessary and assist with data collection and tagging. In order to encourage greater community participation in the programme a nest protection incentive scheme was initiated in January 2002, whereby individuals who report a nest receive US$3.0. They help to protect the nest during the two month incubation period and are then awarded US$0.40 per live hatchling and US$ 0.20 per rotten egg. Over the past three years, the number of nests that have hatched successfully has increased from 25% to 85% and the number of nests poached has declined from 49% to 1%. This has been due in part to the incentive scheme but also to awareness raising activities which have included village and fisher meetings, establishment of Environment Clubs and schools' projects.

Seabirds and shorebirds

H3

Many MPAs in the WIO protect important populations of both seabirds and shorebirds, but their management is often overlooked. Birdwatchers frequently visit MPAs and they may become regular visitors and be willing to help with monitoring. This sheet provides some background information on birds relevant to MPA 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. A total of 23 species of seabird breed on the WIO islands, and an additional number (such as jackass penguins and cormorants) are known also from the mainland coast of eastern and south-eastern Africa.

SHOREBIRDS

A second group of birds that are important in MPAs are coastal resident or migratory waterbirds and waders. These species include herons, egrets, storks, ibises, spoonbills, flamingos, plovers and the larger waders. They tend to congregate in estuaries, creeks, salt pans, mangroves and beaches, particularly along the mainland coast as these provide good feeding grounds. Some species use these areas as wintering grounds; for others, they are essential stopovers on journeys from the northern tundra to the southern Cape, but there is very little information on their migratory patterns.

THREATS

The main threat to both resident and migrant birds in the WIO is habitat degradation. Other threats are disturbance by fishers and tourists, egg collecting, and predators such as rats, cats, dogs and potentially oil spills. 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. The Roseate tern however is of particular concern in the WIO as populations have undergone major declines.

Some of the large nesting seabird colonies and key roosting and feeding sites for coastal migrants lie within MPAs. For example, the Seychelles has a particularly large number of important breeding sites which are now protected e.g. Aldabra, Cousin Island, and Aride. Another mechanism for the protection of bird populations is through the designation of Ramsar sites under the Convention on Wetlands (Ramsar). 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, and several of these are included either within or overlap with MPAs. The following occur in the WIO:

Country	Important Bird Areas
Comores	None
French Territories	Baie de Boueni (Mayotte), Ile du Lys (Glorieuses Archipelago), Juan de Nova, Tromelin, Europa, (none on La Réunion).
Kenya	Kiunga, Tana River Delta, Sabaki River Mouth, Mida Creek/Whale Island/Malindi-Watamu area, Kisite Island and Diani.
Madagascar	ca. 20 IBAs around the coast, with the majority on the west. The following IBAs are also protected areas: Nosy Be and satellite islands, Cape Sainte Marie Special Reserve, Mananara-Nord National Park and Masoala National Park.
Mauritius	Rodrigues Islets, Cargados Carajos Shoals, Round Island and Serpent Island.
Mozambique	Maputo Reserve, Bazaruto, Pomene, Zambezi Delta, Moebase Region.
Seychelles	Aride Island, Cousin Island, Bird Island, Cousine Island, Fregate Island, African Banks, Etoile Island, Boudeuse Island, Marie-Louise Island, Desnoeufs Island, Islets of Farquhar Atoll, Cosmoledo Atoll and Aldabra Atoll.
South Africa (north-east coast only)	Kosi Bay system, Richards Bay Game Reserve.
Tanzania	Tanga North, Tanga South, Dar es Salaam Coast, Rufiji Delta, Mafia Island, Mnazi Bay, Pemba Island, Zanzibar South Coast, Zanzibar East Coast, Latham Island.

KEY POINTS FOR THE MPA

- Determine if the MPA has important bird populations and is an IBA; if so, ensure management plans and MPA operations address their protection.
- Establish a monitoring programme, documenting: populations of the most important birds; when and which part of the MPA 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.
- Protect nesting, roosting and if possible feeding sites, noting that breeding seasons of many sea birds do not follow a 12-month cycle. The most important feeding zones may be difficult to determine if outside the MPA. 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 MPA 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.

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Convention on Wetlands: **www.ramsar.org**

CASE STUDY

Seabird monitoring in the Seychelles

The Seychelles are internationally recognised as a key area for seabirds both in terms of sheer numbers and diversity with 18 species breeding in the islands, and many globally important colonies occuring in protected areas, notably Aldabra, Aride and Cousin Special Reserves. In some MPAs, seabirds form the focus of ecotourism activities, but also suffer from poaching. For such visible birds surprisingly little is known about population sizes, breeding success and longevity.

Methods to monitor seabird populations and to increase information about them have been developed by the national NGO Nature Seychelles, with funding from the Dutch government. The methods were tested in Cousin Island Special Reserve and other MPAs, and discussed in a number of workshops involving experts and practitioners working on seabird protection and management in the Seychelles. As a result, a Seabird Monitoring Handbook for Seychelles has been published, detailing practical methods for monitoring seabirds by personnel such as Wardens and Rangers, and describing the national seabird database.

Workshops have been held with the owners and managers of important seabird sites in Seychelles, including several MPAs, to encourage them to start using the methods. A Seychelles Seabird Group (SSG) was also set up to facilitate management of seabird populations by setting priorities, providing training, coordinating monitoring activities and using the information to direct future research and/or management. The SSG publishes a newsletter twice a year, and is developing a strategy that promotes long-term monitoring in order to detect slow changes in numbers of long-lived species.

Coordination of the SSG is funded by Nature Seychelles, with support from Airtel Telecom and the Seychelles Environment Trust Fund, whilst individual islands and MPAs cover their own expenses. After two years of use, the Seabird Handbook needed to be updated and a new version was published in 2003 with funding from WIOMSA and the US government.

M. Richmond

Pink-backed pelicans (*Pelicanus rufescens*) and Long-tailed cormorants (*Phalacrocorax africanus*) roosting on rocks in the Ilhas da Inhaca e dos Portugueses Faunal Reserve.

Marine mammals H4

The WIO has a diverse marine mammal population and several species are found in or migrate through MPAs. Few of the existing MPAs undertake specific management of marine mammals, apart from the dugong, but dolphins and whales are increasingly becoming tourist attractions, and in some cases are providing important revenue for the MPA. This sheet outlines some of the management issues that need to be considered for these species.

About 34 species of marine mammals (whales, dolphins and the dugong) inhabit the WIO. Several species are on the IUCN Red List, 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 are fishing-net entanglement, chemical pollution and noise pollution.

Dugong

These were once common in many WIO countries. Although they are listed globally as 'Vulnerable', their status in the WIO is almost certainly 'Endangered' and they are probably one of, if not the most, threatened large mammal in Africa. Dugongs are particularly at risk from fishing, as their meat is highly valued, and from loss of seagrass beds, their main feeding habitat. Several remaining key locations are the focus of projects either to strengthen MPAs (Kiunga Marine Reserve in Kenya, Mafia Marine Park in Tanzania, Bazaruto National Park in Mozambique, Moheli Marine Park in Comores and Aldabra World Heritage Site in Seychelles), or to create new ones (e.g. Mnazi Bay-Ruvuma Estuary Marine Park in Tanzania).

J. Rubens

Dugong drowned in gill-net off Rufiji Delta near the Mafia Island Marine Park, Tanzania (2004).

DOLPHINS

Dolphins are often fished for bait for shark fishing and for their meat, but there is little information on their status. Dolphin watching is a popular tourist attraction, for example in some MPAs, including Zanzibar (Menai Bay), Kenya (Watamu and Shimoni) and South Africa.

KEY POINTS FOR THE MPA

- ❑ **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 MPA 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 these. 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 MPA, ensure that information is made available to visitors, local communities and key government officials about the status of, threats and biology of the particular marine mammals. Obtain information on relevant marine mammal conservation programmes elsewhere and partner up with relevant agencies.**
- ❑ **Dugong - Raise awareness amongst 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.**

WHALES

These are seen in the WIO particularly when they are on migration. Humpback whales are regularly sighted between July and November as they migrate south through the Mozambique Channel and along the east coast of Madagascar, to their Antarctic feeding grounds. They are also seen on their return once the southern winter sets in. Sperm whales are seen in Seychelles in July-September, and are sometimes stranded on the northern Kenyan Coast. Whale populations were originally reduced drastically through whaling. This has now ceased in the WIO, as a large part (to 40 degrees South) is included within the Indian Ocean Whale Sanctuary which protects whales from exploitation. Carcasses of whales that die at sea are occasionally washed up on beaches, and sometimes groups or individual whales appear to beach themselves deliberately. Whale-watching is a commercially important activity in many countries, including in some MPAs.

CASE STUDY

Protection of the dugong in Bazaruto Archipelago National Park, Mozambique

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 bed 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. Gill-nets 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 go 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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The following sites have information on strandings, responsible whale watching and other marine mammal conservation issues:

Great Barrier Reef Marine Park publications on marine mammals: **www.gbrmpa.gov.au/corp_site/key_issues/tourism/whale_dolphin_watching.html**

Indian and South Atlantic Consortium on Humpback Whales (ISACH): **http://www.isach.org**

International Fund for Animal Welfare: **http://www.ifaw.org**

International Whaling Commission (IWC): **http://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 **http://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: **http://www.wdcs.org**

Biodiversity & ecosystem health

H5

Most MPAs 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 apart. 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 2000 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. Many MPAs in the WIO are thus located in areas of high biodiversity.

SPECIES

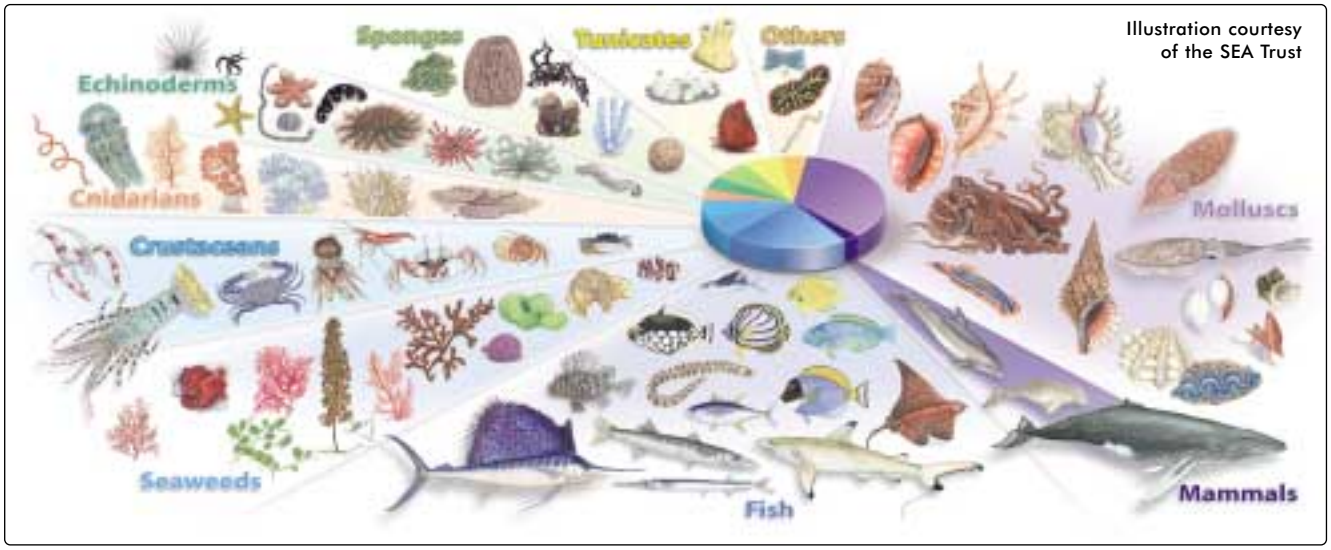
A species is the fundamental unit of biological organisation. Individuals in the same species are genetically similar, look the same, and normally reproduce viably only with each other. The ocean has fewer species than does the land, with about 250,000 known marine species compared with 1.5 million terrestrial 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. In the WIO, 28 phyla are marine (11 exclusively so), and of the larger creatures, over 1mm in size, there are estimated to be at least 11,000 species.

Two coral reef areas of the WIO are considered globally significant (or 'hotspots') because of their species richness and endemism – the Southern Mascarenes (Mauritius, Réunion and Rodrigues), and waters and shores off eastern South Africa. Marine waters of the WIO in general have high species diversity, typical of tropical regions.

ECOSYSTEMS

Ecosystems are communities of organisms, together with their habitats, that can be defined by certain features and characteristics, and that function as an integrated unit. Ecosystems comprise 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 whole systems. At larger scales, an area comprising linked mangroves, seagrass beds and coral reefs could also be considered an 'ecosystem' as each component is integrated through ecological processes (e.g. fish movement, nutrient exchange) taking place between them.

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.



Biodiversity pie-chart, showing approximate proportions of the larger, shallow-water, marine life in the WIO.

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.

The main coastal and marine habitats and ecosystems in the WIO 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. Coral reefs tend to attract most attention, but all ecosystems in an MPA must be managed, including the less appealing ones such as muddy bays!

ECOREGIONS

An ecoregion is a biogeographic unit of land and/or water that includes a range of ecosystems, is relatively large, but can be characterised by distinct features. The WIO includes two ecoregions as defined by WWF: the East African Marine Ecoregion (EAME) along the mainland coast, and and the Western Indian Ocean Marine Ecoregion (WIOMER) including the islands. A biome is an even larger ecological unit, generally defined by climatic regime; the ocean is often considered a single biome.

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.

KEY POINTS FOR THE MPA

- ❑ **Carry out baseline assessments of all the main species and ecosystems of an MPA 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).**
- ❑ **Promote the concepts of biodiversity health and ecosystem integrity using simple, clear language and minimal jargon.**
- ❑ **Understand the ecological linkages with other MPAs, including in adjacent countries, and encourage the management of MPAs as a 'system'.**

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Coral reef rehabilitation H6

Coral reef rehabilitation can be an expensive and labour-intensive activity, but there are occasions when it may be warranted in an MPA. This sheet provides general guidance on when it is appropriate, and on some of the methods that can be used.

Active rehabilitation can be used to aid recovery of damaged reefs by enhancing natural processes but is a controversial issue for three main reasons. Firstly, it can be expensive unless volunteer labour is available. Secondly, the activity may cause damage if coral colonies or fragments for transplantation are taken from healthy reefs, and finally, it has not yet proved effective on a large scale. Most attempts have been in areas of <100 m2, and have been experimental with little overall impact. Where rehabilitation is deemed necessary, the four approaches described below should be considered.

REMOVING NEGATIVE IMPACTS

This should always be the first priority, as it will encourage natural recovery. Many of the other theme sheets will help with this. More active techniques for reducing stresses include removing 'pest' or predatory species, such as sea urchins or crown of thorns starfish (see sheet H8).

INCREASING SUBSTRATE FOR SETTLEMENT

On a damaged 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:

Introducing artificial surfaces for larval settlement - concrete blocks, wrecks or other purpose-designed structures. Such artificial reefs may have an additional benefit for fisheries management (see sheet J8) but the cost may be prohibitive for large areas.

Encouraging natural surfaces - This can be done by 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. Certain substrates, e.g. *Goniastrea* skeletons, appear to induce settlement and larval metamorphosis. This approach should only be taken if expert scientific advice is available.

Creating new surfaces through electrolysis - This technique is not recommended, but has been tested in some WIO countries. Electrical currents are passed through a conductive material, such as chicken wire, causing calcium and magnesium minerals to precipitate from seawater to form a limestone framework. This requires considerable financial and human investment, and a source of permanent electrical current while the structure is being built. The long-term impact of the electrical current on marine life is not known.

TRANSPLANTING CORALS

Coral fragments or colonies can be removed from a 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). Many species survive transplantation provided environmental factors are favourable, but it is expensive in terms of labour, unless volunteers can be used. Also transplanted fragments are highly vulnerable to dislodgement by waves and human disturbance, and are easily buried or smothered. The source of corals for transplantation must be chosen with care, to avoid damage to other reefs (preferably choose reefs that are likely to be lost from dredging or land reclamation). Transplantation has been carried out at several MPAs in Kenya (see case study) and Tanzania (Mafia Marine Park, Dar es Salaam Marine Reserves and at several sites in Zanzibar) with variable success. It is of greatest value in shallow, accessible sites that are important for tourism.

FARMING CORALS

Attempts have been made to farm corals, mainly in SE 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

KEY POINTS FOR THE MPA

Rehabilitation should not be attempted if the damaging impacts are still present, and natural recovery may be a better solution. Managers must evaluate the potential success rates, cost-effectiveness and long-term viability of different methods and:

- **Identify the objectives of rehabilitation (e.g. biodiversity conservation, tourism, fishing, protection from coastal erosion) as these will help to determine methods.**
- **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 cost in relation to available funding.**
- **Identify whether technical expertise and sufficient labour is readily available.**
- **Encourage active participation of those whose livelihoods depend on the reef.**

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. Further investigation is required to reduce costs and increase success rates.

D. Obura

Transplanted colonies of *Porites* onto a larger dead colony in an MPA in Kenya.

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CASE STUDY

Reef rehabilitation initiatives in Kenyan MPAs

The 1998 El Niño-induced bleaching on reefs of Kenya resulted in very high coral mortality in many MPAs. The importance of these sites to tourism and fisheries replenishment provided a strong impetus to find methods that might accelerate reef recovery. With support from CORDIO, a comparison was therefore made between natural recovery processes and transplantation of coral fragments. Sites were selected in shallow reef lagoon areas in Mombasa and Kiunga Marine National Reserves and in Mombasa Marine National Park. All sites had been affected by the bleaching with 80-95% reduction in coral cover.

Small fragments of coral were taken from a source colony (seven species in Mombasa and four in Kiunga) and attached to cleared natural coral rock substrate with epoxy putty (in Mombasa) or to cement (in Kiunga). In Mombasa some transplants were also placed on tiles fixed to elevated racks. Over 100 fragments were transplanted at each site. The size of natural recruits, surviving colonies and transplants was measured every three months for one year in Kiunga and over a two year period in Mombasa. In Kiunga, the transplantation was carried out by fishers, KWS rangers, WWF staff and one scientist. One individual was designated to look after each site and visit it regularly to look for any problems, such as loss of transplants, signs of mortality or predation. In Mombasa the transplantation was carried out by scientists only.

The study found that recovery through recruitment and regrowth of surviving colonies was far greater than through transplantation. The growth rate of natural recruits was twice as fast as that of surviving colonies, while the lowest growth rates were those of the transplanted fragments. Average survivorship of natural corals, both recruits and surviving colonies, was over 80% whereas in transplants it was about 50%, dropping to under 30% after two years.

This study thus did not demonstrate a major value in transplantation, but rather that where natural recruitment is high or even moderate it is better to promote natural recovery. A further advantage of natural recovery is the much higher species diversity: in this study there were 31 genera among the natural recruits, but only nine species were involved in the transplantations.

Coral bleaching H7

Coral bleaching is a particularly difficult issue for an MPA manager as its cause cannot be 'controlled'. This sheet summarises recent information on bleaching and outlines the various ways that an MPA 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°C above normal maximum) appears to be the main stress. Low wind speed may also be important, as this apparently favours localized 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.

High sea surface temperatures (SSTs) 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 3°C for 3-5 months in some places of the WIO. By August 1998, many reefs had experienced some mortality, with up to 100% in some places (e.g. around the Seychelles granitic islands). Recovery has been very variable, but most places now show considerable improvement. To date, the socio-economic impact has not proved to be as serious as feared although potentially bleaching could have long-term impacts on fisheries and tourism.

The Intergovernmental Panel on Climate Change has predicted an increase of 1-2°C in SST over the next 100 years and coral bleaching may become a more regular event.

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.

Corals seem to be more resistant (i.e. colonies do not bleach or do not die if they bleach) if they are near, or affected by: cooler oceanic water and upwellings; strong currents, winds and high wave energy; shallow waters cooled through exposure to air at night; deeper waters less affected by the sun; turbid water which reduces penetration by UV light; cyclone conditions with high cloud cover and mixing of shallow with deep water; points and narrow channels in the reef; and angled away from the sun.

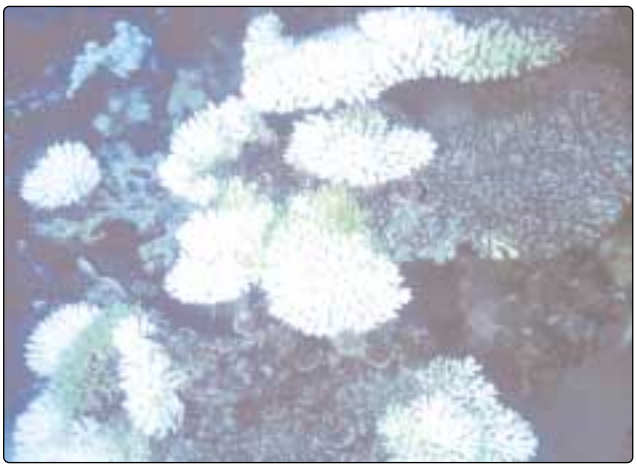
Speed of recovery of a reef from bleaching or its resilience is affected by: connectivity with other reefs through currents; abundance of coral recruits; abundance of species that eat algae and create free substrate for coral larval settlement; and prevalence of bioeroders, corallivores and disease.

MONITORING AND MITIGATION

Even though there is no 'cure' for bleaching, MPAs 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 corals that consistently resist bleaching and resilient reefs that recover quickly. Determining the start of a bleaching event is important but not always easy. Different categories of 'paling' tend to be subjective, but methods are being developed using standard colour charts (e.g. CoralWatch chart – see sources of information) or photographic/computer analysis techniques. Always seek expert advice if it looks as if bleaching may be starting.

KEY POINTS FOR THE MPA

- ❑ **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.**
- ❑ **Install temperature monitors (see sheet G5) and monitor SST web sites that give 'early warning' alerts for bleaching (see sources) – if the MPA falls into one of these areas, increase monitoring activities in order to record the start date of any bleaching event.**
- ❑ **Inform MPA 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).**
- ❑ **If the MPA is affected badly by bleaching, rehabilitation may be necessary (see sheet H6) but seek expert advice first; where bleaching is mild, reefs often recover naturally.**



M. Richmond

Bleached *Acropora* corals off Zanzibar, Tanzania, during the most recent El Niño event, May 1998.

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Reefs at Risk: **www.wri.org/wri/reefsatrisk**

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Information on bleaching in French: **http://www2.univ-reunion.fr/~coraux/blanc/**

CASE STUDY

Rapid response to a bleaching event in Réunion, 2001

Réunion has only about 12 km^2 of reef, all lying within the Parc Marin de La Réunion, and any major bleaching event could have a devastating impact. Fortunately, less than 10% of the coral communities were affected by the 1998 bleaching event, as a result of a cyclone that caused cloudy conditions at the time. However, in February-March 2001, a warm water spot resulted in localised but intense bleaching, although reefs on neighbouring Mauritius were not affected. Data loggers had been installed and these showed that SST was 0.5-1°C higher than the average for that period.

A rapid response monitoring programme was put in place immediately, starting with a survey of 80 sites by scientists from the organisations ARVAM and ECOMAR, and the MPA 'ecoguards', with financial support from the Ministry of Environment (DIREN). This showed that the La Saline lagoon area was most affected, with 50-90% of corals showing some bleaching. Pockets of resistant corals, with 5-10% mortality or less, were rare. A long-term monitoring programme was then set up to study the recovery, with 14 permanent monitoring stations in seven sites and using GCRMN methods.

The bleaching events, as well as two cyclones in early 2002, resulted in high levels of siltation and freshwater input causing further bleaching and mortality. Despite this, overall reef condition has been relatively stable. This demonstrates that natural recovery can occur quickly (in some cases, bleached areas recovered within 4 months) and also the value of a long-term monitoring programme that includes physical parameters. In this case it showed that bleaching occurred not only in response to elevated SST, but also to siltation and freshwater input, or a combination of these stresses.

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Crown-of-thorns outbreaks

Crown of Thorns starfish (COTs) are predators of Indo-Pacific corals, and population outbreaks can devastate entire reefs. So far, outbreaks have been rare in the WIO but MPA 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 corals, perhaps because they can gain a firmer foothold on these. They 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, resulting in major reductions in coral cover. Other areas where outbreaks are common are the Red Sea, Japan, Palau and Fiji.

To date COTs have rarely occurred in true plague proportions in the WIO. Reefcheck surveys between 1997 and 2001 found no COTs except for one 'low' count in Madagascar. However small outbreaks have been recorded off mainland Tanzania in the mid-1990s (Mnazi Bay) and 2003 (Songo-Songo and Dar es Salaam), in Mauritius (see case study), and in Zanzibar in 2004.

Despite more than 30 years of research on the Great Barrier Reef (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 the WIO. 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.

MONITORING COTS

COTs should be included in any regular reef monitoring programme (50m belt transects is the standard method used in the WIO). 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:

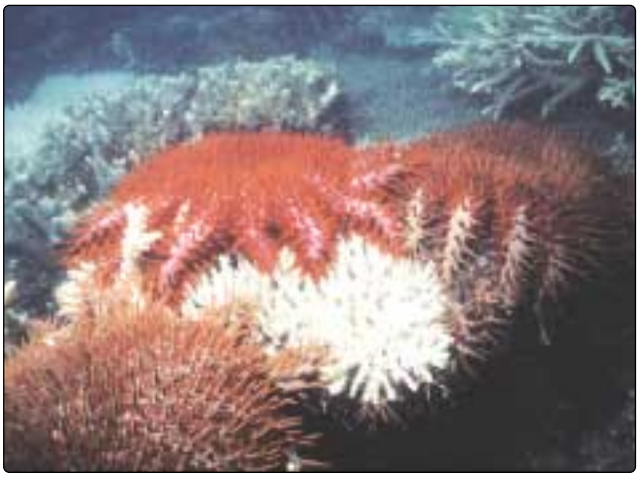
- **Incipient outbreak** - Meaning the density at which coral damage is likely. Occurs when there are 0.22 adults per 2-minute manta tow; or >30 adult and subadults per hectare, where subadults are 15-25cm diameter (2 years old) and adults are >26cm (>3 years old), using SCUBA diving counts. (N.B. starfish 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* cited overleaf) and in Mauritius (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 (see case study). Other poisons are copper sulphate, formalin, liquid ammonia, and hydrochloric acid.



M. Richmond

Adult COTs, over 40cm diameter, in localised outbreak reported in January 2004 on shallow reefs in Tanzania.

Note that cutting COTs under water does not kill them and may risk their numbers increasing (starfish can regenerate from single arms). 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: 5 ha is manageable, 200 ha 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.

KEY POINTS FOR THE MPA

- ❑ **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 MPA 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 MPA they are visiting.**

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CORDIO – **www.cordio.org** – for information on reef monitoring in the WIO

CASE STUDY

COTs outbreaks in Mauritius

In October 2002, COTs starfish were observed in high numbers on a patch reef, 0.6km^2 in size, between Ile aux Cerfs and the fringing reef, adjacent to the fishing reserve of Trou d'Eau Douce. Ministry of Fisheries personnel demarcated the infested site using a GPS, and surveyed the abundance and distribution of COTs using the Line Intercept Transect (LIT) method. 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. Four adult COTs were brought from the site to the laboratory for *in vitro* tests and were kept alive in a concrete tank supplied with running seawater. Two of the COTs were marked and injected with dry acid solution, made of 140 gm of sodium bisulphate dissolved in one litre of seawater, using a hypodermic syringe. The other two COTs were injected with seawater as controls. The COTs injected with dry acid were found dead and those injected with seawater were still alive 24 hours after the injections.

The infested area was therefore searched by divers from the Ministry of Fisheries and the 30 COTs found were injected *in situ* with 6 ml of dry acid. The area was checked 48 hours later and all the COTs were found dead or dying, suggesting that injection of dry acid is an effective method of elimination, killing the COTs without affecting any other organisms. As the animals are injected *in situ*, no damage was done to the corals as the COTs do not have to be dislodged from colonies with metal bars or divers' knives.

The following year an outbreak was recorded near Flic en Flac in an area 80 x 50m. In this case, some 200 starfish were removed by hand by the Mauritius Marine Conservation Society, using volunteer divers. Joint initiatives with the Ministry of Fisheries might be appropriate for future outbreaks.

M. Richmond

Juvenile and adult COTs. Note that it is relativey rare to see very young individuals because they are so well hidden.

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 MPA can take a leading role. Mangrove restoration is generally inexpensive, has a high degree of success, and is being undertaken in many parts of the WIO. 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 the WIO are under some form of pressure but mangrove forests are being successfully managed in some places, and there are sites that can still be considered pristine. Many of the MPAs on mainland East Africa and in Madagascar 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 original 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 re-planted, there have been many attempts at mangrove restoration, undertaken often as a forestry management initiative though also for conservation of the ecosystem. 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.

M. Richmond

Planting of mangrove propagules is simple and can involve schools and other local community members.

- Deciding on the techniques to use which will depend on: whether the soils needs treatment (e.g. to reduce acidity) or physical re-working 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.
- 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.

J. Turner

Young mangrove trees planted on Rodrigues Island as part of a large scale forestry programme in the late 1990 s to stabilise sediment movement and increase fish nursery areas.

One of the oldest examples of mangrove restoration in the WIO is in Kiunga in northern Kenya where, in the early 1900s *Rhizophora mucronata* was planted in a small clear-cut area and attained harvestable size within 50 years. Other small scale planting efforts include Kisakasaka (Zanzibar) where villagers began planting propagules in the early 1990s under guidance from the Forestry Department; Mbweni Creek near Dar es Salaam where in 1999 over 3,000 *R. mucronata* and *Avicennia marina* propagules were planted by villagers; and Tanga, northern Tanzania where the national Mangrove Management Project in collaboration with the Tanga Coastal Zone Conservation Programme has been replanting mangroves since 1997, with 107.4 ha of mangroves actively rehabilitated by 2004.

Larger scale programmes include Rodrigues Island (Mauritius), where in 1998 43,500 *R. mucronata* propagules were planted with the involvement of a private contractor. Similarly, on the main island of Mauritius a comprehensive programme was developed in 1995 (see

case study), while in Kenya at Gazi Bay, over 300,000 propagules were planted with the involvement of the local community. Some large-scale mangrove restoration efforts are also underway in Eritrea, using a technique that is considered controversial, as it involves adding nutrients to the planted propagules. This could potentially damage other ecosystems and communities (such as coral reefs) that require relatively low levels of nutrients, and so is not recommended. Although most mangrove restoration efforts are inexpensive, large scale programmes are labour intensive and may require donor assistance.

KEY POINTS FOR THE MPA

- ❑ **Endeavour to restore any degraded mangrove ecosystem within the MPA boundaries.**
- ❑ **Before starting seek advice from experts and discuss the ideas with the Forest Department or government agency responsible for mangrove management.**
- ❑ **Identify people willing to help, such as local communities, school children and teachers (mangrove restoration is a good environmental education activity), or other volunteers.**
- ❑ **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.**

Sources of further information

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CASE STUDY

Restoration of mangroves in Mauritius - improving the habitat for juvenile fish

The MPAs in Mauritius include six Fishing Reserves, which have been established to ensure that the appropriate environmental conditions are maintained and appropriate fishing methods are used for sustainable fisheries management. Around 70% of commercial fish species depend on mangroves particularly in their juvenile stages. It is thus vitally important to maintain healthy mangroves in this country, but as in many WIO countries, forests have been damaged by a range of human activities as well as cyclones. Two species of mangroves are found: *Rhizophora mucronata* which is most common and is found along the north-east and east coast; and *Bruguiera gymnorrhiza* which is found in only a few localities. In 1995, the Ministry of Fisheries started a Mangrove Propagation Programme with the aim of protecting and reforesting denuded areas and also sensitising the public about the importance of this ecosystem. The programme consisted of five phases. A mangrove nursery was set up at Mahebourg Fish Farm and mangrove propagules were collected, placed in small plastic bags with mud and kept in the nursery until they reached four-leaf stages. The seedlings were then planted at selected sites around the Island.

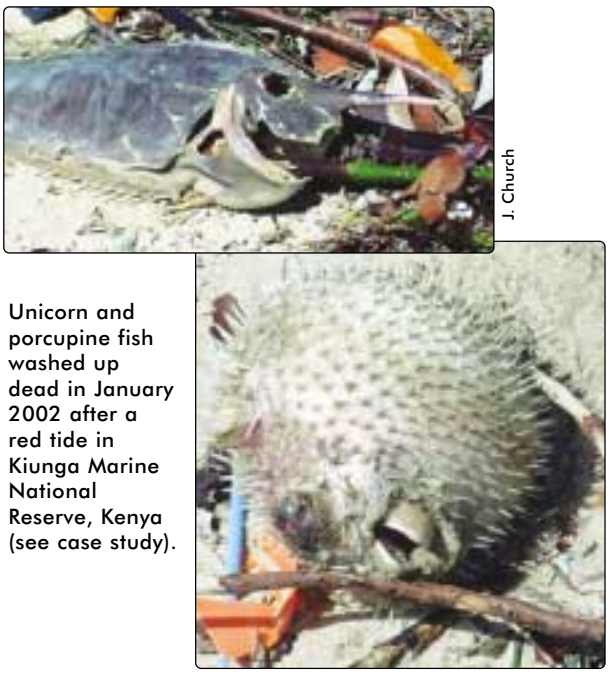
During the first phase (June 1995 - 1996), 12,400 seedlings were planted at nine sites around the island covering a total lagoonal area of 22,750m^2, much of this in and adjacent to the MPAs including Black River, Poudre d'Or and Grand Port Fishing Reserves. An average survival rate of 65% was noted. The second phase (June 1997 - December 1998), involved four sites along the west coast, covering an area of 23,750 m^2 where 47,500 seedlings were planted. During the third phase (February 2000 - 2001), five sites along the north shore were selected and 40,000 seedlings were planted covering 20,000 m^2. For the fourth phase, three sites in the east with an area of 29,000 m^2 were planted with 58,000 seedlings. The fifth phase, involved a mud flat of 23,000 m^2 on the western part of the island. No seedlings were planted at this site but 41,000 propagules were collected from mother trees and directly inserted in the mud to about one third their length, without prior development in the nursery. A year later, over 95% of the propagules had developed into healthy plants reaching four to six leaf stages, confirming the success of planting propagules without the need for the nursery and pre-culture facility.

Red tides & harmful algal blooms

Red tides are natural and seasonal phenomena but some cause damage and are referred to as Harmful Algal Blooms (HABs). An MPA may never be directly affected by a red tide or HAB, but MPA 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 common in Eastern Africa around November and at the beginning of the north-east monsoon. For example, red tides were reported in Kenya (see case study), Zanzibar, Yemen, Oman and Mauritius in early 2002.

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.



J. Church

Unicorn and porcupine fish washed up dead in January 2002 after a red tide in Kiunga Marine National Reserve, Kenya (see case study).

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.

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 the WIO have 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 or discoloration 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 MPA

If a red tide occurs in or near an MPA, the MPA 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 off 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 MPA 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.**

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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For testing samples: Analabs Ltd, P.O.Box 24780, Nairobi, Kenya. **analabs@net2000ke.com**

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 ten 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 MPA, with support from WWF, also helped with publicity and answering the numerous queries from the local and international media.

Diseases of marine organisms

H11

Diseases are increasingly being reported from a range of marine organisms. In part this is due to the larger number of researchers and observers in the water, but it may also be related to changes in water quality and other human impacts. This sheet gives a brief introduction to the topic and advises the MPA manager on how to deal with suspected cases of disease.

During the last two decades, the potential for severe impacts to coral reef populations and communities from the effects of various diseases has been recognised. Diseases have been described affecting corals, fish, coralline algae, and sea urchins, sometimes with wide-ranging effects. Disease is defined as any impairment in an organism's vital functions, systems, or organs. A pathogen is an agent that causes disease, which can be biotic, such as a virus or bacterium, or abiotic, such as a toxic chemical or above-normal water temperature. Often, biotic and abiotic disease agents are closely related. 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, like a genetic defect. To recognise disease, it is important to look for signs of change(s) that indicate abnormal structure or function (metabolism, morphology, behaviour), morbidity, or death in organisms; it is not necessary to identify the pathogen causing the changes (this can be very difficult).

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 herpesviruses interacting with tumour-promoting biotoxins. It has reached epidemic proportions in Florida, Hawaii and parts of Australia, and is possibly linked with pollution. FP has been reported from the WIO, but has yet to be confirmed through clinical analysis of tissue samples. Another poorly understood disease, coccidiosis, killed many green turtles in Florida in 2002.

CORALS

Coral diseases were largely unknown until the 1970s, but have become a catastrophic problem for coral reefs in the western Atlantic. Direct and indirect mortality as a result of disease has modified the composition and structure of reefs in several parts of the Caribbean Sea by removing common and locally abundant species. For example, white-band disease killed some of the important acroporid reef-building corals. Pathogens have been identified in two coral diseases: aspergillosis of Caribbean gorgonians is caused by a fungus; and, a white plague type II is caused by a bacterium. More than 100 hard and soft coral species in 54 countries, mainly in the Caribbean, have been affected by possible diseases. Diseases have been reported from other regions, including the WIO, but have been much less well studied. One example is black-band disease that is known to affect many species in the Indo-Pacific and Red Sea, as well as in the Caribbean. Bleaching can be an important sign of disease, indicating that the mutually beneficial 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 temperature during El Niño events (e.g. in 1998) is not a coral disease.

Loss of tissue from the skeleton of corals can result from abiotic stressors and pathogenic microorganisms. Physical damage similarly removes tissue and must be ruled out when investigating disease. The CD on Caribbean coral diseases (see Sources) provides information on damage from coral predators. Butterfly fish, parrotfish, 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 parrot fish have been feeding there will be clear bite marks.

T. McClanahan

Astreopora colony with pale patches resulting from death of polyps due to an unidentified pathogen.

SEAGRASSES

Diseases can have an impact on seagrass beds, as seen in the wasting disease that devastated eelgrass beds in the 1930s, and the more recent 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. Seagrass die-offs have also been reported in eastern and western Australia, with a large die-off in Queensland in 1996.

To date, no comprehensive study has been conducted on diseases in the WIO. A common fish disease, ciguatera,

which is communicable to humans, is widespread in the Pacific Ocean, and does occur in the WIO. It is caused by dinoflagellates living in blue green algae, and probably occurs naturally, but may be triggered by elevated sedimentation and loss of water quality through human impacts.

KEY POINTS FOR THE MPA

There are no known cures for most of the diseases of wild marine organisms, but it is important to understand if changes seen are due to disease or other sources. If disease is suspected:

- **Keep records, particularly as part of the monitoring programme (e.g. ReefCheck protocol).**
- **Clearly describe the changes from normal function or behaviour seen; 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) or abiotic factors (e.g. increased water temperature or turbidity, decreased salinity, algal blooms, chemical spills).**
- **Try and get the disease identified (because several laboratory procedures are often needed to do this, you might contact the local fisheries agency or a veterinary pathologist at an aquarium).**

Sources of Further Information

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Global Database on Coral Diseases. Marine and Coastal Programme, UNEP-WCMC: **info@unep-wcmc.org; www.unep-wcmc.org**

For information on turtle diseases: **www.turtles.org** and **www.turtletrax.org**

CASE STUDY

Coral disease in Kenya and Tanzania

A fungal disease caused mortalities of *Montipora* spp., *Astreopora* spp., *Echinopora* spp. and other hard coral species on reefs along 600km of coastline in Kenya and Tanga, Tanzania, in March 2002. *Montipora* was nearly eliminated from Kenyan reefs. *Acropora* spp., *Platygyra* spp., *Goniopora* spp., and massive *Porites* spp. were also affected; however, *Porites* spp. and *Goniopora* spp. rarely died and often recovered, whereas death for most other species occurred within two weeks. In *Echinopora* spp. and *Montipora* spp., a dull ashy tissue color and brittle skeletons characterized the early stages of this event with a mucus layer forming on the tissue surface. The mucus then disappeared and the surfaces were covered in a white calcareous dust. *Astreopora* spp. tissues became dull and pale without mucus, and eventually the skeleton became bare. Samples fixed in seawater-formalin were sent to two laboratories, but samples for microbiological studies could not be obtained from the field sites. Microscopy revealed fungi in the three genera that died. These were possibly secondary invaders that killed the corals already weakened by some another pathogen that could not be identified. This illustrates the difficulty in identifying diseases even when, as in this case, experts are called to assist (see reference McClanahan *et al*. in press).

T. McClanahan

Echinopora colony showing clear signs of disease (pale patches) where the polyps have died. The dark portion is still living.

No-take areas I1

No-take areas, either as zones within MPAs or as entire MPAs, are important tools for biodiversity conservation and fisheries management especially when implemented in close consultation with the stakeholders. This sheet describes the issues involved and how MPA managers can most effectively promote establishment of no-take areas.

No-take areas (sometimes called marine reserves in the literature) are marine areas that are closed to all forms of extraction including fishing. In the WIO, they include the Marine Parks in Kenya and all the MPAs in Seychelles, as well as no-take zones within multiple use Marine Parks in Tanzania, Comores, Mozambique and Madagascar, and other management areas.

BENEFITS OF NO-TAKE AREAS

An extensive literature exists on the role of no-take areas in protecting biodiversity and contributing to fisheries production. The details are still being debated by the scientific and conservation specialists but no-take areas are nevertheless internationally accepted as an essential conservation and management tool.

Protecting biodiversity

Research around 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 the WIO, the no-take MPAs of Chumbe (Zanzibar) and Kisite (Kenya) have larger fish and a higher diversity of fish species than fished reefs nearby. The abundance of triggerfish, surgeonfish and parrotfish in particular is higher. No-take areas at Malindi, Watamu, Mombasa, Kisite and Chumbe appear to have led to partial recovery of the heavily overfished triggerfish *Balistapus undulatus* within 5-10 years.

Higher biomass and diversity could be because the MPAs were selected because they were naturally more species-rich, but similar effects have been seen in areas closed for other reasons. For example, the closed reefs in the six collaborative management areas in Tanga Region, Tanzania, were selected by local communities for fishery stock replenishment and reef recovery and now show higher biomass and biodiversity than surrounding areas. 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 this purpose, and FAO recommends them as a tool. They allow fish to grow older and larger (thus producing more eggs and juveniles) and fish density to increase. Together, these should result in replenishment of adjacent fished areas through export of larvae and movement of adults (the 'spillover' effect) across the MPA boundary. A few studies have demonstrated spillover, but some have been inconclusive. However, many fishers perceive catches to increase following establishment of closed areas, for example in Tanga Region, Tanzania and Quirimbas National Park, Mozambique. The extent of spillover 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

The WIO closed areas 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 Kenya and Tanzania. 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.

M. Richmond

Large schools of fish, such as these snappers, can rapidly increase in no-take areas, boosting diving tourism.

Location

Protecting biodiversity versus enhancing fisheries productivity may involve closing different areas. For

fisheries, habitats important for 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 (see sheet B4). For example, in Moheli Marine Park in the Comores, some of the no-take areas selected were subsequently found to be inappropriately located for protecting fish populations. Discussions were held with the fishers and the boundaries have now been changed.

Size

The optimal area to close will probably depend on local conditions although scientists and conservation organizations 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 MPA 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. 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. 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 MPA

- ❑ **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, practices 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 a no-take area in Kenya - Mombasa Marine National Park

Mombasa MNP was gazetted in 1986, initially without enforcement of the regulations banning fishing. An annual monitoring programme was implemented by CRCP (Coral Reef Conservation Project) in association with KWS, starting in 1987 when fish biomass was estimated at 180 kg/ha. The fishing ban was eventually enforced in 1991, and shortly after, populations of surgeonfish, triggerfish, butterflyfish, wrasse, emperors, parrotfish started to increase. By 2004, fish biomass in the MNP had reached 1,000 kg/ha. In the surrounding Marine Reserve, where certain forms of fishing are allowed, biomass has remained lower, and at Vipingo, a site outside both the Park and Reserve, biomass was lower still (70 kg/ha in 2000).

After 1991, catches per fisher in the Reserve increased by about 50%, and were highest at landing sites closest to the MNP. Nevertheless, total fish catch was about 30% lower than before the MNP was enforced due the number of fishers decreasing from 100 to 35, as many had to move fishing grounds or find other livelihoods. Pressure from fishers in 1994 resulted in an 'informal' reduction in the size of the MNP from 10 to 6 km^2 which resulted in total catches increasing to levels close to those before the initial area was closed. Reductions in the use of damaging forms of gear (notably beach seines) have also increased total catches.

This example demonstrates the benefit of a no-take area to biodiversity and fish biomass, and also illustrates the complexity of its impact on a fishery. A good monitoring programme to track trends in fish catches at different distances from the closed area is essential; the size of the closed area must balance fishers' needs with ecological requirements; and other fishery management measures (such as eliminating damaging gear) must be maintained.

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Managing fishing gears I2

Fishing gears have different impacts on marine resources and habitats, depending on a variety of factors. It is important for MPA 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.

Many MPAs in the WIO have the dual objectives of improving coastal livelihoods and protecting biodiversity. Unsustainable fishing practices, such as the use of destructive fishing gears, dynamite and poison, prevents the achievement of both these aims. Some fishing gears 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 gears 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. Although the MPA 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. If such fishing is done from boats anchored on coral reefs or seagrass beds, this should be discouraged, although 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. 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. 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.

J. Rubens

Small-meshed seine nets when used in shallow seagrass areas often result in high by-catch of juvenile fish.

Nets

Gill and seine nets are the main types of net used in the WIO 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, and result in incidental catch, which is one cause of the drastically reduced populations of dugong and sea turtle. 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.

Spear guns

Spear guns if used selectively to target larger, mature fish (i.e. not juveniles) cause little damage. They are also easy and cheap to make and use (e.g. a boat is not essential). 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 MPAs and under national fishery regulations (e.g. Tanzania).

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 over-collected, 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, i.e. restricting certain gears to certain areas (see sheet C2);
- encouraging fishers to use gears that are more benign, and/or to use their existing gear in a less damaging manner; a gear exchange programme where non-destructive fishing gears are offered (usually free in the

first instance) in exchange for destructive gears 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 gears. Education, training and patience may be necessary. The least destructive gears 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 gears 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. Examples of gear exchange programmes include the Tanga Coastal Zone Conservation and Development Programme, Tanzania (exchanged beach seine nets for gill nets), Kigomani in Unguja, Zanzibar (where the Dutch Embasssy provided fishers' cooperatives with larger boats and gill nets to fish for large pelagic species in open waters), Nampula Province in Mozambique (beach seines exchanged for light attraction fishing gear for small pelagic species), and Mafia Island, Tanzania (see case study).

KEY POINTS FOR THE MPA

- ❑ **In order to understand the fishing methods used in an MPA, 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 gears into the system slowly) and evaluate sustainability.**

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CASE STUDY

Gear exchange programme in Mafia Island Marine Park

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' gears 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 (13-15 cm) 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.

M. Richmond

In MIMP, beach seines were swapped for large meshed gill nets for use offshore (as seen here), resulting in less by-catch.

Mariculture potentially provides an income or food for local people in and around an MPA 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 MPA 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 over the last 20 years, and now exceeds 30%. Mariculture has been tried in the WIO in many places, but only a few species have been commercially farmed on a long-term basis. Many projects have been hampered by a lack of aquaculture traditions and technology or by local political instability and economic uncertainties.

Aquaculture 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;
- Introduction and escape of exotic species (see sheet K5) or disease vectors such as viruses.

SPECIES INVOLVED

Algae (seaweed) - See case study.

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 SE Asia, and the Caribbean but this has not yet been tried in the WIO. 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 operations in the Seychelles, Madagascar and Mozambique. Shrimp farms require ponds. The simplest systems obtain water and stock through natural flushing and little or no feed is given; annual production is about 400-900 kg/ha. With greater investment, intensive ponds with pumped water, formulated feeds and higher pond-stocking densities, and hatcheries, can produce 7,000 kg/ha annually. 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, an operation currently undergoing trials near Mombasa. 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.

M. Richmond

Seaweed farming, as seen here on Zanzibar's east coast, may be an option for reducing pressure on wild resources in an MPA.

Molluscs - Pearl oysters (*Pinctada* spp.) can be cultured for pearls, and mangrove or rock oysters (*Crassostrea*) and the 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.), two species of which occur in the WIO, have been farmed in the Pacific and in SE Asia, and offer potential

(with demand by the aquarium trade and for meat). The blood cockle (*Anadara* spp.) and pen shell (*Pinna* spp.) are fast growing intertidal species widely collected as food, and with potential for culture. Although there is potentially demand for these species, very few attempts have been made at culturing them in the WIO.

Holothurians - Certain species of sea cucumbers are being successfully farmed in the Pacific (e.g. Solomon Islands and Japan) and there is potential for this in the WIO.

Fish - Most fish farming in the WIO involves freshwater species (e.g. carp, trout and tilapia). However, some *Oreochromis* tilapia tolerate brackish water and may be acclimatised to full strength seawater. Other candidates include rabbitfish (*Siganus* spp.), milkfish (*Chanos chanos*) and mullet (*Mugil* spp.). These fish are desirable on the local market but not to exporters, and so economic margins are marginal. Nevertheless, MPAs experiencing fishing pressure on natural stocks might benefit from the development of small-scale fish farms.

KEY POINTS FOR THE MPA

- ❑ **Mariculture may be appropriate in or adjacent to an MPA 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.**
- ❑ **MPA managers should consult guidelines for investment in mariculture enterprises (e.g. those for Tanzania and Mozambique - see below) before approval of any project.**
- ❑ **If a proposal is provisionally approved, MPA 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 MPA staff may need to be strengthened to interpret monitoring results.**

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FMC BioPolymer, Philadelphia, Pennsylvania, USA. **www.fmcbiopolymer.com** – importing seaweeds from the WIO.

CASE STUDY

Seaweed farming in the WIO

Two species of the red seaweed *Eucheuma* have been cultivated widely in the WIO since the late 1980s. Asian strains are used, grown from cuttings attached to rafts or strings staked to the seabed in shallow clear inshore waters. The harvested seaweed is dried and exported to factories in Europe and the USA where it is processed to extract carrageenan, a substance used as a thickener in products ranging from paints to tooth pastes and foods. Farming is expanding rapidly, offering a relatively simple income generating activity for coastal communities.

It is conducted within several MPAs in Tanzania including Mafia Marine Park and Mnazi Bay-Ruvuma Estuary Marine Park, and in collaborative fishery management areas in Tanga region. It was discouraged in Moheli Marine Park, Comores, and Kisite Marine Park, Kenya, because of concern that it might cause damage and conflict with the MPA objectives, but operations in more environmentally suitable adjacent areas were promoted. Considerable experience now exists in the WIO that should be used when MPAs are deciding whether to support this activity directly. Guidelines for seaweed farming are included in the general mariculture guidelines published by the Tanzania Coastal Management Programme.

Key issues to consider are:

- Although often promoted in the hope that the increased revenue will result in a reduction in fishing pressure, this may not happen as seaweed farming suits women in particular, and men may continue to fish.
- Unless carefully planned, seaweed farming may conflict with other uses of an area as boats can cause damage to the rafts and lines. A zoning plan, developed with users of the area, can reduce this risk.
- Income from seaweed farming can fluctuate due to crop losses from predation, poor weather conditions, and market issues.
- The long-term environmental impact of seaweed farming in terms of spread of introduced species, shading of benthos and increased nutrients has not been determined. The Asian species and strains seem to have no negative impact when farmed in SE Asia, but major problems arose in Hawaii where they began over-growing coral reefs. In the WIO, no serious negative impacts have been determined so far, though a more thorough EIA is required.

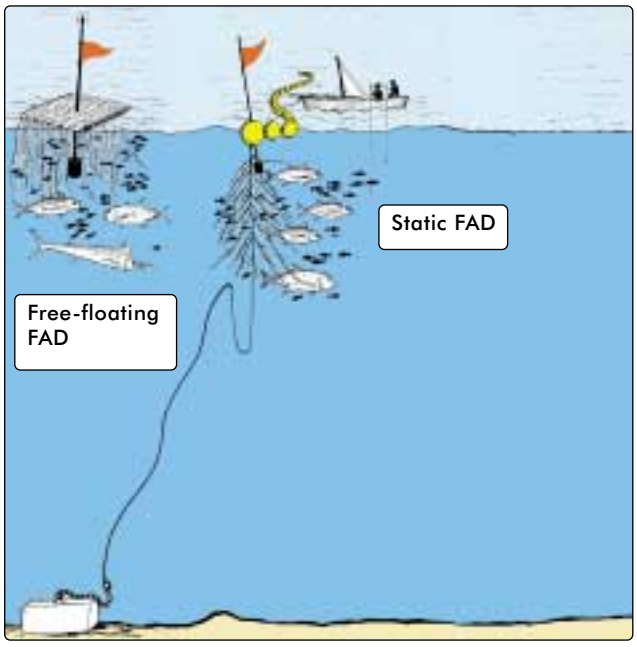
Fish Aggregating Devices (FADs) I4

MPA managers may want to help fishers who use either the MPA itself or the surrounding waters to find alternative fishing technologies that will reduce the impact of existing gears and take pressure of resources within the MPA itself. FAD technology is one method that is proving to be appropriate and is being tested in the WIO.

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 up-wellings, which are areas of the ocean that are usually very productive 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.

Fish aggregating devices (FADs) are floating objects that are specifically designed and located to attract tunas, and therefore allow fishers to find them more easily. No one understands exactly why tunas are attracted to FADs, but the ropes, floats and the other materials used presumably mimic the build-up of driftwood and seaweed found naturally in the sea. A FAD comprises 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 is attached to facilitate finding the FAD.

FADs may be placed in shallow (50-100m) or deep (500-1,500m) 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. 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. FADs aggregate the smaller tunas (Skipjack and immature Yellowfin, for example) at the surface and larger tunas (such as mature Yellowfin and Bigeye) at depths of 300-400m.



SEA Trust

Types of FAD used in deep water in the Indian Ocean.

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 kilometers away searching for food, before moving on. Fishing captains have reported finding individual schools of tuna that exceeded 1,500 mt 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 WIO, including in Seychelles, Comores, and Mauritius where a programme has been underway since 1985. There are currently 21 FADs around Mauritius in depths of 400-3,000m and at distances of 1.5-12 n.mi from the coast. The average CPUE is 4-5 times higher than the CPUE in the traditional reef-based fishery. Inshore, shallow-water FADs have also been trialed in Tanzania (e.g. Tanga, Latham Island) and in Kenya, although with variable success. 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 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;
- Tuna must be present and not over exploited 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. 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 but there is at least one suitable SONAR device available for hire in the WIO (see www.amarulasail.com). The South Pacific Commission FAD Manual describes how to conduct a site survey (see Sources).

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 but are typically around US$3,500 per unit excluding import duties. Because the FAD will be deployed in a high-energy environment and subject to stress from currents and waves, 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.

KEY POINTS FOR THE MPA

- **Since there are a number of options for assisting fishers who are affected by the presence of an MPA, a careful evaluation is required before deciding to spend resources on a FADs programme.**
- **An MPA itself is unlikely to have the resources/capacity/finance to install 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 MPA, seek expert advice at an early stage.**

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CASE STUDY

Using FADS to help MPA management in Tanzania

Following an evaluation of the potential of FADs in East Africa, a cooperative programme was initiated in Tanzania in 2003 between the UK Government's Department for International Development (DfID) and two independent conservation initiatives: Mafia Island Marine Park (MIMP) and Conservation Corporation Africa (CCA), which jointly manages a protected area off the north-east coast of Unguja Island, Zanzibar with the Zanzibar Department of Fisheries and Marine Resources (DFMR). The programme is being designed to diversify fishing opportunities for local fishers who have had the size of their fishing grounds reduced by the declaration of closed areas or who use fishing techniques that are believed to damage the benthic environment and take large quantities of juvenile fish.

Two FADs are being jointly funded by DfID and MIMP (WWF) and two are funded by CCA. In addition to providing the FADs, the programme is funding a highly experienced Masterfisherman to guide their construction and deployment and, crucially, to provide local fishers with training in the use of longline technology. The project is managed by a Tanzania-based marine resources consultancy company, Samaki Consultants Ltd., in collaboration with the MIMP authorities and DFMR. The project is still at an early stage but will provide extremely valuable experience in how FAD technology can be used to improve MPA management.

Samaki Consultants Ltd. www.samaki.net.

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 MPAs might contribute to their conservation and sustainable management.

Sharks and rays, with over 50 and 30 species respectively in the WIO, 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. Although populations of some species are still abundant in the WIO (e.g. Dusky shark and Great White shark), there are rapid declines in other parts of the world.

EXPLOITATION

Sharks and rays are directly targeted in some fisheries and caught as bycatch in others. Illegal off-shore 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 many WIO countries. Prices of shark meat are similar to those for other fish.
- Shark fins have a particularly high value and sharks are increasingly caught for these alone, with the rest of the carcass wasted. Dried shark fins are used for soup in many Asian countries. In the WIO, fishers are likely to get far higher prices for shark fins than for the meat.

S. Wells

Black-tip reef sharks off Aldabra, clearly showing the fins that are the main reason for the fishery for sharks.

- Sharks have enormous livers that are rich in oil, and in Eastern Africa 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, 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.

MANAGEMENT

For much of the WIO there are inadequate data on the status of populations and no reliable statistics for the fisheries, which means that information to guide 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 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 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 socio-economic considerations** - Management and conservation objectives and strategies should recognize 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, due primarily to lack of resources, progress with implementation of the IPOA-Sharks has been very slow. Regional cooperation and education at all levels of society are urgently needed. In the case of some inshore species, for example reef sharks, MPAs may be the only hope for their recovery and survival.

KEY POINTS FOR THE MPA

- ❑ **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 MPA 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 MPA 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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TRAFFIC **www.traffic.org**

Shark Trust **www.sharktrust.org**

CASE STUDY

The role of MPAs in shark conservation in South Africa

South Africa has the most advanced shark conservation and management activities underway in the region, with a comprehensive national shark management strategy approved by the government. For more than 10 years, there has been a strict daily bag limit for sharks, with several species (including the Sawfish, Great White and Ragged-tooth) totally protected. Where sharks form the basis of a commercial fishery or permitted bycatch, only whole sharks may be landed in order to avoid "finning" and hence wasting the resource. The value of sharks to tourism is increasingly recognised. Diving with sharks has become a major attraction at several sites, including the Maputaland MPA of the Greater St Lucia Wetland Park for Raggedtooth/Nurse and Whale sharks, the new Aliwal Shoal MPA for Raggedtooth and Tiger sharks and Dyer Island near Cape Town for White sharks.

South Africa has a long history of shark research, largely as a result of problems experienced with shark attacks in the 1960s. This resulted in the establishment of the Natal Sharks Board, which operates 29 km of shark gill nets at 38 locations along 320 km of KwaZulu-Natal coast, aimed at reducing the risk of shark attacks. Each set of nets is serviced about 20 times per month and sharks that have been caught are removed. Although shark netting reduces the possibility of attacks on bathers, it carries a high ecological cost (up to 1000 sharks may be caught a year in South Africa, as well as by-catch such as turtles). However, it has generated much valuable scientific data. Current practice is to release and tag live animals from the nets and in some cases to replace nets with baited drum lines that have less impact on shark populations and avoid by-catch.

Shark netting is not appropriate in an MPA, even if water sports are a feature of the MPA. There has been moderate success with a personal electrical shark repellent that may help MPA managers in locations where aggressive sharks are a problem. However, it is more effective to manage the behaviour of people (e.g. ensuring that they do not approach sharks inappropriately).

Natal Sharks Board **www.shark.co.za**

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J.Rubens

Many sharks, such as this white tip reef shark, are accidental catches of gill net fishing.

Octopus and sea cucumber fisheries

In the WIO, there are numerous invertebrate fisheries that an MPA may have to consider. Two of the commonest and most valuable are octopus and sea cucumber. Both of these are artisanal fisheries, both are poorly documented, and both are being over-exploited. This sheet provides some suggestions as to how MPAs might assist in their sustainable management.

Artisanal fishing for octopus and sea cucumbers is an important economic and subsistence activity throughout the WIO. Both are fished from intertidal reef flats and subtidal reefs during low water spring tides. With the arrival of marine product processors and foreign buyers in recent years, fishing intensity for both groups has risen markedly, placing greater pressure on these resources.

OCTOPUS

Octopuses have been collected for centuries in the WIO and are a favoured food item. *Octopus cyanea* is the main target species and usually comprises 99% of the catch. Octopuses are collected either by walking over the lower reaches of the intertidal reef flat or by snorkelling along the reef edge. There is little information on the WIO fishery but an estimated 600 tonnes are taken each year in Tanzania.

Octopuses grow extremely fast, increasing in weight by as much as 200g in only ten days, and thus potentially supporting a highly productive fishery. This is only possible if it is well managed, which requires a good understanding of the life-history. When females are ready to spawn, which happens only once in their lifetime, they barricade their den. Following spawning, they attach the eggs to the den roof, clean and aerate them for about 30 days, and then die. The 'brooding' is essential for successful hatching, and so a reduction of fishing pressure during this season is highly recommended. Furthermore, as females normally brood at their largest size, fishing of large individuals could reduce recruitment and eventually stock size. In heavily fished areas both size and weight of octopus is often low, and reproductive output may already be affected.

A licensing scheme, agreed jointly by octopus fishers and relevant government departments, would help to provide the information on catch and effort that is needed for management. It would also permit regulation of fishing effort by restricting numbers of licences. Maximum size limits should also be considered, although this might be difficult to implement as the value of octopus increases with weight.

SEA CUCUMBER

About 80 species of sea cucumber occur in shallow waters of the Indian Ocean. They have been collected since the 1940s in the WIO, when commercial collection started in Madagascar. While not consumed in the region, at least 24 species are dried and exported to South-East Asia where they are considered a delicacy, the main ones being: *Thelenota ananas, Stichopus hermanni, S. chloronotus, Holothuria scabra, H. atra, H. nobilis, H. fuscogilva, and Bohadschia sp.*. Dried sea cucumber is known as 'trepang' or 'bêche-de-mer'. As sea cucumbers are sessile and defenceless (apart from sticky threads some species exude) they are hand collected on the intertidal reef flat when walking, and in deeper water either by snorkelling or using SCUBA.

Due to their ease of collection, these important detritivores are prone to localised overfishing yet the effects of their removal 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. 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.

M. Richmond

Octopus being sun-dried on Rodrigues Island.

POTENTIAL MANAGEMENT ACTIONS

Monitoring programmes for sea cucumber and octopus fisheries should be established where possible, with catch and effort data collected for at least one spring tide per month, although 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.

O. cyanea has been shown to brood year round but with seasonal peaks (June-August in Tanzania) in spawning activity. During such peaks it would be beneficial to either stop fishing or reduce fishing intensity in the main brooding zone (sub-tidal areas). Further research may find similar spawning peaks in sea cucumbers' reproductive cycles, and seasonal closures could similarly be recommended.

Fishing could also be restricted to a maximum of six days over the spring tide with no fishing allowed during neap tides. This would ensure a minimum number of no-fishing days during which octopus and sea cucumbers could recover. 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. In Mafia Island Marine Park, Tanzania, octopus fishing is already prohibited during neap tides and there is a maximum size limit of 500g.

KEY POINTS FOR THE MPA

- **Initiate a monitoring programme for sea cucumbers and octopus (the ReefCheck protocol includes sea cucumbers as an indicator species – see sheet G3).**
- **Include the issue of over-exploitation of sea cucumbers and octopus in awareness raising materials produced by the MPA.**
- **Support research on sea cucumbers and octopus, especially where this will contribute to understanding the role that MPAs might play in their conservation and management.**
- **Where exploitation is allowed within an MPA, consider limiting it to spring tides and/or introducing seasonal closures and rotational fishing regimes.**

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Great Barrier Reef Marine Park Authority **www.gbrmpa.gov.au** – information on sea cucumber fishery regulations.

CASE STUDY

Using an MPA to help manage invertebrate fisheries in Madagascar

Nosy Atafana Marine Park, in north-east Madagascar, is part of the UNESCO Biosphere Reserve of Mananara-Nord. The Marine Park is small (10 sq km), but covers three islands and their surrounding reefs. The area is important for artisanal fishing and reef fish, but also for a number of invertebrates including octopus, sea cucumbers, lobsters, and bait. All these activities were unregulated prior to gazettement of the Marine Park.

The Marine Park was established through an agreement between the Mananara Biosphere programme and the local community. It has a central core zone where no activities are allowed and a buffer zone were fishing is regulated. The agreement stipulates that the Marine Park is open to fishing on three days of the week only, that fishing is restricted to fishers from four adjacent villages, and that fishing for lobsters and sea cucumbers is prohibited throughout the area. Two park rangers patrol the Park on days when fishing is permitted to check that fishing gear and catches are in compliance with the regulations that are part of the joint agreement. Contravention of regulations is punished with a ban on fishing in the Park for two weeks to three months, depending on the nature of the offence. The catches are monitored from landings at the fishing villages.

Octopus is an important resource for many of the fishermen, and for some it is their sole source of income. They are collected on foot with a harpoon, and there were concerns that this was resulting in damage to live coral on the reef flat. With the reduction in the number of days that the area is fished, it is thought that some recovery of the reef flat is occurring, and that there has been an increase in reef fish catches. In addition, the Mananara Biosphere Programme is running trials with bamboo octopus traps with a view to introducing these as a less destructive fishing method.

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M. Richmond

Thelenota ananas, one of more than 20 species of sea cucumber collected in the WIO.

Sport and recreational fishing I7

Sport and recreational fishing are permitted in some MPAs in the WIO. Sport fishing clubs sometimes want to establish themselves near MPAs to benefit from the associated tourism and perceived better fish catches. This sheet provides MPA 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 fishing clubs and services exist in all WIO countries, most notably in Kenya, Mauritius, South Africa and the Seychelles. They often keep good catch records and may have valuable data going back decades.

FISHING METHODS

These depend on the environment and species sought. The main gears used are described below.

- **Trolling** - Mainly carried out offshore, this is the term used for dragging either a 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. This gear probably accounts for most sport fishing in the region, the most sought after species being the larger pelagics such as marlin, sailfish, tunas, mackerels, jacks and sharks.
- **Fly-fishing** - This mostly takes place in shallow waters, commonly for jacks (trevallies) and the highly sought after elusive bonefish. It may also be practised in open water (as done in Kenya for sailfish), 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 (with a long, flexible casting rod), or from a boat, using a short boat-rod.

S. Wells

Sportfishing, as here in the Seychelles, is a popular activity in the WIO and MPAs may be able to collaborate with fishing clubs.

- **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.

IMPACTS

If managed well, recreational and sport fishing can bring economic benefits through employment and revenue from businesses. It 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 or illegal fishing. For example, the presence of illegal long-liners off Mombasa and Dar es Salaam has been reported to the national authorities by sport fishing boats.

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 over-fished for a variety of reasons (e.g. groupers on reefs). Other potential negative impacts include anchor damage by boats. Conflicts have arisen in some places (e.g. Mafia Island Marine Park in Tanzania) between the tourism industry (particularly SCUBA divers) and sport fishing enterprises; equally 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. 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 with 3,500 recreational fishers involved and over 120,000 fish tagged to date. In Kenya and Mauritius hundreds of sailfish and other species have been tagged by sport fishers over the last ten years. The tag shaft holds

the address details to which the tag should be sent. The 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 there 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.

MPAs can potentially play an important role in the management of sport and recreational fishing. Those that are no-take areas (e.g. Marine Parks in Kenya and Seychelles) 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 MPAs (**www.celb.org/marine**).

KEY POINTS FOR THE MPA

- ❑ **If sport and recreational fishing is allowed within the MPA, 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 over board.**
- ❑ **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 MPA patrol boats.**
- ❑ **Any landings from sport or recreational fishing within an MPA should be recorded as part of the MPA fishery monitoring programme.**

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National Coalition for Marine Conservation - **www.savethefish.org**

CASE STUDY

Sport and recreational fishing in South Africa and Mozambique

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 MPA 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 40 km offshore, is already a popular sport fishing area. The zone will comprise all the 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 sportfishing regulations (Regulamento da Pesca Desportiva).

S. Wells

Beach angling is popular in St. Lucia MPA, South Africa.

Marine organisms for aquaria

I8

MPAs are sometimes approached by aquarium dealers who would like to use the MPA or adjacent areas for collection of live specimens. This sheet gives background information on the problems and potential benefits of collecting marine organisms for the aquarium trade, provides information on environmentally sound practices, and suggests appropriate policies for an MPA.

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 anemonefish (*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.

Indonesia and the Philippines currently supply over half the marine fish, and Indonesia and Fiji are the largest suppliers of corals and live rock. Less than 2% of specimens are captive-bred and this is growing only slowly as there are major biological and economic constraints to breeding and rearing aquarium species (but see case study). The main importers of marine ornamentals are the US, Europe and Japan. The WIO is a only small supplier but several countries are involved, and interest among aquarists for WIO species is growing. Kenya has one exporter, Mauritius has three exporters and French companies are interested in developing links with suppliers in the region. Mozambique was once large supplier of corals but the trade was banned in 1999.

M. Richmond

Anemone fish, one of many species collected for aquaria.

POTENTIAL PROBLEMS

The collection of marine ornamentals has the following effects:

- Damaging techniques have been, and still sometimes are, used to collect specimens, involving poisons (e.g. sodium cyanide, bleach, fish anaesthetics). This practice can lead to the death of both targeted and non-targeted species, including the coral reefs themselves. Fish that shelter in corals are sometimes extracted with sticks that cause damage.
- Poor husbandry and shipping leads to high mortalities for some species (e.g. by leaving cartons of animals outside in extreme weather).
- Endemic species may be at risk if they occur in small populations with a very restricted range.
- Sedentary species such as clams, corals and anemones are at risk as they are very easy to collect.

Since reef fish species are also at risk from other impacts that can damage coral reefs, careful thought should be given before authorising a collection operation to go ahead in an MPA.

BENEFITS FROM MARINE ORNAMENTAL COLLECTION

Keeping tropical fish, however, brings pleasure to millions of people and the trade can be an important source of income for local communities. Marine ornamentals have much higher value than food fish, and may provide a good alternative to other forms of fishing as for a certain amount of revenue generated, fewer fish are removed. The species involved are different from those targeted for food, and their collection could be seen as a complementary activity. Efforts are underway to train collectors in environmentally sound methods and transport methods are being improved to minimise mortality before the specimens reach their destination. Collection and trade in threatened or potentially threatened species, those that have poor survival rates in captivity and those for which there is little to no demand is being discouraged. The life cycle of a species plays a large part in determining how suitable it is for the aquarium trade. Species with slow growth and late maturation will be more vulnerable than those with rapid population turn-over. Corals capable of rapid growth and regeneration, such as *Acropora* spp. may be suitable but slow growing species such as *Porites* spp. usually cannot be maintained in captivity.

SUSTAINABLE MANAGEMENT

Collection of marine ornamentals is often regulated through national or municipal fisheries legislation and a permit is often required. All corals, Giant clams and some 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 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. MAC Certification requires compliance to established international, national and local regulations, assessment of sites before collection and implementation of a monitoring programme, and encourages the formation of no-take MPAs as replenishment areas within MAC Certified collection areas.

KEY POINTS FOR THE MPA

- **If an aquarium collector or dealer wishes to set up an operation in or near an MPA a very thorough EIA should be undertaken to determine if the operation is in line with MPA objectives.**
- **The collecting operation should be allowed to operate only if it has been approved by an environmental certification scheme (e.g. MAC which requires an EIA, management plan, and monitoring).**
- **Monitor collectors and the numbers of specimens collected, using, for example, the logbook methods developed in the Maldives and Sri Lanka; check figures against export data available from airport customs.**
- **A carefully developed zoning plan, ensuring that there are some areas with no collection, will be necessary (aquarium species are often found in very specific locations) and should be part of the overall MPA zonation. The zones should be monitored regularly (particularly nursery areas) and compared to detect any changes due to collection. 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.**
- **Ensure that local communities are involved in any development; since traders and exporters are often outsiders, local people may be overlooked.**

CASE STUDY

A potential new technique for rearing aquarium fish in the WIO

One potentially environmentally sound method is to catch post-larvae (juveniles that swim in open waters before metamorphosing and become reef-based) and rear these in captivity. The technique is well-developed and has been assessed in La Réunion, Mayotte and to a lesser extent Madagascar. A preliminary attempt was made in the Comores, in association with Moheli Marine Park, but was not continued. Reef crest nets or channel nets and light traps are used to harvest the fish larvae when they are most abundant, i.e. when they return to the reef and lagoon from the plankton stage and before they suffer high levels of mortality. Subsequent rearing of the caught fish in cages or inland systems increases the survival rate of the settlement stage by at least 80%.

In addition to exporting the reared fish for the aquarium industry, some of them could be released back onto the reefs. Their larger size means that they are likely to be less susceptible to predation, thus potentially enhancing local reef fish populations. The best location for release of reared fish could be an MPA. This relatively low cost technique may therefore be of value not only for supplying the aquarium trade but also for restocking MPAs. It could also provide employment and income for coastal villages as the methods involve relatively simple technology. However, further commercial testing is required to confirm that the approach is economically viable.

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Marine curios I9

Many MPAs 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 MPA 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 MPA.

Marine curios, and handicrafts or souvenirs containing marine products, are sold to visitors and tourists throughout the WIO, often in the vicinity of MPAs and in some cases within them, either by beach hawkers or even in shops managed by the MPA. 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 the WIO, cowries from Zanzibar were historically traded as currency, helmet shells were exported to Europe for the cameo industry (carved jewellery), *Murex* spp. to India for button-making and the Black-lipped Pearl Oyster (*Pinctada margaritifera)* for mother-of-pearl. The shell business in the WIO is currently small compared to that of SE Asia, but nevertheless shells are collected in fairly large numbers for sale to tourists, for export and for some handicraft industries. Tanzania (e.g. Songo Songo), Mozambique (northern Provinces) and northern Kenya (Lamu Archipelago) are among the main sources. 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.). Collecting is generally carried out by men, women and children on the reef flats at low tide, and men may also collect shells while snorkelling or diving.

IMPACT

For 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 the Great Green Turban (*Turbo marmoratus)*. Increasingly in the WIO, shells for tourists are imported from other countries, even from as far away as SE Asia. Since the 1970s, populations are considered to have declined in Kenya, a country where the most detailed research has been carried out. Densities of gastropod species that are important in the shell trade have been found to be slightly higher inside the Marine Parks than outside, which suggests that overcollection may be occurring. Studies here have also shown that some of the most valuable shells are naturally rare.

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 which has a direct impact on populations. An additional impact from 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 MPA is often banned or controlled, as part of general regulations prohibiting the collection of living animals. In most countries, live molluscs can only be collected and sold under licence (usually from the Fisheries Department), although in some, such as Mozambique, collection for subsistence purposes is unregulated. Curio shops usually require licences, but many beach vendors avoid licensing and there is little enforcement. A few countries protect certain species under national legislation. The Seychelles has established four Shell Reserves, specifically to protect molluscs valued for their ornamental shells, but these have not been actively managed and data are not available to assess their impact.

S. Wells

Opportunistic shell stall set up inside the Dar es Salaam Marine Reserve, Tanzania.

International trade in some marine curios is regulated, and MPAs 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 tortoiseshell jewellery (made from the shell of hawksbill turtles) were once widely sold but their trade is now strictly controlled; all marine turtles are listed in Appendix I of CITES which means export and import is prohibited.

KEY POINTS FOR THE MPA

- ❑ **Ensure that regulations concerning marine curio collection in the MPA are in place, are clearly understood by all MPA 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 MPA, particularly whole large ones.**
- ❑ **Do not allow sale of shells, corals or other marine curios (particularly of CITES-listed species) in the MPA, either on the beach or in souvenir shops, as this gives a bad impression.**
- ❑ **If there is good evidence to suggest collection of certain species is sustainable and in line with the management aims for the MPA, 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 Kiunga National Marine Reserve, Kenya

Licensed exploitation is allowed in Marine National Reserves in Kenya, especially when it involves an important income-earning activity for local communities. This is the case for shell collecting in Kiunga which is a major activity in the period April–September, during the south-east monsoon when there is less fishing. About 20 women and two men collect molluscs (principally Tiger *Cypraea tigris* and Gold Ringer *C. annulus* cowries) on the seagrass flats. After collection, they are buried to kill the living animals, the flesh is taken out, and the shells are boiled to remove the smell and then cleaned. The Gold Ringer cowries are threaded onto chains for sale to a local dealer for around 3-7 US cents each. The dealer sells them to exporters in Mombasa or directly to tourists in Lamu, where they may fetch US$3 per string. Tiger cowries are sold to the dealer for 8-30 US cents each, and are sold on in Lamu or Mombasa for about $ 0.7-1.0 each, as ornamental shells.

Lobster fishers also bring home any attractive molluscs that they find while snorkelling, particularly tritons, murex, helmet shells and the Great Green Turban. These are usually boiled, the meat consumed, and the shells sold to the local dealer for 8-40 US cents each. The dealer can make over 100% profit, depending on the species. The Giant Triton is the most valuable species and, being very rare, can be sold to dealers for over US$5 or directly on the street for $13-26.

Given concerns that such activities might not be appropriate in an MPA visited by tourists, encouragement is being given to women to collect shells washed up on the beach, rather than live molluscs. Many buyers are willing to take these and so the women still receive an income.

S. Wells

Curio stall on beach adjacent to Diani Marine Reserve, Kenya.

Tourism policy and planning

J1

Tourism and recreation are important activities in most MPAs in the WIO, providing revenue both for management and local communities. 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 focusing on the attractions of relatively pristine natural environments. A visit to an MPA is increasingly part of coastal holidays for foreign visitors, as well as an outing for local residents. Investors often want to construct tourism facilities near to an MPA, as this gives them additional marketing value. Visitors and tourism operators are thus key stakeholders in the MPA, bringing benefits through revenue and employment. Tourism can however have negative impacts through: increased resource use (for both food and souvenirs); habitat destruction and pollution from construction; social and cultural impacts; physical damage to sensitive habitats such as coral reefs and mangroves, and disturbance of wildlife.

Many MPAs in the WIO 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. There is much literature providing guidance on sustainable tourism, as well as international schemes that give recognition to initiatives adopting high environmental standards. An MPA may be able to link with one of these, or learn from the approach (see case study).

POLICIES AND PLANS

The policy should lay out how the MPA 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:

1. An explanation of the objectives of the MPA that relate to tourism and recreation, the activities to be encouraged or excluded in different zones, and the amenities to be provided;
2. The national context (e.g. tourism growth rates, impact of global or national socio-economic events) and policies concerning tourism development;
3. Carrying capacity and limits of acceptable change (see sheet J2);
4. 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 MPA is essential; and the extent to which tourism/ recreation is expected to provide income for the MPA and other protected areas in the national system;
5. Interpretation and education activities;
6. Recognition that tourism activities and infrastructure must respect MPA regulations and national legislation; these should meet required standards and demonstrate best practices; the MPA will benefit from this through good publicity and potentially tourism awards (see case study).
7. The roles of the MPA, government agencies, the private sector and local communities in tourism development in and adjacent to the MPA, and any potential or existing conflict between this and other economic activities e.g. fishing;
8. 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 MPA (e.g. use questionnaires or a comments book).

KEY POINTS FOR THE MPA

- ❑ **Be aware of national tourism policies and plans and participate in discussions about tourism develop-ments that relate to the MPA.**
- ❑ **Ensure that there is a policy, strategy or plan if tourism is important to the MPA, 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 MPA, financially or through management activities (e.g. beach clean-ups, removal of COTs, monitoring); 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 MPA 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).**
- ❑ **Respect EIA requirements and regulations when constructing tourism infrastructure within the MPA.**

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S. Wells

Tourism planning is essential to prevent damage to sensitive habitats, such as these sand dunes on Inhaca Island, Mozambique.

CASE STUDY

Ecotourism principles for Cousin Island Special Reserve, Seychelles

About 11,000 people visit Cousin Island each year to see the seabird breeding colonies, the endemic terrestrial birds, a restored coastal forest, and nesting hawksbill turtles. It has been recognised through ecotourism awards from British Airways and Conde Nast Traveller.

Nature Seychelles (the management agency) has a tourism policy and Tourism Code of Practice. The ecotourism operation on Cousin has been aligned to eight principles defined under the International Ecotourism Standard for Certification developed by a partnership comprising the Ecotourism Association of Australia, the Cooperative Research Centre for Sustainable Tourism of Australia, and Green Globe (a programme of the World Travel and Tourism Council). The facilities have not been certified, but the aim is to ensure that they ultimately meet ISO 4001 Standards. The principles are:

Natural area focus: The aim of a tour is to see very tame birds and wildlife - a unique experience for visitors.

Interpretation: The Wardens are trained as guides and are bilingual (English and French), ensuring visitors increase their appreciation of nature.

Environmental Sustainability Best Practice: To reduce impact: guided tours are limited to half days, four days a week; there is no picnicking, overnight accommodation, or taking of specimens or souvenirs; distance is kept from nesting birds and turtles; mooring buoys have been installed; and the reserve uses solar power. Wardens may stop anyone suspected of violating Reserve Regulations.

Direct contribution to conservation: Revenue generated from landing fees (US$25 for overseas visitors) and sale of T-shirts, drinks and postcards covers most Reserve management costs, some goes to conservation and environmental education projects at other sites, and some to the Local Environment Action Programme (LEAP) which funds small conservation activities.

Benefiting local communities: Ecotourism generates over US$600,000 annually to local people through employment (Reserve staff, transportation, tour operators), and accommodation on adjacent Praslin I.

Cultural respect: All the Reserve staff are Seychellois.

Customer satisfaction: Over 90% of visitors questioned in 2003 found the tours informative, interesting and well organized, with many willing to pay more.

Responsible marketing: Visitors receive a free booklet, and information sheets are sent annually to operators; the possibility of rough boat rides, mosquitoes, a humid forest, and the need for personal insurance are highlighted.

Visitors and carrying capacity

J2

MPA personnel may devote a large part of their time to management of visitors and recreational activities. An MPA manager may want to quantify or predict at what point environmental damage may occur from this and so needs to understand the concept of carrying capacity. 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 MPA, 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 MPA 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. swimm--ing, 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 MPA. 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 MPA can provide. Many tourists visiting an MPA want to increase their understanding of marine life and what the MPA 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 CAPACITY

An MPA manager often wants to know how much use the MPA 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 MPA 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.

Most published studies concern 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.

Thus, carrying capacity may have limited practical application. 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. 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 MPA. 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 MPA, the cultural and heritage values, social customs and the visitor experience itself.

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

S. Wells

A crowded beach bordering Diani Marine Reserve in Kenya. Visitors in such numbers need careful management.

developed another method, based on what is termed 'Thresholds for Potential Concern' for determining when management intervention is needed in a certain situation.

MINIMISING VISITOR IMPACT

If it seems that an MPA 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.
- 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.
- 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.

KEY POINTS FOR THE MPA

- ❑ **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 MPA personnel are familiar with them and can explain why certain activities and behaviours are not allowed.**
- ❑ **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 MPA 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 MPA (see sheet D4).**

Visitor guidelines and codes-of-conduct can be made available at the MPA 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 MPA regulations are observed. Fields 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.

Sources of further information

(see also J1 and J6)

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Coral Reef Alliance (CORAL) – **www.coral.org** - fact sheet on carrying capacity.

Saba Marine Park Management Plan: **www.sabapark.org/studies/lac_plan.pdf**

Publicity materials & promotion

J3

Publicity materials and other promotion tools (often referred to as 'communication' tools) are essential for raising awareness about the issues that an MPA is addressing, and for education and advocacy. However, MPA personnel often lack the appropriate skills and experience for developing these. This sheet describes some of the approaches and materials that can be used.

Publicising and promoting an MPA is essential for many reasons, including:

- Raising awareness among stakeholders and encouraging their participation;
- Changing people's thinking and behaviour in relation to a particular issue (e.g. dynamite fishing);
- Informing people about the MPA and its achievements and any changes in regulations or management activities;
- Raising awareness about the MPA at regional and international levels to strengthen linkages;
- Assisting with fundraising.

Tools for communicating information about the MPA 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, but can be improved through training and practice. Some MPA staff, particularly the manager and public relations or community development officers, have to do this regularly and so training will be beneficial. Different types of presentations are required depending on the purpose and target audience (politicians, donors, visitors, scientists) and it is important that the contents are adapted as appropriate. 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 (see the WIOMSA Training Manual for MPA managers for advice).

A 'communications strategy' is a useful tool for planning and fundraising, and is sometimes part of the 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 (involving the '4-P Workshop'), which can be used to identify the Problems, Public, Products and Plan that are needed for effective awareness raising and communication (see WIOMSA Training manual). 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

Posters – Relatively inexpensive and can be displayed in numerous locations, such as the MPA buildings, public buildings, community halls, and schools. Designs should be kept simple and eye-catching, with minimum text and a strong clear message.

Leaflets – Generally inexpensive and can be used for advertising events and short term activities; a general leaflet about the MPA is also useful.

Longer brochures and pamphlets – Useful for describing the MPA in more detail, or for specific topics of interest.

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 MPA.

Calendars – Have the advantage that they are displayed for at least a year and often have space for different messages and images. Mafia Island Marine Park produced a calendar in Swahili, giving both international and Muslim dates, which proved very popular with local fishing communities. Calendars have since been produced by other Tanzanian MPAs.

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.

Video – Production (and screening) of a video requires careful thought. The costs can be considerable (a 30-minute documentary might cost US$ 5,000 - 20,000), but a video can disseminate a message more strongly and more widely than printed material. Consideration should be given to VHF versus digital and DVD formats. Moheli Marine Park (Comores) and Kiunga National Marine Reserve (Kenya) both produced videos that have brought these MPAs international attention and helped fundraising.

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 MPA is being actively managed. Many MPAs in the WIO 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.

USING THE MEDIA

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 (see WIOMSA Training Manual). The establishment of contacts within the media is always useful. Regular stories in local newspapers (or a regular column) about the MPA can be an invaluable means of integrating it in community life. When interesting events happen in the MPA (e.g. whales observed passing through the MPA, coral bleaching event, visit by an important dignitary, a school trip, or workshop), inform the media and provide the necessary information for a story.

SPECIAL EVENTS AND EXHIBITIONS

Publicising the MPA 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.

KEY POINTS FOR THE MPA

- **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 of the audience and is it literate?).**
- **Check all publicity materials, press releases and other products for accuracy, and to ensure that they are in line with agreed policy. Disseminating incorrect information about an MPA 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 MPA immediately recognisable.**
- **Following dissemination of publicity material, evaluate and quantify their usefulness so that improvements can be made in the future;**
- **Develop a logo – either for the MPA itself, or for the management agency.**

Sources of further information

Conservation International. 1999. *The 4-P workshop. Designing Communications Strategies for Conservation Projects*. Conservation International, Washington D.C., USA.

GreenCom (Strategic Participatory Communications): **www.greencom.org** - provides resources and information.

IUCN Commission on Communication and Education: **www.iucn.org/themes/cec** - provides information and resources on communication, media and public relations.

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Shoals Rodrigues Associaton. **www.shoalsrodrigues.org**

Educational activities

J4

Careful thought should be given to developing an environmental education programme, especially in MPAs 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 MPA may provide a framework for developing an educational programme, but this is often overlooked. By working with schools, fishing groups and local government departments, the MPA can help to stimulate environmental awareness and to develop local capacity for marine resource management. MPAs 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 MPA can help before starting an education programme. These might include:

Universities and institutions - The MPA 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 MPA to broader issues that are being taught. A good contact point within the school is essential for liaison with staff and parents.

General public and local communities - The MPA 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 MPAs.

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 MPA 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 MPA. 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 Kenya Wildlife Service and the MPAs organise an annual Marine Environment Day).

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 MPA 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 MPA 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 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 MPA

- ❑ **Develop an environmental education programme if this is appropriate, particularly if education is one of the objectives of the MPA; if there is no education officer, find a means of obtaining the necessary staff capacity or a volunteer.**
- ❑ **Develop a monitoring system to measure whether environmental awareness is increasing as a result of MPA 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.**

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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**

Shoals Rodrigues Association: **www.shoalsrodrigues.org** – can provide a range of educational materials (see case study).

Teaching and Learning for a sustainable future: **www.unesco.org/education/tlsf/** - a multimedia teacher education programme.

International Centre for Conservation Education: **www.icce.org.uk** – affordable conservation education materials, including a CD on protected area case studies.

IUCN Commission on Education - a global network of experts in environmental communication and education; various materials available through **www.iucn.org/cec/**

T. Hooper

Group discussion among Club Mer members on Rodrigues.

CASE STUDY

Environmental Education, Rodrigues, Mauritius

A marine environmental education programme has been underway on Rodrigues since 1999, developed by the Shoals Rodrigues Association, a programme providing technical support on marine conservation, including the establishment of MPAs. Funding comes from several commercial sponsors and donors (including the SEA Trust), and from sales of a board game (Coralation) and a video (The Reef Beneath) produced through the programme.

Club Mer is aimed at students aged 14-21 years and has many members. Two previous members are now the education officers and organise the activities, visiting secondary schools and encouraging membership. The main initiative is a 20-module course on coral reefs, with subjects ranging from coastal dangers to oceanography and coral reef fish. Teacher notes, power point presentations, and demonstration and activity guidelines for the modules are available. There are also courses on swimming, snorkelling and diving. The 'Lagoon Snorkeller' and the more advanced 'Reef Snorkeller' are 10-module courses, led by an instructor, that cover techniques and theory about equipment, safety procedure, ecology and conservation and, in the more advanced case, basic survey techniques. Student manuals are available for these. Students can also work towards other certificates such as 'Fish Watcher', 'Beach Patrol' and 'Oceanographer'.

Primary school children are targeted through programmes in their own classrooms. Workshops have been held to show teachers how marine education can be incorporated into the curriculum. Each primary school has been given a 'treasure chest' of resources such as posters, modelling clay, paints and games and a 120-page teacher pack (Discovering the Ocean World) containing lesson plans, curriculum objectives and activities.

Students are encouraged to come to the Shoals Rodrigues Centre at other times to read books, watch educational videos and undertake their own projects. There have been a variety of special events such as Open Days for families and other Rodriguans, picnic outings, beach clean ups and carnivals. Rodrigues is at an early stage in developing MPAs, and the strong basis of understanding that the education programme will engender in local people, passing from students into the communities, will help generate support for MPAs. Individual MPAs in other countries are unlikely to be able to develop such a comprehensive programme, but many of the ideas could be adapted.

www.shoalsrodrigues.org

Visitor centres J5

A centre where visitors can learn about the MPA, and the natural environment that it has been set up to protect, is a very useful addition to the MPA facilities and can become a major focus of MPA 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 MPA 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 MPA has been set up for, and has several aims. These include bringing alive the meaning of the MPA 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 MPA 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 MPA;
- How the MPA is managed;
- A map of the MPA and surrounding area;
- Ways in which visitors can help with the management or funding of the MPA.

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;
- Language of displays – labels and information should include local languages and also the language of the main groups of tourists visiting the MPA;
- 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 MPA 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 follows 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

M. Richmond

A range of graphic displays used at the Jozani Forest - Pete mangrove boardwalk visitor centre on Zanzibar.

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 MPA

- ❑ **If your MPA 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 MPA 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.**

S. Wells

Curieuse Marine Park visitor centre.

Sources of further information

Eagles, P.F.J., McCool, S.F. and 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**

CASE STUDY

Curieuse Marine Park visitors centre

A two storey visitors centre has been developed at Curieuse Marine Park, in a renovated, historically important building (previously the house of the doctor who was in charge of a leprosy centre on the island in the 19th century). On the ground floor there is a display on historical and cultural aspects of the island. The display panels are portable. Upstairs there is an interactive educational exhibition on the natural history and conservation of Curieuse and coastal Seychelles, prepared by local people using local materials. Use is also made of the upstairs veranda for displays. Visitor numbers to the Marine Park appear to have increased, partly as a result of the Centre; many tourists visit Curieuse Marine Park from charter boats, yachts, cruise ships and on day trips from Praslin. Most display materials are labelled in English, French, German and Italian, a few have information in English and French only. There are a number of specially prepared puzzles, portable board games and card games for children but outreach would be easier if there was a trained education officer. However, some exhibits were successfully transported to the main island of Mahe for the annual SUBIOS underwater festival in 2003.

The panels of the ground floor are imported from the UK and made of a plastic material that should not be allowed to get wet. This is unfortunate as the room has shuttered doors on all four sides which are preferably left open to allow light and cool breezes to enter, but which also let rain in if they are not promptly shut. Furthermore, tourists coming off the beach bring in seawater and sand. The Centre insists that visitors dry themselves first, but this can be embarrassing and is not always well accepted by visitors. The Centre is looked after by one of the Park staff. T-shirts, posters and paintings of underwater life are currently sold and it is expected that sales of booklets, maps of Curieuse, postcards and other materials at the Centre will help to fund its maintenance. Snacks and drinks are also sold.

The Centre has received large numbers of visitors as evidenced by the visitor's book, and most have been very appeciative. Although the visitor centre is popular with children who reach Curieuse, school visits are relatively scarce due to lack of financial support for such activities, but it is hoped that this will gradually change.

Visiting the reef

J6

Coral reefs are a major attraction in many WIO MPAs for tourists and local visitors. Reef-related activities encourage people to take an active interest in the MPA 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 with bush walking 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. Reefs are home to many harmful creatures, and diving and snorkelling can be dangerous if individuals are not experienced or supervised (see sheet D4).

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. However, research suggests that most divers and snorkellers have little negative impact and there is no evidence that they cause declines in coral diversity or abundance.

Many MPAs have codes of practice or guidelines for divers and snorkellers. For example, in Brazil, guidelines were produced through a national workshop. Dive boat operators using an MPA should be required to implement best practices. These include: securing trailing 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. 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).

S. Wells

A glass bottom boat in Mombasa Marine Park, Kenya.

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, 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 (but this must not be used to poke animals). If an organism is picked up for interpretation, 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. 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. 1 kg/day/site), should be used.

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 corals, 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 MPA

- ❑ **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.**
- ❑ **Pre-departure briefings by tourism operators or MPA personnel should be essential, using or adapting existing codes-of-conduct.**
- ❑ **Regular meetings can be held with boat and dive operators to inform them of MPA 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.**

Sources of further information

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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.

Guidelines for Recreational Diving in Marine Protected Areas – Portuguese with English summary. Contact: Associação Cunhambebe, Brazil. **www.cunhambebe.org.br**; and **www.ambiente.sp.gov.br/cemar**

Co-operative Research Centre for the Great Barrier Reef World Heritage Area – **www.reef.crc.org.au** – information on many reef related tourism activities.

Coral Reef Alliance (CORAL) – fact sheets on coral friendly diving and snorkelling. **www.coralreefalliance.org/parks/guidelines.html**

Great Barrier Reef Marine Park Authority: Best Environmental Practices – Snorkelling and Diving. **www.gbrmpa.gov.au/corp_site/key_issues/tourism/diving.html**

PADI Project AWARE Foundation – **www.projectaware.org** – information for divers on helping to protect the marine environment; also provides trainers for MPA courses targeting dive operators - see **www.komodonationalpark.org/downloads/dive%20workshop%20report.pdf**

UNEP-WCMC/WMO/UNEP-GPA (eds.) 2002. UN Atlas of the Oceans. (electronic book) **www.oceansatlas.org**

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**

CASE STUDY

Reef visits at Chumbe Island, Zanzibar

Tourists, local and international education groups, and government officials regularly visit the reef at Chumbe Reef Sanctuary. Group size is limited, and the rangers act as guides. Novice snorkellers are given lessons, and lifejackets are provided if necessary. Covered inner-tubes, known as Floating Information Modules (FIMs), with fish identification guides attached, are used for resting or as a buoyancy device for less confident swimmers. Snorkelling is restricted to periods of mid-tide, so that fins do not touch the reef if the snorkeller is vertical in the water.

The ranger gives a simple but comprehensive introductory talk, including a description of the MPA, information on coral and fish species, the reef in general, and safety, and a request not to touch anything or kick corals. After questions, the ranger enters the water first with the FIM and waits for the snorkellers. They drift with the current in order not to have to swim far or fast, the boat drifting with them nearby but giving them enough space. A snorkel trail was set up, consisting of three stationary FIMs (removed after each snorkel session) attached to concrete-filled tyres on the substrate. This is no longer regularly used as the FIMs proved time consuming to set up, and snorkellers tended to spread out between them and were difficult to manage and check for safety.

www.chumbeisland.com

Artificial reefs J7

Artificial reefs are established for a range of purposes including fisheries enhancement, 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 MPAs.

An artificial reef is a structure that is deliberately or accidentally introduced to the seabed and that attracts marine life. It provides shelter from predation and surfaces for larvae to settle on; the organisms that are attracted create new food sources and thus attract other species. Coastal communities in some countries have traditionally used artificial reefs to increase their catches. They are now established with the involvement of governments, the private sector and NGOs for many reasons, using a diverse range of materials from disused oilrigs, ships, vehicles and railway tracks, to purpose made concrete blocks and bamboo structures; in the US and Japan, artificial reef construction is a major commercial activity.

The purpose of an artificial reef determines how it is installed, the materials to be used, and whether it is an appropriate activity. Some artificial reefs may fulfil more than one purpose, but all artificial reefs 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.

Artificial reefs are usually installed for the following reasons:

FISHERIES ENHANCEMENT

Despite much research, the role of artificial reefs in fisheries enhancement is controversial. Some studies indicate that production is enhanced, but others suggest that artificial reefs act more as a Fish Aggregating Devices (FADs) (see sheet I4), concentrating fish but not increasing overall population. An artificial reef can very quickly display high fish densities and attract heavy fishing, but the surrounding area may experience a reduction in fish populations. Artificial reefs thus potentially contribute to overfishing unless carefully managed, and 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 artificial reef should develop to have similar species diversity and population densities as natural reefs nearby.

In SE Asia, artisanal fishing communities traditionally used natural materials such as bundles of brushwood, boxes of leaves and coconut palm fronds to attract fish. Now a range of materials, including tyres, are used. The topography and height of the structure are believed to be important in attracting certain fish species.

Artificial reefs 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 MPA and should only be attempted in close consultation with all involved. Artificial reefs can, however, reduce pressure on natural reefs by redirecting fishing and tourism elsewhere (see case study).

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 polluting and able to withstand extreme weather conditions. Wrecks must be thoroughly cleaned and materials that might result in pollution (e.g. cables, 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, artificial reefs should be placed in 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).

B. Phillips

D. Obura

The sinking of the *Dania* (above) off the Kenya coast has provided a site for recreational diving and scientific research, and has attracted large shoals of fish (below).

COASTAL PROTECTION

Specially designed modular artificial reefs can be used as submerged breakwaters to protect coastal areas from erosion. This should only be considered if expert advice is available (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 MPA

- ❑ **Before installing any artificial reef, clearly define the purposes for which it is needed. MPAs 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 artificial reef in relation to other fisheries management mechanisms must be considered.**
- ❑ **An EIA may be a legal requirement (see sheet A6) but if not, a full assessment of the environmental and socio-economic impact of the proposed artificial reef should be undertaken.**
- ❑ **If installing an artificial reef, consider doing so in partnership 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.**
- ❑ **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.**
- ❑ **A baseline survey of the seabed is required before installation, and the development of the artificial reef should be monitored.**

Sources of further information

(see also sheet H6 Coral reef rehabilitation)

Clark, S. & Edwards, A.J. 1999. An evaluation of artificial reef structures as tools for marine habitat rehabilitation in the Maldives. *Aquatic Conservation: Marine and Freshwater Ecosystems* **9**: 5-21

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Seaman, W. Jr. (ed.) 2000. *Artificial Reef Evaluation with Application to Natural Marine Habitats*. CRC Press. 246pp.

www.artificialreefs.org - resource page on prefabricated artificial reef units.

Reef Ball: a US-based organisation promoting prefabricated concrete artificial reefs: **www.reefball.com** - Reef Ball Foundation Services Division; **www.reefball.org** - Reef Ball Foundation Charity Division, an associated non-profit charity that provides grants.

NOAA Coral Health and Monitoring Programme: **www.coris.noaa.gov** and **www.coral.noaa.gov** - information on artificial reefs.

CASE STUDY

Artificial reefs in Mauritius

Since 1981, fourteen ships have been sunk by the Mauritius Marine Conservation Society (MMCS) in association with relevant authorities such as the Ministries of Fisheries and Environment and the Port Authority. The aim was to create artificial reefs for marine biodiversity conservation, as MMCS was concerned about the lack of MPAs set aside for this. The six Fishing Reserves in Mauritius receive little active management, having been established primarily to protect fish breeding and nursery areas. Pelagic fish were attracted within weeks of the sinking of each vessel, and all now have benthic fish populations and are covered with soft corals and algal growth.

However, the early reefs became a major attraction for fishers and were quickly over-exploited. Subsequently, awareness-raising by MMCS and the demonstrated benefits from the increased diving industry (fishers provide boat services for tourists) has led to an acceptance of their value in many parts of the island, with less fishing (despite no legal protection) and some fishers are involved in their installation. On other parts of the island, fishing communities are opposed to them fearing that they will cause a navigation hazard. Overall, the wrecks are considered to benefit the tourism industry, and have a conservation benefit by reducing diver pressure on natural reefs, enhancing biodiversity, and providing an education opportunity. They have also stimulated awareness of the need for MPAs, and two Marine Parks have been designated, one of which includes an artificial reef.

The location for each artificial reef is carefully selected (usually a bare area so that no damage is done to marine life, and near a natural reef to facilitate recruitment). One of the first lessons learned was the difficulty of ensuring that the ships settle at the chosen spot. The first wreck was sunk with dynamite which caused much damage to its superstructure. Vessels are now sunk more slowly by allowing water into their hulls but this means that they may drift away from the planned site while sinking. One ship sank so slowly that it was lost and not found for 10 years, a mile from the planned location and at 70m depth, beyond the range of normal SCUBA diving. The wrecks also tend to get damaged and moved by cyclones and heavy swells. Costs are reduced by using voluntary assistance from the MMCS, and by using old barges, fishing boats and ships abandoned in the port.

Artificial Reefs of Mauritius: special issue of *Diodon*, newsletter of the Mauritius Marine Conservation Society. **http://pages.intnet.mu/mmcs**

Visiting the mangroves

J8

Many MPA 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 on 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 WIO 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 wells 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 pedestrian, as well as cyclists, wheelchairs and children's pushchairs.

Well-situated, designed and constructed boardwalks can raise public perceptions and increase stewardship for the forest among users. They are a powerful tool for recreation and education in an MPA and as such, construction and maintenance of boardwalks can be an important management activity. Examples from the WIO include: Pete-Jozani Mangrove Boardwalk Zanzibar, Tanzania; and three in Kenya, including those at Mida Creek in Malindi Marine Reserve, and Wasini Island (see case study). Many boardwalks are capable of generating enough funds from visitor usage to cover maintenance costs and provide a contribution to community development projects. For example, 25% of the visitor's fee for the Pete-Jozani boardwalk goes directly to the local community of Pete village. Boardwalks in other habitats can also be a useful visitor facility, such as the Gonubie River Mouth Boardwalk, Eastern Cape, South Africa.

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. The Pete-Jozani boardwalk is U-shaped. 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. 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 to be aesthetically pleasing.

The deck height must be carefully calculated. For the WIO island states and Madagascar's east coast maximum tidal range is about 1.5m, but for most of Eastern Africa and Madagascar's west coast, it can be up to 4m. The

S. Wells

Wasini Island boardwalk.

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 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. The Pete-Jozani boardwalk is 220m long and the Wasini boardwalk is some 1,500m long. Widths are usually 1.5–5.0m. Short wider sections can be incorporated to provide space for educational displays, exhibitions, performances or other activities. Deck surfaces should not retain water and may need to be smooth to meet wheelchair requirements. Spacing between wooden planking can prevent water accumulating. Bannisters 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. In Zanzibar, the 220m Pete-Jozani boardwalk was constructed over three months in 1997 and cost about US$ 8,000. The Municipality of Gonubie invested about US$ 17,000 in a 500m boardwalk.

KEY POINTS FOR THE MPA

- ❑ **Investigate the options for establishing a mangrove boardwalk or other mechanisms for visitors to experience mangrove forests.**
- ❑ **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.**

Sources of further information

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Skilleter, G.A. & Warren, S. 2000. Effects of habitat modification in mangroves on the structure of molluscs and crab assemblages. *J. Exp. Mar. Biol. Ecol.* **244**: 107-129.

Environmental Planning Department. 1997. Port of Durban: Bayhead Natural Heritage Site. Port of Durban Pamphlet, October, 6pp.

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

CASE STUDY

Wasini Mangrove Boardwalk, Kenya

In 2001 a mangrove boardwalk was built on Wasini Island, adjacent to Kisite Marine Park and Mpunguti Marine Reserve. The boardwalk extends from Wasini village, through a unique fossil 'coral garden' and into the mangrove forest over a distance of 1.5 km. The fossil coral area had long been an attraction for tourists, intrigued by the strange shapes of the weathered rocks, but there was no organised system for visiting the area. The Kenya Wildlife Service (KWS) was searching for activities that would demonstrate the value of the natural environment and the idea for the boardwalk arose from discussions with the village women's group who had heard of boardwalks elsewhere.

The Wasini boardwalk was constructed by KWS staff and villagers, with technical assistance from a construction engineer experienced in building in similar environments and financial support from the governments of Netherlands and Germany. The 70 or so member women's group are responsible for its management, collecting visitors fees, and providing guiding services. IUCN organised training in book keeping and group dynamics, provided women with management skills, and some members were trained in customer care, visitor handling, and basic natural history of mangroves. The group developed their own guidelines for management of the boardwalk.

The visitors' fee was negotiated at a meeting between the women's group and locally-based boat operators who are responsible for transporting most visitors to the boardwalk. Non-residents pay about US$1.25, residents about US$0.75. The revenue generated is used to maintain the boardwalk, with any remainder going to community development activities that are identified and prioritised by the group. Since the inauguration of the boardwalk several thousand dollars have been generated, bringing considerable benefit to the local community, and encouraging them to support the MPA.

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 MPA manager some guidelines.

Coastal dynamics are a complex and poorly understood issue, 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 a decade or even generations. 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 15-95cm by 2100, with a 'best estimate' of 50cm.

EROSION

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. At Kunduchi Beach, north of Dar es Salaam, hotel development and stream bed mining contributed to major shoreline changes, with over six hectares of land being lost in a few years, extensive damage to properties and coconut trees, and new beaches being created elsewhere.

S.Wells

Collapsing sea walls, such as this one in Moheli Marine Park, Comores,are a common result of beach erosion and emphasise the need for set-back regulations.

The continual movement of sand and sediment along the shore or on and off it by waves and currents, known as littoral transport, 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 also results from reduced replenishment, if dunes have been lost or stabilised by vegetation or if sand is mined. It may also occur where vegetation and flotsam and jetsam are regularly removed from beaches by hotels (see case study), and where protective coral reefs have been destroyed.

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 increase erosion. For example, seawalls erected to prevent erosion may increase it by cutting off the supply of material from the land.

LIVING WITH CHANGING COASTS

Current thinking is that 'soft-engineering' is the best way to deal with shoreline changes, which means accepting natural change and building on natural protection systems. Techniques include:

- Beach nourishment (putting sand back where it has been lost), and using coconut matting and jute mesh for sand dune stabilisation;
- Defining setback lines in legislation for coastal construction; for example, in Mozambique and Tanzania these are 100m from highwater mark (and see case study for Kenya);
- Minimising damage to coral reefs and promoting their growth (see sheet H6) or creating artificial reefs, to absorb wave energy, and protecting mangroves and other coastal ecosystems that provide protection.

IMPACTS OF COASTAL ENGINEERING

It is often essential to carry out engineering activities, such as construction of harbour and landing facilities, within the boundaries of an MPA. An MPA will also be affected by engineering activities that take place outside its boundaries. In some cases, an MPA will have to face the consequences of erosion and take a decision on whether to try to mitigate impacts from this. 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 MPA 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 become artificial reefs and can perhaps be left unless they are a hazard to navigation or fishing (see sheet J8).

Dredging should be avoided as it is expensive and, if undertaken to facilitate navigation, often has to be repeated regularly. Unless professionally carried out with silt curtains and screens, damage to adjacent coral reefs is likely to occur.

KEY POINTS FOR THE MPA

- ❑ **Monitor shore line changes within the MPA 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 MPA 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 and lobby for banning of sand mining from areas adjacent to the MPA, to maintain sources of beach sand replenishment.**
- ❑ **Ensure that full EIAs are carried out for any construction or activity that might affect the MPA (see sheet A6).**
- ❑ **Provide guidelines for hotels concerning beach raking.**

Sources of further information

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Ochieng, C.A. & Erftemeijer, P.L.A. (1999). Accumulation of seagrass beach cast along the Kenya coast: a quantitative assessment. *Aquatic Botany* **65**(1-4): 221-238.

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CASE STUDY

Managing beaches in Kenya

Kenya's beaches are vitally important for tourism and coastal protection and many beaches lie within the six MPAs. The Kenya Wildlife Service (KWS) and other stakeholders thus play an important role in their maintenance.

Environmentally sound beach cleaning - Large banks of seaweed and seagrass are deposited during the south-east monsoon, helping to prevent erosion by reducing loss of sand through backwash and wind, whilst the floating material dampens wave action. The beachcast contains numerous invertebrates that provide food for fish at high tide, and crabs and shorebirds at low tide. However, it is not aesthetically pleasing for visitors and so hotels bury it under the sand each day, which increases erosion as the sand is loosened and left unprotected. KWS has therefore produced guidelines to encourage hotels to leave the beachcast unless it is several feet thick, and then to remove only the top layers, using it as mulch rather than burying it. If removal is essential, a rake with large spaces between the teeth is recommended to minimise the amount of sand disturbed. Visitors should be sensitised to the role of beachcast in erosion prevention and as a food source.

Enforcement of set-back lines - Kenya's MPAs have a set-back regulation of 100ft (30.7m) from the high tide mark in which permanent structures may not be built. However, many structures existed before the MPA regulations were put in place, and property owners adjacent to Mombasa Marine Park have also rebuilt or extended seawalls and beach-front restaurants and bars farther out over the beach. This is counter-productive, causing further erosion. The seawalls thus require constant rebuilding and beaches in front of them can be 1m lower than those on properties with no sea walls. In 2003, unusually high equinoxal tides in April and October caused extensive erosion and demolition of many walls, some installed only three months beforehand. Some 3-4m of land was lost along the beach adjacent to the Marine Park. Some owners rebuilt their walls within a few meters of the previous ones but these are likely to succumb to further erosion. At some other MPAs, set-back regulations are being observed; for example, the warden of Malindi Marine Park managed to halt construction of a hotel that was too close to the high water mark.

Nutrient and sewage pollution

K2

Nutrient and sewage pollution may affect MPAs from sources both outside and within the boundaries. Ensuring good water quality in the MPA 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 MPA.

Wastewater discharges, including domestic waste and sewage, effluent from commercial and industrial establishments, and urban run-off, combined with agricultural run-off and aquaculture waste which 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 MPA. International standards for water quality in recreational areas exist but have not been applied widely in the WIO, although South Africa and Mauritius have national guidelines. 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). 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 MPA

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. MPA 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.

REDUCING SOURCES WITHIN THE MPA

Wastewater treatment can be very expensive, particular 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 MPA is connected to the main sewerage system, treatment will occur off-site and the MPA itself may have little influence on methods. However, there are simple, inexpensive options that an MPA should consider for disposing of waste water and sewage on-site, and in many MPAs 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.

Re-use 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.

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 MPA in themselves.

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 ground water 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

N. Boucher

Healthy corals in an undisturbed reef area of La Réunion.

the sewage can be piped out to deep water with good currents, where its impact will be minimised.

KEY POINTS FOR THE MPA

- ❑ **Monitor nutrient levels within the MPA 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 MPA from coastal development activities; lobby for effective use of EIA to help mitigate such threats (see sheet A6).**
- ❑ **Within the MPA, 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 MPA as a demonstration model.**

Sources of further information

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

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*. The 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.html; www.vetiver.com (in English and French)

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**

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 MPA on La Réunion. Planch'Alizés is a degraded area of the Saint-Gilles/La Saline fringing reef characterized 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 which 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 MPA 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 waste water disposal mechanisms. In La Réunion, this goes beyond the direct mandate of the MPA. However, representatives of the organisations involved in the economic development of the watershed are being sought to participate in the management structure for the MPA.

O. Naim

Dead coral with high macroalgae cover in a reef area of La Réunion following high urban and agricultural pollution.

Oil spills can result from local incidents within an MPA or from events hundreds of miles away that cause oil to be washed ashore in an MPA. The seriousness of the impact will depend on the species and ecosystems present, and the type and quantities of oil. MPA staff must be prepared for dealing with an oil spill and practised in the procedures for different scenarios.

Each year about 5,000 tankers use the Mozambique Channel and some 30% of the world's oil is transported through the WIO. This emphasises the need for MPA 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;
- River discharge and terrestrial run-off containing oil.

Many countries in the WIO 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 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 weather, and this speeds up biodegradation.
Emulsification - Rough seas can stir oil slicks into an emulsion which 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 re-settlement. 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 in-fauna 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). MPAs should have an Oil Spill Contingency Plan (OSCP) and be aware of national OSCPs produced by harbour authorities or environment departments, and other emergency procedures (see Sheet D4). OSCPs are generally divided into 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 MPA 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;
- 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 MPA

- ❑ **MPAs should ensure procedures are in place to prevent local spills within MPA boundaries.**
- ❑ **An OSCP should be prepared for the MPA especially if there is no national plan; if there is a national OSCP, MPA personnel should be aware of, and fully understand it, and have good relations with those responsible for it.**
- ❑ **Where necessary, MPAs should lobby governments to adopt legislation minimising oil spill risks, e.g. reducing the risk of vessel collisions near the MPA. Aldabra World Heritage Site, Seychelles, recently successfully lobbied for a shipping exclusion zone around the atoll.**
- ❑ **Ensure responsibilities of the MPA and other organisations are fully understood in relation to different types of oil spill.**

Sources of further information

International Petroleum Industry Environmental Conservation Association (IPIECA): **www.ipieca.org** - produces 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 Enviro-nmental 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

Oil spill at St. Lucia World Heritage Site, South Africa

In September 2002, a fire caused the freighter *Jolly Rubino* to ground 12km south of the St. Lucia estuary, adjacent to the St. Lucia Marine Protected Area, about 300m from the shore, and accessible only at low tide. The cargo included fuel oil, gasoil, hazardous chemicals and stainless steel. Two tugs, an oil pollution abatement vessel and patrol aircraft, and two helicopters were mobilised immediately and the crew was airlifted off. A disaster management committee was established; pollution control experts, conservation officers and volunteers were brought in to help; the army was used to control public access; and a coordinator responsible for liaison between the conservation agencies was appointed. KwaZulu-Natal Wildlife (EKZNW) prepared detailed plans outlining vulnerable ecosystems, preventative measures required, and proposed rehabilitation measures.

J. Harris

The *Jolly Rubino* still ablaze and spilling oil off the coast of Natal in late 2002.

About 650 tonnes of oil was spilled but most slicks veered out to sea and broke up. Some oil washed ashore, mostly as thick tarry lumps, and was removed by EKZNW staff. Oil pollution of estuaries and mangroves was prevented with floating absorbent booms and other mechanisms. Monitoring programmes were put in place very quickly, involving daily bird surveys and aerial surveys for marine mammals and whale sharks. The initial salvage plan was to patch the hull, pump out seawater and re-float the vessel. Concerns that this might weaken the hull, spilling the remaining fuel, and the difficulty of access, meant that the remaining 400 tonnes of fuel was ultimately pumped to another ship. In February 2004, cargo was still being removed, demonstrating the long time that such operations can take.

The incident involved a prolonged fire, hazardous chemicals, oil, and bad weather, but there was no loss of life and negligible environmental damage. This highlights the value of having effective oil spill contingency plans and personnel adequately trained. Although South Africa has more resources than many WIO states, the principles involved and the careful planning could be addressed by most MPAs in the region.

Solid waste disposal

K4

MPAs have to deal with a variety of forms of solid waste, some of which is generated within the MPA and some of which will come from beyond its boundaries. This sheet describes how an MPA 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 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 is 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.

DEBRIS FROM OUTSIDE THE MPA

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) technically limits some of this. Some floating materials remain offshore for years and eventually sink, but many eventually wash ashore. An MPA has little control over this but can participate in activities to reduce it and to clean it up.

S. Wells

Solid wastes are often dumped on the shoreline, as seen here in the Comores.

Few MPAs in the WIO are serviced by municipal solid waste agencies but it may be possible to raise awareness about the issue. Depending on the situation, the MPA or a local authority will be responsible for cleaning beaches. Through reporting of incidents and problems, and by creating publicity, the MPA can help to improve waste management. An MPA 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 4000 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 MPA

Construction and maintenance of buildings and facilities, as well as day-to-day operations, generate a range of solid waste materials within the MPA. A waste management strategy should therefore be prepared, based on three guiding principles:

1. **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.
2. **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.
3. **Select** products that use recycled materials.

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 MPA 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. Tyres can be re-used (e.g. for artificial reefs, sandals), as well as flipflops (see case study). 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 reefs. Re-use 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 WIO climate.

Burial, or dumping 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 ground water 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 MPA

- ❑ **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.**
- ❑ **MPA authorities may be able to lobby relevant government authorities to abide by and enforce international or regional waste and pollution prevention conventions and agreements.**
- ❑ **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.

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

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.

CASE STUDY

Beach cleanups in Kenya

In Kenya (the main WIO participant in the annual ICC beach cleanups), cleanups are organised by an NGO, the Baobab Trust (**Baobabtrust@swiftmombasa.com**), in collaboration with the MPAs, the Wildlife Clubs of Kenya and various hotels, NGOs, and government agencies. In 2003, about 1,300 people (including many children) took part and over five tonnes of rubbish were collected from 165km of beach.

Kiunga Marine National Reserve, with the assistance of WWF, organises the cleanups with local villages. In 2002, 13 villages took part, involving nearly 2,400 people (mainly children) who collected four tonnes of debris. A co-ordinator is appointed for each village or beach area to assist with the distribution of equipment (collection receptacles, gloves, scales to weigh the debris, recording cards and refreshments). The rubbish is sorted and weighed, the information for each village or beach area is recorded, and a report submitted to the national organising body. Flip flops and some of the other debris are also used as materials for an 'eco-friendly' enterprise which makes items such as key-rings, jewellery, and other handicrafts (see picture). This is run by women and youths from the local villages who receive a 3-4 week training. The beading and carving is done at home and the items are then finished off at a purpose built workshop in the Reserve that ensures quality control and organises packaging. The handicrafts are marketed internationally and country wide, providing income to the communities.

J.Church

Watamu Marine Park and Reserve assist with beach cleanups that are organised by an NGO, Watamu Turtle Watch, at least once a year and often more frequently. Schools, fishermen's associations, boat operators, other NGOs, hotels and tourists are involved, with local businesses contributing transport, equipment and refreshments. The cleanup events are combined with boat tours to the coral gardens, talks on the importance of pollution prevention, and sports, which help to attract participants. Similar cleanups have been organised at beaches in Mombasa involving Mombasa Marine Park and Reserve, including those run by Kenya Wildlife Service as part of its annual Marine Environment Day. In all cases, the collected rubbish is disposed of carefully at recycling centres, or if essential at landfill dumps.

Alien invasive species

K5

Alien invasive species are one of the greatest threats to biodiversity. Introduced terrestrial species on islands 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 MPA staff to this emerging issue, so that preventative action can be taken if required.

Terrestrial, marine and freshwater ecosystems within an MPA can be affected by alien species from several sources. This sheet focuses more on marine species as this is a relatively new issue that may be unfamiliar to MPA practitioners.

MARINE INTRODUCTIONS

Marine plants and animals can be transported huge distances on the hulls of vessels or in ballast water. Most do not survive but many do, some with major consequences. Examples include:

- The European Green Crab (*Carcinus maenus)*, native to the Atlantic and introduced to Southern Australia, South Africa, USA and Japan; competes with and displaces native crabs, consuming and depleting many other species;
- Australia where there are now a known 250 alien marine species;
- Several non-indigenous sessile species found on reefs in Guam, having been introduced via ships hulls; hydroids have spread particularly widely and rapidly;
- In Hawaii, introduced species of algae, soft coral, crustaceans, sponges and fish have been recorded on reefs, with algae having a major negative impact.

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 3.4 billion tonnes of ballast water that are used annually may move some 7,000 species around the planet at any one time. Over 22 million tonnes are estimated to be discharged at South African ports each year. Large amounts are probably also discharged at Mombasa, Dar es Salaam, Maputo and Victoria, making these ports high-risk for alien species introductions.

Many MPAs are located adjacent to ports and shipping lanes, or to sites that will eventually become ports. MPAs are also at risk from species carried on the hulls of yachts and fishing boats, as has been discovered in Guam.

Eradication has been largely unsuccessful to date, but 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. Programmes to assess and monitor alien species, particularly in MPAs, are being set up in several countries, including the USA, Australia and Seychelles (the last with IUCN support). The GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast), with support from the Great Barrier Reef Co-operative Research Centre and IUCN-EARO, is providing training for several WIO countries using standardised methods developed by the Centre for Research on Marine Pests (CRIMP) in Australia. 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 is planning a general protocol for monitoring invasives on coral reefs, also based on the CRIMP Protocols.

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 adapted for national use by some countries. Globallast (see case study) is promoting good practices through a series of demonstration sites. The recently adopted global convention on the regulation of ballast water movement may help to reduce the threat by promoting better practices.

TERRESTRIAL INTRODUCTIONS

The impact of terrestrial introduced species, a major problem on small islands, is well documented. Many islands in the WIO, some of which lie within or adjacent to MPAs, have already been affected. Introduced species of particular concern include rats, dogs and cats, birds (such as the Indian House Crow), ants, carnivorous snails and plants (such as creepers and vines that smother indigenous vegetation). Many animals are affected by introduced predators that feed on molluscs and other invertebrates, and on eggs and young of nesting seabirds and turtles.

M. Richmond

Ocean-traversing vessels, such as tuna purse-seiners, are potential carriers of alien invasive species in ballast water.

Numerous techniques have been developed and tested for eradicating such species, with varying degrees of success. The Seychelles has played a key role in testing these in the WIO. Codes of conduct and protocols are available that can be used to minimise the risk of introductions (see sources of further information).

AQUACULTURE INTRODUCTIONS

Aquaculture (see sheet I3) 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. In Eritrea, alien plants, some of which are becoming established, have been introduced as part of a mangrove restoration programme. Information on aquaculture species that may pose threats is available from the various information sources and databases cited below.

KEY POINTS FOR THE MPA

- ❑ **Check for alien species when biodiversity surveys are being carried out in an MPA, particularly if the MPA is adjacent to a port, shipping area, or mariculture enterprise.**
- ❑ **Ensure that alien species are included in the MPA monitoring programmes.**
- ❑ **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.**

Sources of further information

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Wittenberg, R. & Cock, M.J.W. (eds) 2001. *Invasive Alien Species: a toolkit of best prevention and management practices*. CAB International, Wallingford, UK. **www.cabi-publishing.org**

FAO Database on Introduction of Aquatic Species (DIAS), available on Fishbase **www.cgiar.org/iclarm/fishbase/**

Global Invasive Species Programme (GISP) (a partnership programme with IUCN): provides many resources **www.gisp.org**

Globallast, Global Ballast Water Management Programme and newsletter Ballast Water News **http://globallast.imo.org**

IUCN Guidelines for the Prevention of Biodiversity Loss caused by Alien Invasive Species.
http://iucn.org/themes/ssc/pubs/policy/invasivesEng.htm

IUCN/SSC Invasive Species Specialist Group (ISSG): **www.issg.org**; services include the Global Invasive Species Database: **www.issg.org/database**; Aliens-L, a listserver dedicated to invasive species- **issg@auckland.ac.nz** and a newsletter Aliens.

Turning the Tide: the eradication of invasive species. Papers from the International Conference on Eradication of Island Invasives. Available from ISSG.

CRC Reef Research Centre (Australia) – information fact sheets on alien species and introductions. **www.reef.crc.org.au**

CASE STUDY

Addressing alien species from ballast water in South Africa

In South Africa, GloBallast has been running a 5-year programme with local co-ordination by the Department of Environmental Affairs and Tourism (DEAT), and funding from the Global Environment Facility (GEF), to tackle the issue of invasive species introductions from ballast water. The programme has resulted in a draft national policy on Ballast Water Management prepared in 2002, a national awareness campaign, standardised methods for surveys and risk assessments, and training and capacity building activities.

Saldanha Bay, 150 km north of Cape Town on the west coast, was selected as a demonstration site. The large volumes of ballast water transferred at the deepwater port (8 million tonnes a year) pose a significant threat to the mariculture industry in the Bay and to the adjacent West Coast National Park. The project has involved educational projects, awareness raising, a biological survey within Saldanha Bay using students from local universities, assessing the risks of introductions, and training port and shipping personnel in techniques to minimise and monitor introductions. The survey revealed eight alien species, of which four were previously unrecorded from this area. A ballast water management plan has been prepared for the Bay, in which the roles and responsibilities of all stakeholders are identified.

The programme has also established a Regional Task Force and developed a Regional Strategic Action Plan. The first activity under the plan will be a survey by GloBallast South Africa with the Kenya Marine Fisheries and Research Institute (KMFRI) and the Kenya Ports Authority, of the port of Mombasa to catalogue natural biodiversity and identify any non-native species.