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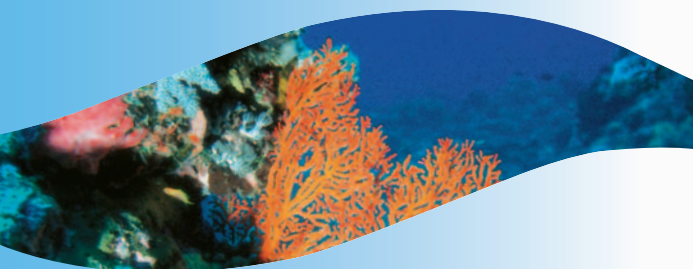

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Regional Action Plan for the Conservation of Coral Reefs in the Red Sea and Gulf of Aden

GEF UNEP UNDP

The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden

Regional Action Plan for the Conservation of Coral Reefs in the Red Sea and Gulf of Aden

PERSGA Technical Report Series No. 3

PERSGA Jeddah 2003

PERSGA - 'The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden' is an intergovernmental organisation dedicated to the conservation of the coastal and marine environments in the region.

The Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (Jeddah Convention) 1982, provides the legal foundation for PERSGA. The Secretariat of the Organization was formally established in Jeddah following the Cairo Declaration of September 1995. The PERSGA member states are Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan, and Yemen.

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LIST OF ACRONYMS AND ABBREVIATIONS

CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
GCRMN	Global Coral Reef Monitoring Network
GEF	Global Environment Facility
GIS	Global Information System
ICLARM	The WorldFish Center (formerly the International Center for Living Aquatic Resources Management)
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
ICRIN	International Coral Reef Information Network
ICZM	Integrated Coastal Zone Management
IDB	Islamic Development Bank
IOC	Intergovernmental Oceanographic Commission
IUCN	The World Conservation Union
MARPOL	International Convention for the Prevention of Pollution from Ships
MEMAC	Marine Emergency Mutual Aid Centre
MPA	Marine Protected Area
MOOPAM	Manual of Oceanographic Observations and Pollutant Analysis Methods
NCWCD	National Commission for Wildlife Conservation and Development
NOAA	National Oceanic and Atmospheric Administration
NESDIS	National Environmental Satellite, Data, and Information Service
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
Ramsar	International Wetlands Convention
RAP	Regional Action Plan
ROPME	Regional Organization for the Protection of the Marine Environment
RSGA	Red Sea and Gulf of Aden
SAP	Strategic Action Programme for the Red Sea and Gulf of Aden
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-ROWA	UNEP - Regional Office for Western Asia
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHC	World Heritage Convention
WWF	World-Wide Fund for Nature

EXECUTIVE SUMMARY

This Plan, specific to the Red Sea and Gulf of Aden, was drafted directly from the *Regional Action Plan for the Conservation of Coral Reefs in the Arabian Seas Region* that was prepared as an outcome of the "International Symposium on the Extent and Impact of Coral Bleaching in the Arabian Seas Region" hosted by NCWCD under the patronage of H.R.H. Prince Salman bin Abdulaziz Al-Saud, with the participation of ROPME and UNEP-ROWA, and the valuable assistance of IUCN, IDB and all participating countries.

This Regional Action Plan (RAP) provides a set of priority actions for the conservation and sustainable development of coral reefs in the Red Sea and Gulf of Aden. The region supports a wide variety of reefs and coastal habitats, much of high ecological value, and globally significant levels of endemism and biodiversity. Additionally, it provides a wide range of renewable resources for human use.

The Plan was developed in recognition of the great economic, ecological, and aesthetic importance that these ecosystems provide and in response to the serious threats posed by increasing human and natural impacts. These threats range from local to global events and include uncontrolled coastal development, various forms of coastal and marine pollution, destructive fishing methods, over-fishing, unnatural increase in predator numbers, impacts from shipping and disturbances associated with predicted future climate change. Many of the region's reefs are growing near the climatic extremes of reef development and are particularly vulnerable to any increase in disturbance. The seriousness of the threat was demonstrated by major coral reef bleaching in 1997 and 1998, causing massive death of corals and other reef organisms in the Gulf of Aden and parts of the Red Sea. Over the next several decades, predicted increases in these disturbances may cause major disruptions in reef function and the loss of associated resources for human use.

This RAP for the PERSGA region defines a set of priority actions pertaining to six major objectives aimed at ameliorating the predicted impacts to reefs:

1. Integrated Coastal Zone Management (ICZM): Many of the region's reefs fringe the coastline and are particularly sensitive to changes in coastal land-use patterns including development, land-fill, raw sewage, other forms of pollution and alterations to wadi or mersa drainage patterns. Most nations have taken important steps towards effective ICZM, developing national strategies, plans, policies and legislation. The Priority Objective is the implementation by all participating nations of Integrated Coastal Zone Management Planning for conservation of coastal reefs, supported by appropriate legislation, land-use planning, participatory approaches, socio-economic and environmental impact assessment, monitoring and enforcement.

2. Education and Awareness: To be most effective, the priority actions require dedicated and continued support across all governmental and inter-governmental levels and from the public at large. The Priority Objective is to increase government and public awareness through the implementation of education and awareness programmes; these are to be disseminated through communication networks (electronic mail) to decision-makers, the mass media, schools, universities and local communities.

3. Marine Protected Areas (MPAs): Establishment of a biologically interconnected network of MPAs is crucial to the long-term maintenance of reef ecosystems and viability of populations of endemic, rare, threatened or endangered and

harvested species. Most nations in the region have taken important steps towards developing MPAs, although considerable national differences in management capacity exist and capacity-building in all aspects of MPAs is a priority. The Priority Objective is the development of 'flag-ship' demonstration MPA sites as examples of effective coral reef management practices in the region (north to south):

- Aqaba Marine National Park, (Gulf of Aqaba, Jordan)
- Straits of Tiran, (Northern Red Sea, Saudi Arabia/Egypt)
- Ras Mohammed National Park, (Northern Red Sea, Egypt)
- Giftun Islands and Straits of Gubal, (Northern Red Sea, Egypt)
- Dungonab Bay and Mukawwar Island, (Central Red Sea, Sudan)
- Sanganeb Atoll, (Central Red Sea, Sudan)
- Farasan Islands Marine Park, (S-central Red Sea, Saudi Arabia)
- Belhaf - Bir Ali, (Gulf of Aden, Yemen)
- Iles des Sept Frères, (Gulf of Aden, Djibouti)
- Socotra Islands, (Gulf of Aden, Yemen)
- Aibat and Saad ad Din, (Gulf of Aden, NE Somalia).

See map page 7.

As MPA management capacity increases during the RAP, other MPAs will join these initial sites.

4. Ecologically Sustainable Reef Fisheries: Reef fisheries provide essential sustenance to artisanal fisherman and their communities throughout the region. Reef fisheries also play an increasingly important role in supplying commercial quantities of high value reef fish and other products for export to expanding national, regional and global markets. As reef fish stocks are particularly prone to over-fishing, a precautionary approach to the continued exploitation of the resource-base is essential for stock protection and replenishment. The Priority Objective is the implementation by participating nations of accurate stock assessment and monitoring, effective regulation of fishing effort through licensing and other methods, protected areas with "no take" zones, seasonal closures to protect spawning stocks, surveillance and enforcement.

5. Impacts of Shipping and Marine Pollution: The region is one of the major global thoroughfares for international maritime traffic and is also the world's largest producer and exporter of oil, most of which is transported by sea. These factors place the region's reefs and other coastal and marine ecosystems at high risk from major ecological disruption through ship groundings or collisions, the introduction of alien species in uncontrolled ballast water discharges and other forms of marine pollution. The Priority Objective is the implementation by participating nations of obligations under regional and international conventions, adoption of Port State Control, improved navigation systems and oil spill response capacities (particularly in sensitive reef areas), surveillance and enforcement.

6. Research, Monitoring and Economic Valuation: Effective integrated coastal zone and MPA management, and sustainable reef fisheries, require accurate information on status and trends collected through management-related research and monitoring. A second crucial element of monitoring is an assessment of the effectiveness of the management itself. Effective lobbying for conservation and development of coral reefs at government and inter-government levels benefits by providing realistic comparisons of the various costs and benefits of different courses of action, be they development proposals or conservation plans. The

Priority Objective is the implementation by participating nations of standardised methods of biophysical and socio-economic survey and monitoring, data-storage, analysis and reporting, using regional (PERSGA) and international (e.g. ReefCheck, GCRMN) protocols.

SCOPE OF THE PLAN

For each of the six priority actions, regional and national priority actions are identified, expected results, desired outcomes and time frames are defined and performance indicators and methods of quality assurance are outlined. Each component will be co-ordinated at the regional level through PERSGA in liaison with other national and international agencies. In individual countries, implementation will occur through integrated networks of national and local working groups, Task-Force members, government departments, agencies and personnel, non-governmental organisations and other stake-holders. The designation of a level of urgency to each specific priority action in the major objectives allows a phased approach to implementation, such as budget and capacity building. The levels of urgency do not necessarily indicate the sequence of priority.

To assist effective implementation, a Steering Committee will be formed to co-ordinate the RAP over its initial period of implementation. This committee will be composed of representatives from each participating nation and the major regional and national organizations. The committee will act as the interface between government, major donor agencies and other international coral reef initiatives.

Overall Objective: ***The conservation and sustainable development of coral reefs of the Red Sea and Gulf of Aden to maintain their intrinsic biodiversity, ecological, aesthetic and other values. Safeguarding the viability of the reefs will also ensure the continued use (fishing) and enjoyment (tourism) of reefs by future generations of mankind.***

INTRODUCTION

Human and natural impacts on coral reefs and associated habitats and biota have continued to escalate, both globally and within the Red Sea and Gulf of Aden. Increasing habitat destruction, over-exploitation, pollution, bleaching and climate change threaten the continued functioning of the coral reef ecosystem. This became evident in 1997 and 1998, when elevated sea surface temperatures caused mass coral bleaching and mortality in many parts of the Arabian Seas Region (Fig. 1), with serious adverse effects to humans through declining fisheries, tourism and other ecosystem services.

Recent research on the extent and effects of coral bleaching and other reef impacts alerted reef scientists, managers and political decision makers to the urgency of protecting these ecosystems. Subsequently, under the patronage of H.R.H. Prince Salman bin Abdulaziz Al-Saud, a major international symposium was organised by the National Commission for Wildlife Conservation and Development (NCWCD) to review the extent and impact of bleaching and other threats to the Region's reefs. The meeting initiated the '*Regional Action Plan for the Conservation of Coral Reefs in the Arabian Seas Region*' from which this PERSGA-specific Regional Action Plan for the Red Sea and Gulf of Aden (RAP-RSGA) was derived.

At a regional workshop addressing conservation and development issues in the Arabian Seas, held in Aqaba, Jordan in 1997 under the auspices of the International Coral Reef Initiative (ICRI), key goals for achieving effective reef management were identified. They are listed in Appendix 1. Major issues to be addressed, if success is to be achieved, are listed in Appendix 2. These issues have provided the basis for both the '*RAP for Coral Reefs in the Arabian Seas Region'* and this subregional document. The RAP-RSGA involves commitment from a large number of coral reef professionals, national and regional environmental organisations and other stake-holders representing the public and private sectors. It indicates regional commitment, which, to be effective, requires dedicated support across all governmental and inter-governmental levels and from the public at large. The process will be facilitated through co-ordination and integration with other programmes and conventions (see Appendix 3).

Reefs in the RSGA region face increasing levels of threat at local, regional and global scales. As many reefs are growing near the extremes of reef development, they are particularly vulnerable to increases in disturbance. Localised threats include various forms of pollution from shipping, urban, industrial and tourism developments, raw sewage, dredging and land-fill. Uncontrolled coastal development adjacent to fringing reefs and reef-based tourism have already damaged or destroyed reefs in some areas.

At the regional level, threats to reefs include destructive fishing methods and over-fishing, with direct physical impacts and indirect impacts to trophic structure and ecological function. Over-fishing and major pollution events, such as those associated with massive oil spills, have serious trans-boundary implications.

Predicted climate changes over the next several decades are expected to cause substantial coral death and lower the capacity of reefs to recover. This loss of resilience is linked with projected increases in sea surface temperature, causing continued coral bleaching and death. Under worse case scenarios, the synergistic combination of impacts threatens the continued existence of reef ecosystems in the region.

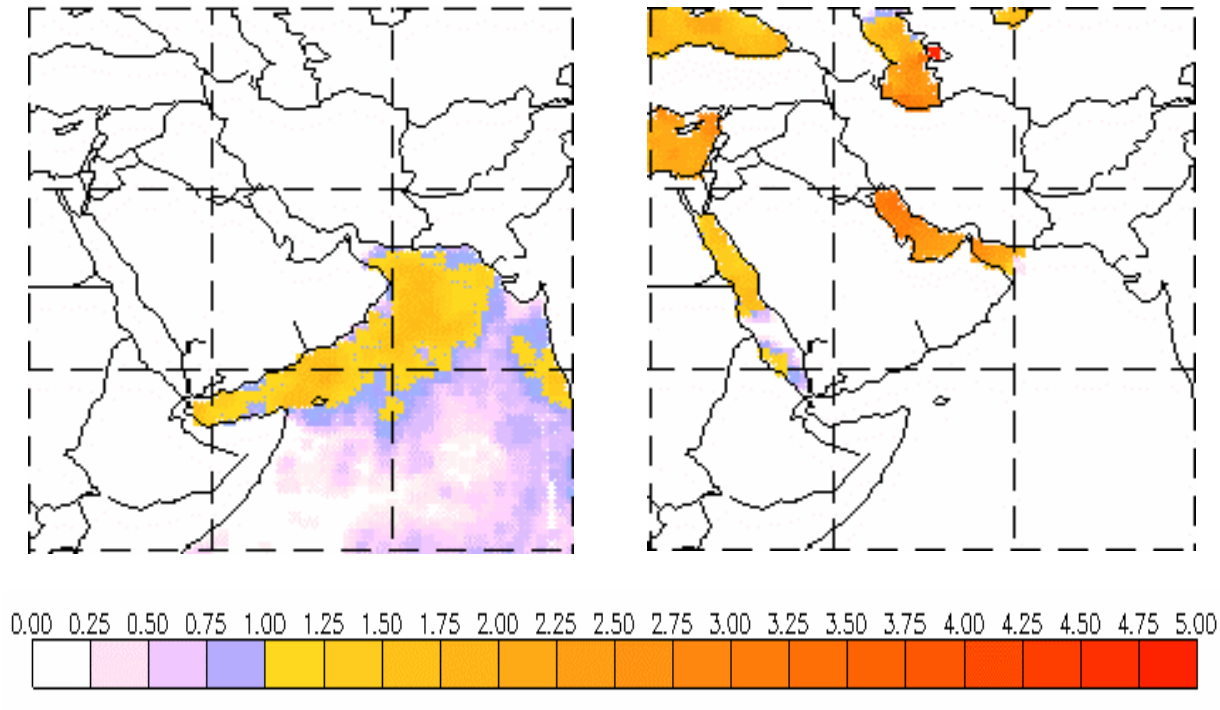
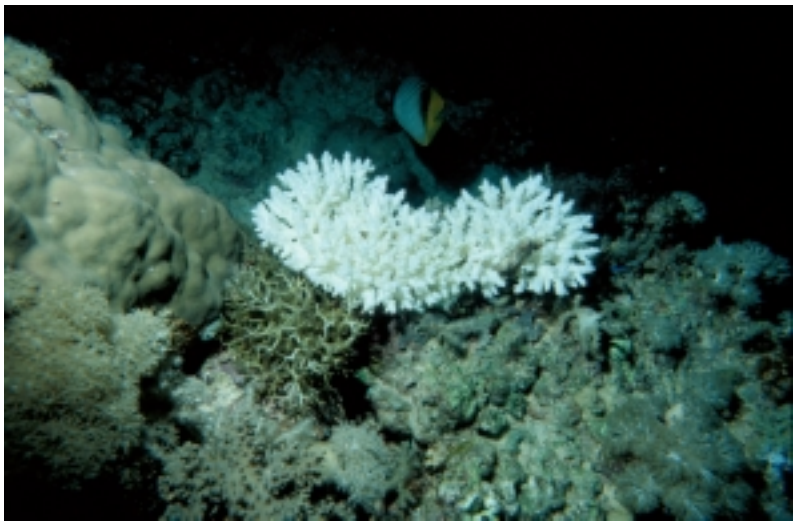


Figure 1. Images of sea surface temperature (SST) anomalies for the Arabian Region in May and August 1998, from the NOAA/NESDIS WWW site. Colours indicate degrees Celsius above 20 year averages. Most reef areas with elevated SSTs experienced intense coral bleaching and subsequent mortality, notably the Yemeni island of Socotra and NE Gulf of Aden, the ROPME Sea Area (Arabian Gulf) and parts of the Red Sea.



Bleached coral

Fortunately, through a unique combination of natural and human factors, some of the region's reefs (Fig. 2) remain in good to excellent condition at the beginning of the 21st century. According to the WORLD RESOURCES INSTITUTE (BRYANT *et al*. 1998) the Arabian Seas Region as a whole harbours some of the best remaining reefs globally. However, a large-scale risk analysis has indicated that about two-thirds of the Region's reefs are at medium or high risk from human activities.

The regional, national and local approach developed here, focusing on a common goal and responsibility throughout the region, will benefit from collaboration and information sharing, particularly with the ICRI partnership (Appendix 4).

Capacities to implement the priority actions vary greatly among countries within the region; there is a pressing need to build capacity in aspects of ICZM, MPAs, fisheries, navigation, research and monitoring. Thus capacity-building and training programmes to improve the national human resource bases, from which the RAP-RSGA will be implemented, are crucial to its overall success. It has been designed as a dynamic approach towards coral reef conservation, which requires regular evaluation and updating as conditions on regional reefs change. If fully implemented, the actions identified here will help to ensure that coral reefs continue to provide valuable ecological, social and economic resources to future generations.

Figure 2. Map of the Red Sea and Gulf of Aden showing coral reefs and marine protected areas**.**

FRAMEWORK FOR ACTION

To be most effective, actions need to be prioritised and integrated into a logical framework (Fig. 3), where strong interconnections and positive feedback among the key components enhance the likelihood of overall success.

This framework for action is constructed of six key components:

1. Integrated coastal zone management,
2. Education and awareness,
3. Marine protected areas,
4. Ecologically sustainable reef fisheries,
5. Impact of shipping and marine pollution,
6. Research, monitoring and economic valuation.

These components were identified through extensive consultation both nationally and regionally. For each component, priority actions are identified, expected results, desired outcomes and time frames are defined and performance indicators and methods of quality assurance outlined. Several of the priority actions are already well advanced in parts of the region. Designation of an urgency level to each specific priority action allows a phased approach to implementation, as budget and capacity allow. The effectiveness of implementation of the priority actions can be optimised through adherence to 12 general principles (see Appendix 5). Although focusing on coral reefs, the Plan is also applicable to associated coastal and marine ecosystems, particularly mangroves and seagrass beds, in light of the strong degree of biological and ecological interconnectedness among them.

Objective independent assessment of the success of implementation of the RAP-RAGA is crucial for adaptive management. This can be achieved through a co-ordinated approach based on the use of performance indicators for results, outcomes and impact of the RAP. Indicators are listed in Appendix 6.

USING THIS DOCUMENT

The RAP-RSGA addresses complex problems with complex solutions. The Executive Summary and Introduction provide a general overview of the background and long-term approach. Operational principles and conservation are outlined under each component of the RAP. The level of urgency for each action is indicated as:

*** - very urgent action, where immediate action or intervention is required, as for example to protect habitats and ecosystems under severe threat;

** - urgent action, where intervention is required to ensure the continued viability of species, communities or ecosystems of regional or global importance;

* - priority action, where there is an institutional set-up or there are on-going projects and opportunities for co-operation with existing efforts.

Time frames under “expected results and outcomes” indicate the number of months required to achieve the result or outcome, starting from the launching of the corresponding activity.

Additional details can be found in tables and appendices. For further reading, a list of literature is provided.

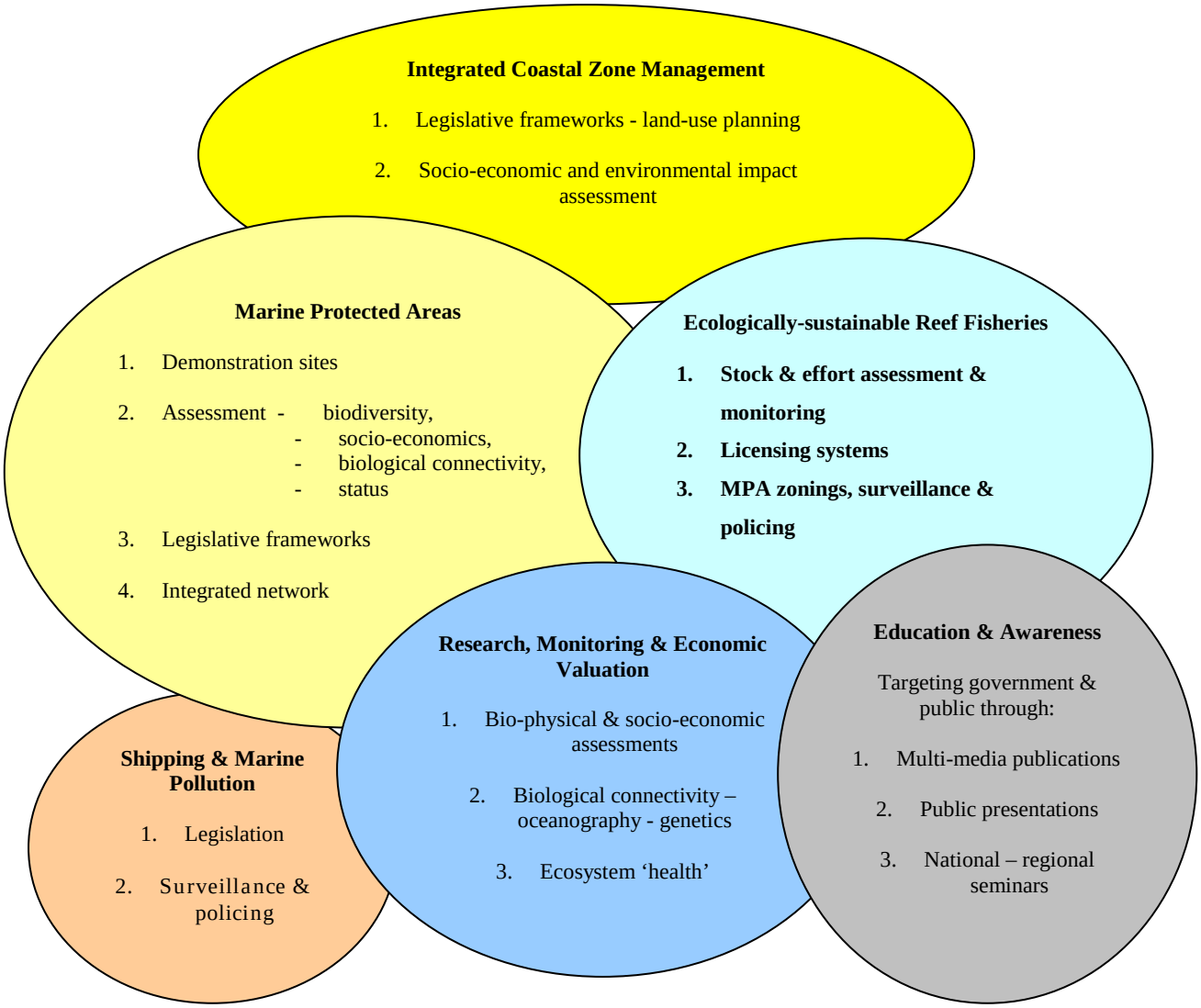


Figure 3. Set of Priority Action components for conservation and ecologically sustainable development of coral reefs and associated ecosystems in the Red Sea and Gulf of Aden. Overlapping ellipses indicate the strong level of interconnection and feedback among the different components.

COMPONENT 1: INTEGRATED COASTAL ZONE MANAGEMENT (ICZM)

The high degree of connectedness among coastal and marine ecosystems is well known (e.g. KENCHINGTON 1990, KELLEHER ET AL. 1995). Land-based sources (industrial, agricultural and municipal wastes and run-off) account for ca. 70 % of coastal and marine pollution and are particularly problematic in estuaries and other partially-enclosed waters (GESAMP 1990).

Most nations in the Red Sea and Gulf of Aden (RSGA) region have recognized that effective management for conservation of reefs requires successful management of adjacent coastal areas. As many reefs fringe the coastline, they are particularly sensitive to changes in coastal land-use patterns (PERSGA 1998a). Their conservation requires appropriate integrated management, based on sound legislative frameworks, land-use planning, participatory approaches, *a priori* socio-economic and environmental impact assessments (EIA) and, where necessary, remedial actions.

Some nations in the region have taken major steps towards managing their coastal zones, with implementation of ICZM plans and their integration into national development plans. For example, the Kingdom of Saudi Arabia has prepared an ICZM plan for its coastal areas and a National Biodiversity Strategy and Action Plan; Egypt has developed a Coastal Zone Management Plan for the Red Sea coast defining areas for urban and tourism development and other major infrastructures, and EIA is obligatory for any development project. ICZM plans for Sudan are under preparation through the Strategic Action Programme (SAP). At the regional level, PERSGA and ROPME have organized several ICZM workshops and ROPME has published "Integrated Coastal Area Management Guidelines for the ROPME Region" (March 2000).

Priority Objective: Implementation by all participating nations of Integrated Coastal Zone Management Planning for conservation of coral reefs and associated ecosystems and species, supported by appropriate legislation, land-use planning, participatory approaches, socio-economic and environmental impact assessment, monitoring and enforcement.

Actions:

i. For each country, identify the relative importance of different types of coastal and catchment development and their impact on coral reefs (***);

ii. Where not already completed, develop national ICZM plans incorporating requirements for reef conservation in land-use planning, socio-economic and environmental impact assessments (***);

iii. Where not already completed, develop policy and legislation relevant to coastal reefs (***);

iv. For each country, identify and develop consultative processes with the key stake-holders with relevance to reefs (**);

v. Develop regional and national Guidelines for ICZM assessment with regards to environmental impacts on reefs (**);

vi. Train national teams to conduct EIA on reefs (*);

vii. Develop key demonstration sites using best practice ICZM of reefs within the region (*).

Expected results – outcomes and time frame:

i. National meetings among the key stakeholders to identify the relative importance of different types of coastal and catchment development and their impact on reefs (after 12 months);

ii. Consultative meetings among the key stake-holders to develop national ICZM plans covering coastal reefs (where not already completed) and to build capacity and co-ordination (after 18 months);

iii. Review of ICZM plans and recommendations on amendments (where necessary) to national ICZM policy and legislation regarding reefs (after 18 months);

iv. Publication of regional guidelines for socio-economic and environmental impact assessment (after 12 months);

v. Publication of national socio-economic and EIA guidelines (after 12 months);

vi. Training courses for national teams to carry out EIA on reefs (after 18 months).

Performance Indicators and Quality Assurance:

i. Publication of regional and national guidelines for ICZM, socio-economic and environmental impact assessments;

ii. Development of policy and enactment of legislative amendments;

iii. Implementation of ICZM and EIA in decision making;

iv. Independent assessment of the effectiveness of ICZM.

COMPONENT 2: EDUCATION AND AWARENESS

The raising of public and government awareness of the importance of reefs and of their current threats is crucial to their long-term conservation. PERSGA has already taken important steps in raising awareness, through regular publication of its newsletter '*Al Sanbouk*' and other material and through the development and enhancement of regional and national communication networks.

There are many approaches to education and raising awareness (see Appendix 7), ranging from talks in remote coastal communities to the WorldWideWeb. Several of these methods are already employed routinely within the region (see e.g. FLEMING 1996), notably by NCWCD in Saudi Arabia and by the Egyptian Environmental Affairs Agency (EEAA) as an integral part of management of the Ras Mohammed National Park in Egypt.

Priority Objective: Increased government and public awareness through the implementation of education and awareness programmes to be disseminated through communication networks to decision makers, the mass media, schools, universities and local communities.

Actions:

i. Produce, publish and disseminate education and awareness materials, using electronic media, information sheets, brochures, booklets, videos, CDs and other media (***);

ii. Make results of research, surveys, monitoring and economic valuations available, in suitable format, to decision makers and the general public (***);

iii. Liase with ICRI (ICRIN) regarding the development of public awareness materials and campaigns for the region (*);

iv. Develop strong links with key government departments to provide important findings to decision-makers (***);

v. Develop strong links with the mass media for the dissemination of major newsworthy items (**).

Expected results – outcomes and time frame:

i. Production of a wide range of education and awareness materials within the next 10 years;

ii. Development of teaching materials for schools and universities (after six months);

iii. Improved links with government agencies and mass media (after 18 months);

iv. Improved media skills through training courses in media presentation (after 6 months).

Performance Indicators and Quality Assurance:

i. Production of education and awareness materials;

ii. Demonstrable increase in government and public awareness and in mass media coverage of reef issues.

COMPONENT 3: MARINE PROTECTED AREAS

The value of marine protected areas (MPAs) in conservation and the sustainable development of coral reefs is well established, both from the perspectives of conserving biodiversity and of sustaining nutritional, economic and other benefits to humans (Box 1, DIXON & SHERMAN 1990, KENCHINGTON 1990, DIXON 1993, AGARDY 1994a, b, DE FONTAUBERT ET AL. 1996). For example, numerous case-studies have conclusively demonstrated the 'flow-on' and 'spill-over' benefits to reef fisheries of even small 'no-take' reserves, *provided* such reserves are not themselves exploited or suffer through ineffective policing (e.g. RUSS 1985, RUSS & ALCALA 1996a, b).

Other economic benefits best obtained from MPAs include the generation of employment and sustainable finances through well-managed reef tourism. Such tourism-based revenue has proven a viable source of funding for reef management and research on Australia's Great Barrier Reef, and there is great potential for implementation of similar systems of 'users-pay' in the region (also see HOOTEN & HATZIOLOS 1995). Following the successful integration of environmental protection and sustainable development along the Gulf of Aqaba, Egypt is now considering that a balance between protected areas and development along the coast of the Red Sea is the only opportunity for long-term sustainability of tourism. Measures implemented to date to protect reefs include entrance fees for protected areas and user fees for mooring installations. Additional means of generating revenue include the establishment of non-profit conservation funds and private-sector grants.

Conservation of biodiversity is more complex, requiring the long-term maintenance of overall ecological integrity, community structure and viable populations of the species of interest (SOULÉ 1987). This may prove particularly challenging in the region, where globally significant levels of endemism, complex biogeographic patterns and the presence of partial barriers to gene flow (SHEPPARD ET AL. 1992, DEVANTIER ET AL. 2000c) pose significant and unique challenges to the development of an effective regional MPA network (also see ROBERTS 1998 and Convention on Biological Diversity (CBD), Articles 2 and 8).

BOX 1. Major reef conservation objectives achievable through MPAs (after DE FONTAUBERT ET AL. 1996):

1. Protection of endangered reef species,
2. Maintenance or restoration of viable populations of reef species,
3. Maintenance or restoration of reef communities, habitats, nesting and breeding areas and genetic diversity,
4. Exclusion of species introductions by humans,
5. Provision of space to allow species distributions to shift in response to environmental or climate changes,
6. Provision of examples of the social, economic and ecological benefits that can accrue from well managed reef resources.

Over the past decade, most nations in the region have taken important initial steps towards establishing MPAs, encompassing a wide variety of reef types and other marine and coastal habitats (CHIFFINGS 1995, KELLEHER ET AL. 1995, PERSGA 1998a). Most reef MPAs in the region (Fig. 2) follow the IUCN multiple-use model, where different reefs or reef areas are afforded various levels of protection and use through the application of a zoning plan (see CHILD & GRAINGER 1990).

Priority Objective: Development of marine protected areas which are representative of the major sub-regional sea areas, into 'flag-ship' demonstration MPA sites, as examples of effective MPA management practices in the region.

Actions:

i. Identify and/or upgrade key MPAs to develop integrated regional and national MPA networks with adequate representation of coral reefs (***);

ii. Develop specific management and, where applicable, zoning plans for all MPAs (***);

iii. Develop capacities for day-to-day management, monitoring, surveillance and enforcement, through training courses (***;)

iv. Assist in developing or improving performance of demonstration MPAs using best management practice (***);

v. Create a regional network of MPA managers and researchers in regular communication for information-sharing (***);

vi. Develop policy and legislation (where required) to safeguard reef MPAs in sound legislative frameworks (**);

vii. Draft regional and national guidelines for achieving sustainable sources of funding for MPAs with important reefs (**);

viii. Develop regional and national guidelines for assessment of MPA management effectiveness in conserving coral reefs (**).

Proposed 'Flag-ship' Demonstration MPA Sites

An initial set of key demonstration MPA sites has been identified for the region (north-south):

- Aqaba Marine National Park, (Gulf of Aqaba, Jordan)
- Straits of Tiran, (Northern Red Sea, Saudi Arabia/Egypt)
- Ras Mohammed National Park, (Northern Red Sea, Egypt)
- Giftun Islands and Straits of Gubal, (Northern Red Sea, Egypt)
- Dungonab Bay and Mukawwar Island, (Central Red Sea, Sudan)
- Sanganeb Atoll, (Central Red Sea, Sudan)
- Farasan Islands Marine Park, (S-central Red Sea, Saudi Arabia)
- Belhaf - Bir Ali, (Gulf of Aden, Yemen)
- Iles des Sept Frères, (Gulf of Aden, Djibouti)
- Socotra Islands, (Gulf of Aden, Yemen)
- Aibat and Saad ad Din, (Gulf of Aden, NE Somalia).

Selection of these sites was based on their relative similarity with the selection criteria (Appendix 8 and Table 1), following comparison with the large number of existing and proposed MPAs in the region (see Table 2). Each of the sites provides relevant models for specific stages in the development of MPAs, including:

1. Initial biodiversity and socio-economic assessment and habitat mapping;
2. Involvement of local stake-holders in all stages of the planning process, including protection of traditional uses where these are compatible with the overall objectives of the MPA;
3. Selection of appropriate zones;
4. Development of draft zoning plans;
5. Public and government consultation re draft zones;
6. Development of management plans;
7. Development of day-to-day management capacity, including staffing and infrastructure;
8. Establishment of bio-physical, ecological and socio-economic monitoring programmes;
9. Development of surveillance and enforcement capacities;
10. Development of sustainable funding mechanisms.

The proposed demonstration MPAs are in different stages of planning and implementation (Table 1). Thus, they will require different levels of support to supply adequate management capacities for the effective implementation of management plans and zoning plans, day-to-day monitoring, surveillance, enforcement and sustained finance. Each country is encouraged to nominate additional MPAs as demonstration sites as these become functional.

Expected results – outcomes and time frame:

i. Development of a protocol for sustained funding for MPAs (to be published after 18 months);

ii. Development of a protocol for assessment of MPA management effectiveness (after 18 months);

iii. Identification of key MPAs and boundaries within the region, with recommendations for additional sites based on reef complexity, biodiversity, fisheries, oceanography, habitat distribution or other considerations, to be published as a regional report (after 12 months);

iv. Demonstrated assistance towards refinement and /or development of sound legislative frameworks for MPAs (after 12 months, including published legislative amendments);

v. Demonstrated enhancement of capacity in the various aspects of reef MPA management, through the provision of training courses (after 12 months);

vi. Demonstrated enhancement of communication networks and information sharing among reef managers and scientists in the region, through fostering both formal information exchange (workshops or conferences) and via electronic mailing lists (after 18 months);

vii. Demonstrated assistance towards improving management effectiveness and performance of the six demonstration MPAs, including appropriate policy and practice (after 30 months);

viii. Demonstrated assistance in the development of at least one additional demonstration reef MPA in each signatory country using best management practice (after five years);

ix. Demonstrated assistance in the development of an integrated network of reef MPAs at national and regional levels supported by best management practice (after 10 years).

Performance Indicators and Quality Assurance:

i. Demonstrable advances in management of the six initial demonstration MPAs;

ii. Independent evaluation of the management effectiveness of the demonstration MPAs (see Appendix 9);

iii. Publications on advancements in research and management of the demonstration sites in the regional reef MPA network, legislative frameworks and sustained funding protocols;

iv. Demonstrable improvements in information-sharing among MPA managers, scientists and other stake-holders through workshops and publication of proceedings.

Table 1. Summary statistics for four of the proposed demonstration sites

Attribute	Ras Mohammed National Park	Farasan Islands Marine Park	Socotra Islands	Belhaf - Bir Ali
Location	Southernmost tip of Sinai Peninsula, Northern Red Sea, Egypt	South - Central Red Sea, Saudi Arabia	Gulf of Aden/Arabian Sea, Yemen	NE Gulf of Aden coast, Yemen
Area	sea area: 672 km^2 land area: 233 km^2	3,310 km^2	sea area: ca 12,000 km^2 land area: ca 3,600 km^2	Undefined
Reef types	Coastal fringing reefs, patch reefs, coastal lagoons	Island fringing reefs, patch reefs, coral cays	Extensive and diverse non-reefal coral communities	Mainly non-reefal coral communities fringing island, patchy coral communities in coastal area
Significant features	Highly diverse reef assemblages, major tourism destination, strong management, research and training capacity for MPAs	Key location in transition area between central and southern Red Sea, large range of reef communities, key monitoring site for local - global threats	Unique biogeographic position, very high coral diversity, minimal human disturbance, key monitoring site for local - global threats	Highly diverse coral communities with unique biogeographic affinities, "stepping stone" for dispersal of reef-associated fauna
Country with management responsibility	Egypt	Saudi Arabia	Yemen	Yemen
Management agency	Egyptian Environmental Affairs Agency (EEAA)	National Commission for Wildlife Conservation and Development	Environment Protection Authority (EPA)	Environment Protection Authority (EPA)
Designation date	1983, extended to Strait of Tiran in 1992	1996	2000	Proposed
Specific MPA legislation	Yes (law 102 of 1983)	Yes	Yes	To be developed
Type of MPA	National Park/Marine Park	Multiple-use, zoned MPA	Multiple-use, zoned MPA	To be decided
Management plan	Yes	Yes	Yes	To be developed

MPA headquarters	Yes	Yes	Yes (under construction)	To be developed
MPA staff	Yes	Yes	Yes	To be developed
Surveillance & enforcement	Yes	Minimal	No	To be developed
Research & monitoring	Yes	Yes	Yes	To be developed
Funding sources	Gov. of Egypt, European Union	Gov. of Saudi Arabia - NCWCD	Gov. of Yemen (EPA), GEF-UNDP Project, Socotra Conservation Fund (being established)	Potential GEF - UNDP support
Major stake-holders	Gov. of Egypt, local community, tourism industry incl. hotels and dive operators	Gov. of Saudi Arabia, local community, particularly fishermen, tourism operators	Gov. of Yemen, local communities – particularly fishermen and fishermen co-operatives, national and international fish buyers, tourism agencies	Gov. of Yemen, local communities, fisherman
Uses	SCUBA-diving and shore-based tourism, research	Commercial and artisanal fishing, diving tourism	Artisanal and expanding commercial fisheries, research, tourism under development	Fishing, tourism to be developed
Impacts	Tourism, crown-of-thorns starfish outbreak 1994-1998	Fishing, coral bleaching, tourism	Coral bleaching, increasing fishing pressure	Fishing, anchor damage, coral bleaching

Table 2. Existing and proposed MPAs that may form part of an integrated regional MPA network. The table includes coastal, island and marine parks conserving reefs and/or associated habitats and biota for all PERSGA member nations and Eritrea. * indicates strong potential for trans-boundary parks fostering international co-operation in management.

Country	Functioning MPAs	Location of proposed MPAs
Djibouti	1. Maskali Sud Integral Reserve 2. Musha Territorial Park	1. Iles des Sept Frères and Ras Siyyan 2. Godoriya
Egypt	1. Ras Mohammed National Park 2. Nabq Managed Resource, Protected Area MNPA 3. Abu Gallum MNPA 4. Gabal Elba Conservation Area * 5. Giftun Islands 6. El-Akhawein / Brothers Islands 7. Abu el-Kizan / Dedalus Island 8. Zabargad / St John Island 9. Rocky Island	1. Red Sea Marine Protected Area from Hurghada to Gebel Elba
Eritrea		1. Dahlak Islands (partially) 2. Dur Gaam & Dur Gella Islands 3. Fatuma Islands 4. Museri Islands
Jordan	1. Aqaba National Park	
Saudi Arabia	RED SEA: 1. Farasan Islands 2. Yanbu Royal Commission Protected Area 3. Umm al-Qamari	RED SEA: 1. Strait of Tiran * 2. Ras Suwayhil (Gulf of Aqaba) 3. Sharm Zubayr 4. Ghubbat Bal'Aksh 5. Sharm Dumagyh – Sharm Antar 6. Al-Wajh Bank – Qalib Islands – Sharm Habban & Sharm Munaybirah 7. Al-Hasani, Libanah Islands – Ras Abu Madd – Sharm Hasi 8. Ras Baridi – Sharm al-Khawr 9. Sharm Yanbu 10. Shi'b al-Qirin reef 11. Marsa al-Usalla, Marsa Tawil 12. Marsa as-Sarraj 13. Ras Hatiba 14. Ash-Shu'aybah – Masturah 15. Marsa Umm Misk 16. Haramil Island 17. Jeddah Salt March 18. Qishran 19. Inner Farasan Bank 20. Outer Farasan Bank 21. Marka Island 22. Ra's Tarfa 23. Khawr Amiq, Khawr Raqa 24. Khawr Nahoud 25. Khawr Itwad 26. Shi'b Abu al-Liqa – Shi'b al-Kabir 27. Khawr Wahlan 28. Duwayyimah

Somalia		1. Aibat & Saad ad-Din Islands, Saba Wanak 2. Daloh Forest Reserve and Maydh Island
Sudan	1. Sanganeb Marine National Park 2. Dungonab Bay & Mukkawar Island	1. Shuab Rumi 2. Suakin Archipelago 3. Khor Kilab Bird Sanctuary 4. Abu Hashish Recreational Park
Yemen	1. Socotra Islands	1. Ras Sharma 2. Dhobbab (Shihr) 3. Belhaf and Bir Ali 4. Ras Isa and Kamaran Island 5. Khor Umaira 6. Aden Wetland 7. Bab al-Mandeb and Perim Island 8. Al-Urg 9. Al-Luhaiyah

COMPONENT 4: ECOLOGICALLY SUSTAINABLE REEF FISHERIES

Reef fisheries provide essential sustenance to artisanal fisherman and their families throughout the region. They also play an increasingly important role in supplying commercial quantities of high value products for expanding national, regional and global markets.

Levels of fishing pressure on reefs in the region vary from virtually non-existent to severe, providing a complex management challenge, with important links to the application of MPAs in stock replenishment. Although destructive fishing activities such as dynamite and poison fishing are less widespread than in other reef areas, dumping of litter, lost or abandoned nets and anchor damage are already causing problems to some reefs. Benthic trawling occurs in close proximity to reefs with direct adverse effects on community structure and by-catch (PERSGA 1998a, GLADSTONE ET AL. 1999). Collecting of ornamental reef fishes and other organisms for the global aquarium market is expanding in the region and has already caused serious damage to reefs in some areas.

The region's demersal reef fish, holothurian, molluscan and crustacean stocks are particularly prone to over-fishing (see Box 2) and careful stewardship of these resources is necessary to ensure their sustainable utilization. For this to be achieved, reef fisheries management must shift from the traditional focus on stocks, methods and increasing catches to concentrate on sustaining both the fisheries and the ecosystems on which they depend (KENCHINGTON 2000). This requires both reliable stock assessment and monitoring and improved understanding of the population biology of the target species. There is a large potential for well-planned mariculture of some ornamental and food species, with an urgent need for the simultaneous development of appropriate legislation and guidelines.

BOX 2. *Over-fishing on coral reefs*

Recent evidence has changed the once widespread belief that reef fisheries were virtually inexhaustible. Many reef areas, both in the region and elsewhere, have been chronically and heavily over-fished over the past several decades, with major loss of production and serious adverse 'cascading' effects to other components of the ecosystems (JACKSON 1997, CARLTON 1998). For example, destructive population outbreaks of crown-of-thorns starfish in the region may be linked with over-fishing of fish predators (ORMOND ET AL. 1990). The level of understanding of these effects, or indeed of many of the target fish species' population dynamics, remains rudimentary. JACKSON (1998) strongly recommends the adoption of a precautionary approach to reef fisheries and notes that:

"… virtually all fisheries … models and data are inadequate to reliably predict the responses of low population levels to any subsequent manipulation or to chance …".

Sustainable reef fisheries are a major corner-stone of the Convention on Biological Diversity (CBD Articles 6b, 8c, 8j, 10b, 10c and 11). This provides several recommendations for action, which are very applicable to the RSGA region (after DE FONTAUBERT ET AL. 1996):

1. Set ecologically sustainable levels of use,
2. Manage the ecosystems as a unit, rather than single harvested stocks,
3. Minimize by-catch and incidental impacts on non-target species and habitats,
4. Eliminate subsidies that encourage over-fishing,
5. Protect traditional sustainable management systems through legal recognition of the systems and any associated sea tenure rights.

Traditional artisanal reef fisheries are of great importance in many parts of the region. They deserve high priority for sustainability and should over-ride any competing commercial exploitation. This has added benefits in building co-operation among local stake-holders and managers, particularly important where the artisanal fisheries are developed in multiple-use MPAs (e.g. Socotra Islands, Yemen, see CHEUNG ET AL. in press).

Priority Objective: Maintenance of sustainable reef fisheries through the implementation of accurate stock assessment and monitoring, effective regulation of fishing effort, protected areas with "no-fishing" zones, seasonal closures to protect spawning stocks, surveillance and enforcement.

Actions:

i. Conduct surveys and interview fishermen to identify important spawning aggregation sites of reef fishes (***);

ii. Develop 'no-fishing' zones in MPAs for the protection of important reproductive stocks, particularly in areas of spawning aggregations (***);

iii. Introduce closed fishing seasons during spawning periods of reef fishes to protect reproductive stocks (***);

iv. Assist in increasing national capacities for the assessment and monitoring of reef fish stock, by organizing training courses (***);

v. Assist in building national capacities for surveillance and enforcement of

reef fisheries regulations, particularly in relation to MPA zonings (***);

vi. Develop regional and national guidelines for responsible and ecologically sustainable collecting of ornamental reef species for the aquarium trade (**);

vii. Through liaison with other programmes and agencies, develop relevant national policy and legislation (where necessary), based on FAO and CBD recommendations for sustainable reef fisheries management (*);

viii. Develop regional and national guidelines for responsible and ecologically sustainable reef mariculture operations for ornamental and food fishes and other organisms (*).

Expected results – outcomes and time frame:

i. Continued implementation of MPA zoning and other regulations incorporating 'no-fishing' replenishment areas and seasonal spawning closures (after four years);

ii. Organization of training courses in reef fisheries management, including stock assessment and monitoring, surveillance and enforcement, particularly in relation to MPA zonings (after 18 months);

iii. Demonstrated improvement in assessment capacity for catch and effort, monitoring, surveillance and enforcement (after 18 months);

iv. Publication of regional and national guidelines for collecting reef ornamentals and for mariculture (after 18 months).

Performance Indicators and Quality Assurance:

i. Incorporation of 'no-fishing' replenishment areas in MPA zoning or other regulations, included in each specific MPA management plan;

ii. Relevant fisheries regulations, based on FAO and CBD recommendations for sustainable reef fisheries management, incorporated in national and local policy and legislation;

iii. Demonstrable improvement in local and national capacities for reef fisheries assessment, monitoring, surveillance and enforcement;

iv. Independent review of the status of the reef fisheries, through stock assessment and monitoring.

COMPONENT 5: IMPACT FROM SHIPPING AND MARINE POLLUTION

The RSGA region forms one of the major thoroughfares for international maritime traffic between Asia-Pacific and Europe. It is also the world's largest producer and exporter of oil, most of which is transported by sea. These factors place the region's reefs at high risk. PERSGA (1998a) identified five major regional threats associated with shipping, navigation, petroleum transport and production:

1. Extensive risk of ship collision and grounding in major traffic lanes,
2. Discharge of sewage from vessels,
3. Ship discharge of solid waste,
4. Oil spills from exploration, production and transport,
5. Illegal disposal of toxic wastes.

The sometimes-complex mazes of reefs, narrow navigation channels, insufficient navigational markers and human error have

all contributed to the numerous ship groundings that have already caused damage to reefs in the region.

Several important measures to minimize the impact to reefs and other coastal ecosystems from oil spills have already been implemented, including the development of local and national oil spill contingency plans. At the national level several countries, including Egypt, Jordan and Saudi Arabia, have developed national oil spill response plans, and a national oil spill contingency plan for Sudan is awaiting government approval. In Egypt three oil spill response units are operational.

The threat from introduced species is less obvious, but perhaps more insidious in the medium to long term, given the enormous amount of ship traffic, loading and unloading of cargo and associated ballast flushing, the major source of alien species introductions worldwide (U.S. NATIONAL RESEARCH COUNCIL 1995).

Priority Objective: Implementation by participating nations of obligations under regional and international conventions, adoption of Port State Control, improved navigation systems and oil spill response capacities, surveillance and enforcement.

Actions:

i. Support implementation of Port State Control throughout the region (***);

ii. Contribute to the development of the regional Navigation Risk Assessment and Management Plan (***);

iii. Support the development and implementation of regional and sub-regional vessel traffic systems, with special emphasis on reef protection (***);

iv. Upgrade existing marine navigation aids, particularly in the vicinity of sensitive reef areas (***);

v. Develop, upgrade and implement local, national and regional contingency plans and assure their adequacy for reef protection (***);

vi. Foster the development of relevant national legislation to define safe shipping routes and passages and, if necessary, compulsory pilotage of vessels carrying high risk cargo through critical reef areas (**);

vii. Assist in building national capacities for surveillance and enforcement of regulations, ensuring legislation has appropriate punitive clauses for legislative breaches on reefs (**);

viii. Ensure ratification of relevant conventions, such as UNCLOS, MARPOL, Civil Liability Convention, Convention on Hazardous and Noxious Substances and Limitation of Liability, and Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (**).

Expected results – outcomes and time frame:

i. Implementation of Port State Control procedures throughout the region (after three years);

ii. Contribution to the development of the regional Navigation Risk Assessment and Management Plan (after six months);

iii. Upgrading of existing marine navigation aids in the region, particularly in narrow reef passages and other high risk reef areas (after 18 months);

iv. Completion of desk-top studies and liaison with other programmes and government agencies to ensure standardization of regional protocols and regulations for shipping and ballast water discharge (after 18 months);

v. Preparation (where necessary) of national oil spill contingency plans (after 18 months);

vi. Development of relevant national legislation defining safe shipping routes and passages and, if necessary, compulsory pilotage of vessels carrying potentially high risk cargo through critical reef areas (after 18 months);

vii. Development of emergency and contingency plans incorporating trans-boundary co-operation in the event of ship grounding, collision, pollution spill or accidental release of alien species on reefs (after three years);

viii. Ratification of all relevant conventions (after three years).

Performance Indicators and Quality Assurance:

i. Demonstrable improvements in response capacity to shipping accidents and emergencies on reefs by the end of 2003;

ii. Demonstrated improvements in national capacities for surveillance and enforcement of shipping regulations with relevance to reefs by the end of 2003;

iii. Notable reduction in the number of ship groundings, pollution spills, collisions or species introductions on reefs through demonstrable compliance with relevant regulations.

COMPONENT 6: RESEARCH, MONITORING, AND ECONOMIC VALUATION

Effective reef management needs the provision of accurate information on the present status of the ecosystems, both for ICZM and MPA planning and for the assessment and monitoring of reef status and reef fisheries and of the effectiveness of management itself. To be most effective, research and monitoring are integrated into a logical overall framework of action (Fig. 3) providing scientifically robust management-oriented information (Fig. 4), including data for:

1. Planning and development of MPAs, such as distribution of habitats, biodiversity and socio-economics;
2. Monitoring ecosystem properties and the status of biological, ecological, oceanographic and socio-economic parameters for ICZM and MPA management;
3. Environmental and socio-economic impact assessment, both before and after development takes place, and economic valuations of different courses of action;
4. Assessing health status of the ecosystems in terms of global-scale disturbances, such as occurred with coral bleaching in 1997 and 1998;
5. Reef fisheries stock assessment and monitoring.

Most nations in the region have initiated reef research and monitoring programmes (WILKINSON 2000, ABUZINADA in press), although major differences exist in national logistics capacities in relation to different levels of finance, manpower and expertise. Until recently, there had been only limited success in pooling national data to provide regional insights. This is being addressed through regional initiatives to develop standard protocols linked with extensive training programmes (see Box 3). These methods are as simple and inexpensive as practicable (ARONSON ET AL. 1994), to be equally applicable in all nations of the region. Consistent application of standard methods will provide scientifically robust information on reef status to local and national management agencies, and facilitate regional and global comparisons.

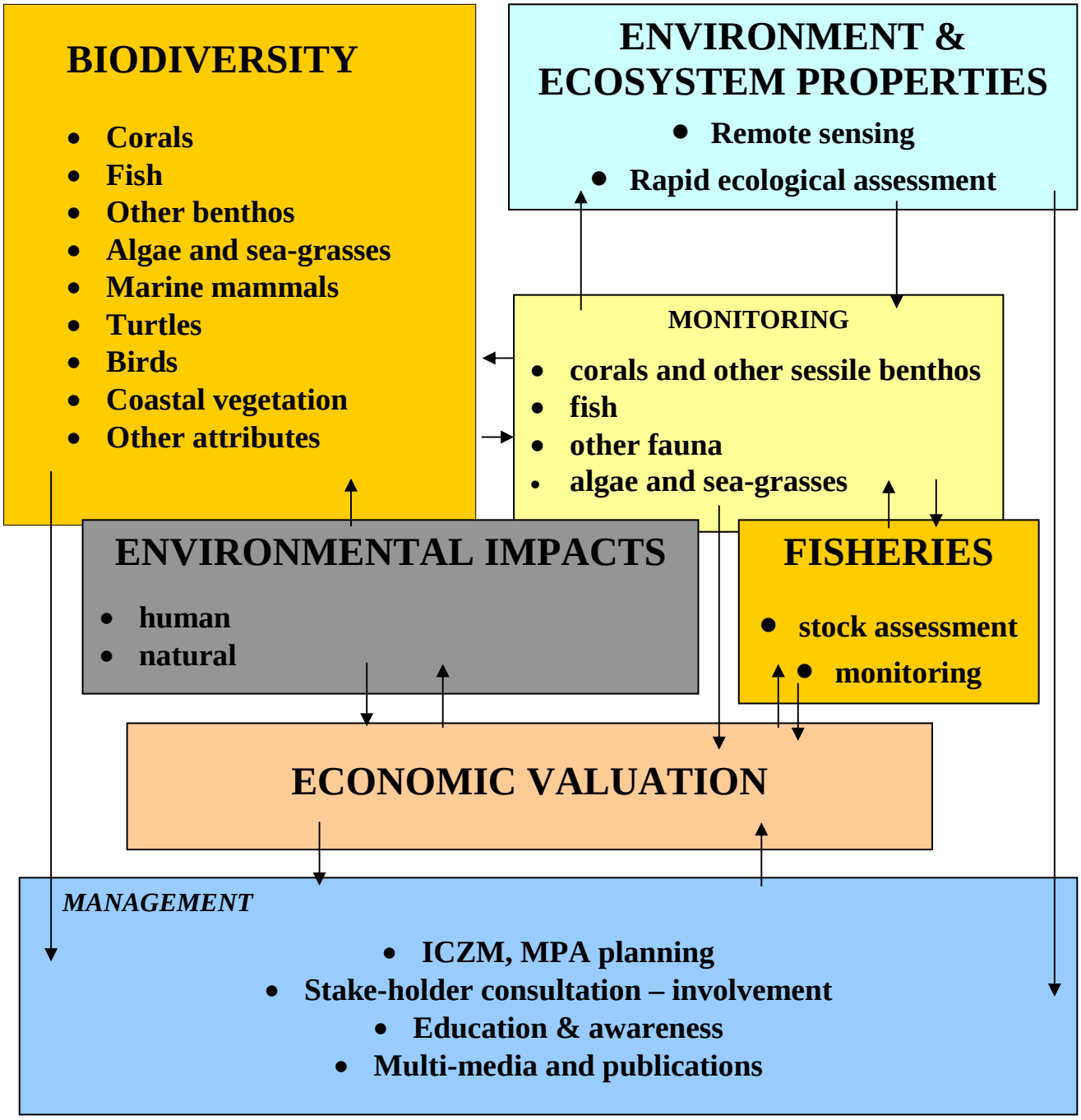


Figure 4. Flow-chart of survey and monitoring designed to provide suitable management support on coral reefs (adapted from DEVANTIER ET AL. in press).

BOX 3. *Standardized research and monitoring protocols*

Application of standard protocols has already facilitated national and regional comparisons, both within the region and elsewhere (CARICOMP - OGDON ET AL. 1997, the ASEAN-Australia Living Coastal Resources Project - CHOU & WILKINSON 1992, ReefCheck - HODGSON 1999, and the Global Coral Reef Monitoring Network GCRMN - WILKINSON 1998, 2000, ABUZINADA in press). These programmes have each produced status reports that have proved highly valuable in informing management agencies and raising awareness at government and inter-government levels.

In the RSGA region, PERSGA is standardizing biological and ecological survey and monitoring methods. The core survey methods for coral reefs include those recommended by ReefCheck and the Global Coral Reef Monitoring Network (GCRMN), as adapted for maximum utility in the region.

Remotely sensed data from satellite-borne sensors are also being used in interpreting large-scale climatic and oceanographic phenomena affecting reefs of the region. Graphical interpretation of anomalies in sea surface temperature are now routinely available on the World Wide Web (e.g. Fig. 1 from NOAA-NESDIS: http://psbsgi1.nesdis.noaa.gov:8080/psb/eps/sst/climohot.html) and have proven highly valuable in predicting coral reef bleaching.

Data generated from the protocols will be stored and analysed at PERSGA. The organization will bear responsibility for data quality assurance, archiving and reporting.

Monitoring data will be valuable in alerting governments to disturbances affecting reefs of the region (Fig. 1). A wide range of recently launched satellite-borne sensors should provide understanding of regional and global effects.

Effective lobbying for reef conservation at government and inter-government levels requires making realistic comparisons of the various financial costs and benefits that can accrue from different courses of action. Such analyses of the various economic values of reefs are at a preliminary stage (e.g. see Box 4, DIXON & SHERMAN 1990, DIXON 1993, CESAR 1996). Most governments rely on economic valuations in prioritising development options.

BOX 4. *Economic valuation of reefs*

Conventional economic procedures for modelling cost-effectiveness can result in sub-optimal policy choices when applied to complex systems such as reefs, where non-linear responses to various kinds and levels of human impact are common. However, the application of fuzzy logic and non-linear economic analysis proved useful in optimising economic policies and maintaining reef quality in a Caribbean reef MPA (RUITENBEEK & CARTIER 1999, RUITENBEEK ET AL. 1999, and http://www.island.net/~hjr).

Standard economic evaluation methods for coral reefs are also being developed within the ICRAN partnership by ICLARM. The RSGA region can benefit from this standard approach, adapting the ICLARM protocols as appropriate.

General concepts, methods and applications of economic valuation of ecosystems are available on the WWW at: http://www.ecosystemvaluation.org, a website developed by the U.S. Natural Resources Conservation Service (U.S. Department of Agriculture) and the National Oceanographic and Atmospheric Administration (NOAA – U.S. Department of Commerce). The website provides information on different valuation methods, their various strengths and weaknesses, and provides links to other relevant websites.

Priority Objective: Implementation by participating nations of standardized methods of biophysical and socio-economic survey and monitoring, data-storage, analysis and reporting, using regional (PERSGA and ROPME) and international protocols (e.g. ReefCheck and GCRMN).

Actions:

i. Conduct biodiversity, socio-economic, oceanographic and genetic assessments of key sites, including likely larval sources and sinks, in support of an interconnected network of MPAs (***);

ii. Develop national survey and monitoring capacities, by organizing training courses in collaboration with ReefCheck, GCRMN, ICRI and ICRAN (***);

iii. Establish and maintain a network of long-term monitoring sites, in collaboration with ReefCheck and GCRMN (***);

iv. Establish a regional node in the RSGA for ReefCheck and GCRMN co-ordination (***);

v. Establish national and regional reporting guidelines, linked to GCRMN schedules (**);

vi. Establish sustainable sources of funding to maintain the monitoring network (**);

vii. Develop capacity for economic valuations (*);

viii. In liaison with other agencies, develop standard regional and national guidelines, policy and legislation regarding bio-prospecting and other forms of research in reef areas, in terms of ethical considerations and benefit-sharing (see Box 5) (*).

BOX 5. *Biodiversity and bio-prospecting*

Biodiversity research and monitoring form a key component of national obligations under the CBD (Articles 7a, 7b) and a crucial initial step in the development of effective MPAs. In conjunction with biodiversity surveys, the CBD identifies protection of traditional knowledge, the rights of local stake-holders and the equitable sharing of benefits derived from exploitation of biodiversity (CBD Articles 7a, 7b, 8j) through bio-prospecting or other means (also relevant under CITES).

Parts of the RSGA region have already been subjected to uncontrolled bio-prospecting by unscrupulous international pharmaceutical companies. There is an urgent need for the development of standard policies and legislation regarding ethical considerations and benefit-sharing from any future bio-prospecting, or indeed from research generally (see DE FONTAUBERT ET AL. 1996 for further information).

Expected results – outcomes and time frame:

i. Survey and monitoring training courses (after 18 months);

ii. Demonstrable increase in national capacities in research, survey and monitoring (after 18 months);

iii. Completion of site assessments for MPAs (after 18 months);

iv. Establishment of regional monitoring network (after 18 months);

v. Establishment of regional node for ReefCheck and GCRMN (after 18 months);

vi. Demonstrable improvement in national contributions to regional and global reef status reporting, such as GCRMN reports (after nine months);

vii. Establishment of sustained funding for monitoring network (after three years);

viii. Establishment of regional node for remote sensing data (after 18 months).

INTEGRATION OF THE RAP

The Plan has both ‘top-down’ and ‘bottom-up’ aspects to its structure and operation. It represents a regional approach co-ordinated and supported by the regional Organization but mostly conducted at local and national levels by all countries within the RSGA region.

The Plan also aims to fulfil the regional goals of larger global initiatives for the conservation and sustainable use of coral reefs, including those of the various United Nations Organisations, major non-government organisations (e.g. IUCN and WWF) and, more recently, ICRI and ICRAN.

To assist effective implementation, a steering committee composed of representatives from each participating nation and the major international, regional and national organisations will be formed to co-ordinate the RSGA RAP over its initial period of implementation. The committee will also act as the interface between government, major donor agencies and international coral reef initiatives.

Effective communication among these various bodies in relation to recent advances in methods and findings, and in the presentation of a co-ordinated consistent ‘picture’ of reef status to the global community will help to achieve the overall objective of the Plan.

ACTIONS REQUIRING BUDGET SUPPORT

1. Integrated Coastal Zone Management

Budget code	**Budget item**
ICZM-1	Publication of regional and national guidelines for ICZM and EIA
ICZM-2	Organization of national meetings among key stake-holders
ICZM-3	Review of existing laws and regulations; development of recommendations on policy and legislative amendments
ICZM-4	Assistance in development of key demonstration ICZM sites
ICZM-5	Independent assessment of the effectiveness of ICZM

2. Education and Awareness

Budget code	**Budget item**
EAW-1	Production, publication and dissemination of education and awareness materials
EAW-2	Coral reef awareness campaigns
EAW-3	Organization of mass-media training courses

3. Marine Protected Areas

Budget code	**Budget item**
MPA-1	Establishment and upgrading of regional demonstration reef MPA sites
MPA-2	Establishment/upgrading of national demonstration reef MPA
MPA-3	Support for integrated network of reef MPAs
MPA-4	Production of publications relevant to key reef MPA sites
MPA-5	Review and refinement of policy and legislative frameworks for MPAs
MPA-6	Information exchange and meetings

4. Ecologically sustainable reef fisheries

Budget code	Budget item
ESF-1	Review and upgrading of relevant laws and regulations
ESF-2	Training in reef fisheries assessment, monitoring, surveillance and enforcement
ESF-3	Reef fish stock assessment and monitoring in MPAs
ESF-4	Production of guidelines for management of ornamental fishery and mariculture
ESF-5	Independent review of MPA effectiveness in relation to reef fisheries

5. Impact of Shipping and Marine Pollution

Budget code	Budget item
SMP-1	Support for implementation of Port State Control
SMP-2	Development of regional navigation risk assessment and management plan for reefs
SMP-3	Establishment of regional and sub-regional vessel traffic systems around reefs
SMP-4	Upgrading of navigational aids near sensitive reef areas
SMP-5	Preparation / upgrading of oil spill contingency plans
SMP-6	Review and upgrading of relevant legislation
SMP-7	Building national capacities for surveillance and enforcement of shipping regulations around reefs

6. Research, Monitoring and Economic Valuation

Budget code	Budget item
RME-1	Surveys and site assessments, especially in MPA areas
RME-2	Establishment of a monitoring network
RME-3	Establishment of regional nodes for monitoring, GIS and remote sensing
RME-4	Training in economic valuation techniques

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The RAP (Arabian Seas Region) builds on the substantial base of previous work by the regional and national organizations, and covers the coral reefs and associated habitats of all member nations of PERSGA, ROPME plus Eritrea**.**

The RAP (Arabian Seas Region) was prepared by Dr. Lyndon DeVantier, AIMS, Australia, and reviewed by the following: Dr. Fareed Krupp and Dr. Eugene Joubert, NCWCD, Riyadh, Saudi Arabia; Dr. Richard Kenchington, Jamison, Australia; Dr. Clive Wilkinson, AIMS, Australia; Dr. Gregor Hodgson, ReefCheck, USA; Dr. Hassan Mohammadi, ROPME, Kuwait; Mr. Abdullah Alsuhaibany, PERSGA, Jeddah; Dr. Abu Gassem Al-Assiri, UNEP-ROWA, Bahrain; Dr. Abdul-Majeid Haddad, UNDP, Riyadh; Dr. Mohammed Abu Zaid, Alexandria, Egypt; Dr. Salim Al-Moghrabi, Aqaba Marine Science Station, Aqaba, Jordan and Dr. Mohammed Abu Bakr, PERSGA-SAP, Sana'a, Yemen.

LITERATURE

ABOU ZAID, M. 2000. Overview of the status of Red Sea coral reefs in Egypt. Unpublished report. 39 pp.

ABOU ZAID, M.M., KOTB, M.M. & HANAFY, M.H. 1999. The impact of corallivore gastropod *Coralliphilia violacea*, Kiener on coral reefs at El-Hamrawain, Egyptian Red Sea Coast. *Egyptian Journal of Biology* **1**: 124-132.

ABUZINADA, A.H. (ed) in press. *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region.* NCWCD, Riyadh.

ABUZINADA, A.H. & DEVANTIER, L.M. 2000. Conserving Arabia's coral reefs. *Ahlan wa Sahlan.* February 2000.

AGARDY, T. 1994a. Advances in marine conservation: The role of marine protected areas. *Trends in Ecology and Evolution* **9**: 267-270.

AGARDY, T. (ed) 1994b. *The Science of Conservation in the Coastal Zone: New insights on how to design, implement and monitor marine protected areas.* A Marine Conservation and Development Report. Gland, IUCN.

ALDER, J. 1996. Have tropical marine protected areas worked? An initial analysis of their success. *Coastal Management* **24**: 97-114.

AL-MOGHRABI, S.M. in press. The status of coral reefs in Jordan (Gulf of Aqaba). In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region.* Abuzinada, A.H. ed: NCWCD, Riyadh.

AL-QASEER, J.A. & UWATE, K.R. in press. Bahrain coral reefs: Recent bleaching events, anthropogenic impacts and long term monitoring using volunteer divers and Reef Check. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region*. Abuzinada, A.H. ed: NCWCD, Riyadh.

AL-YAMI, H.M. & ROUPHAEL, A.L. in press. Patterns of coral mortality across the Farasan Shelf, Saudi Arabia. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region*. Abuzinada, A.H. ed: NCWCD, Riyadh.

ANTONIUS, A., SCHEER, G. & BOUCHON, C. 1990. Corals of the Eastern Red Sea. *Atoll Research Bulletin* **334**: 1-22.

ARONSON, R. B., EDMUNDS, P.J., PRECHT, W.F., SWANSON, D.W. & LEVITAN, D.R. 1994. Large scale, long-term monitoring of Caribbean coral reefs: simple, quick, inexpensive techniques. *Atoll Research Bulletin* **421**: 1-19.

AWAD, H.E. in press. Oil pollution and coral reef diseases. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region*. Abuzinada, A.H. ed: NCWCD, Riyadh.

BENITEZ, M., DURON, G., ERAZO, M., GAMMAGE, S. & MACHADO, M. 2000. A platform for action: Sustainable management of mangroves, Gulf of Fonseca, Central America. *InterCoast Network International Newsletter of Coastal Management* **37**: 16-17.

BRODIE, J. & TURAK, E. 1999. Threats to marine organisms and habitats of Yemen's Red Sea. In: *Ecosystems of the Red Sea coast of Yemen.* DouAbul, A., Rouphael, T.S. & Marchant, R. eds: Protection of Marine Ecosystems of the Red Sea Coast of Yemen. Hassell & Assoc., AMSAT and UNOPS.

BRODIE, J., AL-SORIMI, M. & TURAK, E. 1999. Fish and fisheries of Yemen's Red Sea. In: *Ecosystems of the Red Sea coast of Yemen.* DouAbul, A., Rouphael, T.S. & Marchant, R. eds: Protection of Marine Ecosystems of the Red Sea Coast of Yemen. Hassell & Assoc., AMSAT and UNOPS.

BROWN, B.E. 1987. Worldwide death of corals - natural cyclical events or man-made pollution? *Marine Pollution Bulletin* **18**: 9-13.

BRYANT, D., BURKE, L., MCMANUS, J. & SPALDING, M. 1998. Reefs at Risk. A map-based indicator of threats to the world's coral

reefs. World Resources Institute, Washington D.C. 56 pp.

CARLTON, J.T. 1998. Apostrophe to the Ocean. *Conservation Biology* **12**: 1165-1167.

CESAR, H. 1996. *Economic Evaluation of Indonesian Coral Reefs. Work in Progress Series.* Environment Dept., The World Bank, Washington, D.C. 86 pp.

CHEUNG, C.P.S., SAEED, F.N. & ABDAL-AZIZ, M. in press. Management of the marine biodiversity and resources of the Socotra Archipelago, Yemen. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region*. Abuzinada, A.H. ed: NCWCD, Riyadh.

CHIFFINGS, A.W. 1995. Marine Region 11 Arabian Seas. In: *A Global Representative System of Marine Protected Areas. Volume III Central Indian Ocean, Arabian Seas, East Africa and East Asian Seas.* Kelleher, G., Bleakley, C. & Wells, S. eds: pp. 39-70. Great Barrier Reef Marine Park Authority, The World Bank, The World Conservation Union (IUCN).

CHILD, G., & GRAINGER, J. 1990. *A System Plan for Protected Areas for Wildlife Conservation and Sustainable Rural Development in Saudi Arabia.* NCWCD - IUCN, Gland.

CHOU, L.M. & WILKINSON, C.R. (eds) 1992. *Third ASEAN Science and Technology Week Conference Proceedings, Marine Science: Living Coastal Resources.* National University of Singapore and National Science and Technology Board, Singapore.

CLARK, J. 1996. *Coastal Zone Management Handbook.* New York, Lewis publishers.

DE FONTAUBERT, A.C., DOWNES, D.R. & AGARDI, T.S. 1996. *Biodiversity in the Seas Implementing the Convention on Biological Diversity in Marine and Coastal Habitats.* IUCN Environmental Policy and Law Paper No. 32. A Marine Conservation and Development Report. IUCN Gland and Cambridge. 82 pp.

DEVANTIER, L.M. & HARIRI, K. in press. Preliminary ecological assessment of the coral communities of the north-east Gulf of Aden, with reference to the 1998 bleaching event. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region.* Abuzinada, A.H. ed: NCWCD, Riyadh.

DEVANTIER, L.M., TURAK, E., AL-SHAIKH, K.A., CHEUNG, C.P.S., ABDUL-AZIZ, M., DE'ATH, G. & DONE, T.J. 2000a. Ecological indicators of status of coral communities for Marine Protected Areas Planning: Case studies from Arabia. In: *Information Management and Decision Support for Marine Biodiversity Protection and Human Welfare: Coral Reefs.* Lloyd, D., Done, T.J. & Diop, S. eds: Australian Institute of Marine Science - United Nations Environment Programme.

DEVANTIER, L.M., CHEUNG, C.P.S., ABDULAZIZ, M., SAEED, F.N., ZAJONZ, U. & APEL, M. 2000b. Monitoring Corals in Socotra (Yemen). In: *Status of Coral Reefs of the World: 2000.* Wilkinson, C.R. ed: Global Coral Reef Monitoring Network and Australian Institute of Marine Science.

DEVANTIER, L.M., REINICKE, G., AL-MOGHRABI, S. & ABDULAZIZ, M. in press. Monitoring coral communities around the Socotra Islands. In: *Marine Habitat, Biodiversity and Fisheries Surveys and Management Progress Report of Phase IV. GEF-UNDP Socotra Biodiversity Project.* Senckenberg Research Institute, Frankfurt; Hariri & Associates, Sana'a.

DEVANTIER, L.M., CHEUNG, C.P.S., ABDULAZIZ, M., & KLAUS, R. in press. Coral bleaching in the Socotra Archipelago, Yemen, May-June 1998. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region.* Abuzinada, A.H. ed: NCWCD, Riyadh.

DEVANTIER, L.M., TURAK, E., AL-SHAIKH, K.A. & DE'ATH, G. 2000c. Coral communities of the central-northern Saudi Arabian Red Sea. *Fauna of Arabia* **18**: 23-66.

DIXON, J. 1993. Economic benefits of marine protected areas. *Oceanus* **36**: 35-40.

DIXON, J. & SHERMAN, P. 1990. *Economics of Protected Areas.* Washington D.C., Island Press.

ENGLISH, S., WILKINSON, C. & BAKER, V. 1997. *Survey Manual for Tropical Marine Resources 2nd Edition.* Australian Institute of Marine Science. 390 pp.

FLEMING, R.M. 1996. The role of education in marine sanctuary management. In: *A Marine Wildlife Sanctuary for the Arabian Gulf. Environmental Research and Conservation Following the 1991 Gulf War Oil Spill*. Krupp, F., Abuzinada, A.H. & Nader, I.A. eds: Senckenberg Research Institute, Frankfurt & NCWCD, Riyadh.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNTIED NATIONS (FAO). 1992. *Integrated Management of Coastal Zones.* FAO Fisheries Technical Paper 327, Rome, FAO.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNTIED NATIONS (FAO). 1995a. *Draft Code of Conduct for Responsible Fisheries*. Rome, FAO.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNTIED NATIONS (FAO). 1995b. *Precautionary Approach to Fisheries, Part I.* FAO Fisheries Technical Paper 350/1. Rome, FAO.

FOUDA, M.M. 1983. Oil pollution in the Red Sea. *Cairo Today*, 33-34.

GATTUSO, J.P., ALLEMAND, D. & FRANKIGNOULLE, M. 1999. Photosynthesis and calcification at cellular, organismal and community levels in coral reefs: A review on interactions and control by carbonate chemistry. *American Zoologist* **39**: 160-183.

GESAMP (JOINT GROUP OF EXPERTS ON THE SCIENTIFIC ASPECTS OF MARINE POLLUTION). 1990. *The State of the Marine Environment.* UNEP Regional Seas Reports and Studies 115, UNEP, Nairobi.

GINSBURG, R. (compiler) 1994. *Proceedings of the colloquium on global aspects of coral reefs: health, hazards and history*. Rosenstiel School of Marine and Atmospheric Science, University of Miami. 420 pp.

GLADSTONE, W. 1994. *Draft Management Plan for the Farasan Islands Marine Protected Area.* NCWCD, Riyadh.

GLADSTONE,W., TAWFIQ, N., NASR, D., ANDERSEN, I., CHEUNG, C., DRAMMEH, H., KRUPP, F. & LINTNER, S. 1999. Sustainable use of the renewable resources and conservation in the Red Sea and Gulf of Aden: issues, needs and strategic actions. *Ocean and Coastal Management* **42**: 671-697.

GLYNN, P.W. 1991. Coral bleaching in the 1980s and possible connections with global warming trends. *Trends in Ecology and Evolution* **6**: 175-179.

HOOTEN, A. & HATZIOLOS, M. 1995. (eds) *Sustainable Financing Mechanisms for Coral Reef Conservation, Proceedings of a Workshop.* Environmentally Sustainable Development Proceedings Series 9. The World Bank, Washington D.C.

HEAD, S.M., 1980. The Ecology of Corals in the Sudanese Red Sea. Ph.D. Thesis, University of Cambridge.

HODGSON, G. 1999. A global assessment of human effects on coral reefs. *Marine Pollution Bulletin* **38**: 345-355.

HOEGH-GULDBERG, O. 1999. Climate change, coral bleaching and the future of the world's coral reefs. *Marine and Freshwater Research* **50**: 839-866.

ITMEMS. 1999. *Proceedings: Tropical Marine Ecosystem Management Symposium (ITMEMS).* Great Barrier Reef Marine Park Authority, Townsville, Australia.

IUCN.1997. *Preliminary ecological assessment of the Saardin Islands, Awdal Region.* IUCN EARO Report. 47 pp.

JACKSON, J.B.C. 1997. Reefs since Columbus. *Coral Reefs* **16**: S23-S32.

JACKSON, J.B.C. 1998. Reply to J.L. Monroe (*Coral Reefs* **17**: 191-192). *Coral Reefs* **17**: 193-194.

JAMESON S.C., AMMAR, M.S.A., SAADALLA, E., MOSTAFA, H.M. & REIGL, B. 1999. A coral damage index and its application to diving sites in the Egyptian Red Sea. Special

issue on The Science of Coral Reef Management. *Coral Reefs* **18**: 333-339.

KELLEHER, G., BLEAKLEY, C. & WELLS, S. (eds) 1995. *A Global Representative System of Marine Protected Areas. Volume III Central Indian Ocean, Arabian Seas, East Africa and East Asian Seas.* Great Barrier Reef Marine Park Authority, The World Bank, The World Conservation Union (IUCN). 147 pp.

KENCHINGTON, R. 1990. *Managing Marine Environments*. Taylor & Francis, New York. 248 pp.

KENCHINGTON, R. 2000. Fisheries management and marine protected areas - A 2000 perspective. *InterCoast Network International Newsletter of Coastal Management* **37**: 4-5.

KENCHINGTON, R. In press. Elements for a Regional Action Plan. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region.* Abuzinada, A. ed: NCWCD, Riyadh.

KIMBALL, L. 1996. An international regime for managing land-based activities that degrade marine and coastal environments. In: *Earth Summit Implementation: Progress Achieved on Oceans and Coasts. Ocean and Coastal Management.* Center for the Study of Marine Policy, University of Delaware, Newark, DE, USA.

KLAUSWITZ, 1989. Evolutionary history and zoogeography of the Red Sea ichthyofauna. *Fauna of Saudi Arabia* **10**: 310-337.

KLEYPAS, J.A., BUDDEMEIER, R.W., ARCHER, D., GATTUSO, J-P., LANGDON, C. & OPDYKE, B.N. 1999. Geochemical consequences of increased atmospheric carbon dioxide on coral reefs. *Science* **284**: 118-120.

KOTB, M.M.A., ABOU ZAID, M.M. & HANAFY, M.H. 2000. Overall evaluation of the coral reef status along the Egyptian Red Sea coast. *Proceedings of the 31st Congress of the Italian Society for Marine Biology 13-20 April, Sharm El-Sheikh, Egypt. Biologia Mare Mediterraneo* **8**(1): 15-32.

KRUPP, F., TÜRKAY, M., EL HAG, A.E. & NASR, D.H. 1994. *Comparative ecological analysis of biota and habitats in littoral and sublittoral waters of the Sudanese Red Sea, based on the study of marine fauna and flora.* Report for the period of April 1991 to December 1993. Forschungsinstitut Senckenberg, Frankfurt and Faculty of Marine Science and Fisheries, Sudan. 89 pp.

KRUPP, F., PAULUS, T. & NASR, D.H. 1994. Coral Reef Fish Survey. In: *Comparative ecological analysis of biota and habitats in littoral and shallow sublittoral waters of the Sudanese Red Sea, based on the study of marine fauna and flora.* Krupp, F., Türkay, M., El Hag, A.G.D. & Nasr, D. eds. pp. 63-82. Forchungsinstitut Senckenberg, Frankfurt.

KRUPP, F., ABUZINADA, A.H. & NADER, I.A. (eds) 1996. *A Marine Wildlife Sanctuary for the Arabian Gulf. Environmental Research and Conservation Following the 1991 Gulf War Oil Spill*. Senckenberg, Frankfurt & NCWCD, Riyadh. 511 pp.

LINTNER, S.F., ARIF, S. & HATZIOLOS, M. 1996. *The experience of the World Bank in the legal, institutional and financial aspects of Regional Environment Programs: Potential application of lessons learned for the ROPME and PERSGA programs.* The World Bank, Washington, D.C. 27 pp.

MACCLANAHAN, T. 1999. Is there a future for coral reef parks in poor tropical countries? *Coral Reefs* **18**: 321-325.

MIEREMET, B. 1998. (ed) *Report on the Middle East Seas Regional Strategy Workshop for the International Coral Reef Initiative. Aqaba, Jordan 25-27 September 1997.* US National Ocean Service, NOAA, Silver Spring Maryland, USA. 257 pp.

MISHRIGI, S.Y. 1993. *Identification Study for Sudan Red Sea Fisheries*. Ministry of Economic Planning and Investment (MEPI), Project Preparation Unit. Khartoum. 240 pp.

MOORE, R.J. 1978. Is *Acanthaster planci* an r-strategist? *Nature* **271**: 56-57.

NASR, D. & AL-SHEIKH, K. in press. Assessment of coral reefs in the Sudanese Red Sea in the context of coral bleaching. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching*

in the Arabian Seas Region Abuzinada, A.H. ed: NCWCD, Riyadh.

OBURA D. & DJAMA, N. in press. Coral reef survey in Djibouti post bleaching. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region* Abuzinada, A.H. ed: NCWCD, Riyadh.

OGDEN, J. & 32 OTHERS. 1997. Caribbean coastal marine productivity (CARICOMP): A research and monitoring network of marine laboratories, parks and reserves. *Proceedings 8th International Coral Reef Symposium* **1**: 641-646.

ORMOND, R.F.G., DAWSON-SHEPPARD, A., PRICE, A. & PITTS, R.G. 1984. Report on the distribution of habitats and species in the Saudi Arabian Red Sea. IUCN/MEPA/PERSGA, Kingdom of Saudi Arabia. 123 pp.

ORMOND, R.F.G. & CAMPBELL, A.C. 1974. Formation and breakdown of *Acanthaster planci* aggregations in the Red Sea. *Proceedings 2nd International Coral Reef Symposium* **1**: 595-619.

ORMOND, R.F.G., BRADBURY, R.H., BAINBRIDGE, S., FABRICIUS, K., KEESING, J.K., DEVANTIER, L.M., MEDLEY, P. & STEVEN, A.D.L. 1990. Test of a model of regulation of crown-of-thorns starfish by fish predators. In: *Acanthaster* and the Coral Reef: A Theoretical Perspective. Bradbury, R.H. ed: *Lecture Notes in Biomathematics* **88**, 189-207.

PERNETTA, J. & ELDER, D. 1993. *Cross-sectoral, Integrated Coastal Area Planning (CICAP): Guidelines and Principles for Coastal Area Development*. A Marine Conservation and Development Report, Gland, IUCN.

PERSGA. 1997a. *Draft Country Report: Somalia. Strategic Action Programme for the Red Sea and Gulf of Aden*. Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden. 19 pp.

PERSGA. 1997b. *Draft Country Report: Republic of the Sudan. Strategic Action Programme for the Red Sea and Gulf of Aden.* Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden. 14 pp.

PERSGA. 1998a. *Strategic Action Programme for the Red Sea and Gulf of Aden*. World Bank, Washington, D.C. 98 pp.

PERSGA. 1998b. *Surveys of Natural Habitats and Plans for their Protection in Sudan.* Hunting Aquatic Resources, London, Draft Final Report to PERSGA.

PERSGA. in prep. *Manual of Standard Survey Methods for Coastal and Marine Habitats.*

PILCHER, N., WILSON, S., ALHAZEEM, S.H. & SHOKRI, M.R. 2000. Status of coral reefs in the Arabian/Persian Gulf and Arabian Sea Region (Middle East). *Status of Coral Reefs of the World: 2000*: 55-64. Australian Institute of Marine Science.

PILCHER, N. & ALSUHAIBANY, A. 2000. Regional status of coral reefs in the Red Sea and the Gulf of Aden. *Status of Coral Reefs of the World: 2000*: 35-54. Australian Institute of Marine Science.

REIGL, B. & LUKE, K.E. 1998. Ecological parameters of dynamited reefs in the northern Red Sea and their relevance to reef rehabilitation. *Marine Pollution Bulletin* **37**: 488-498.

ROBERTS, C.M. 1998. Connectivity and management of Caribbean coral reefs. *Science* **278**: 1454-1457.

ROUPHAEL, T., OLIVER, J. & AL SAFANI, M. 1999. A monitoring programme for Yemen's Red Sea. In: *Ecosystems of the Red Sea Coast of Yemen. Protection of Marine Ecosystems of the Red Sea Coast of Yemen.* DouAbul, A., Rouphael, T., Marchant, S. & R. Hannah eds: Hassell & Assoc., AMSAT and UNOPS.

RUITENBEEK, H.J. & CARTIER, C.M. 1999. Issues in applied coral reef biodiversity valuation: results from Montego Bay, Jamaica. World Bank Research Committee Final Report, World Bank, Washington, D.C.

RUITENBEEK, J., RIDGLEY, M., DOLLAR, S. & HUBER, R. 1999. Optimization of economic policies and investment projects using a fuzzy logic based cost-effectiveness model of coral

reef quality: empirical results for Montego Bay, Jamaica. *Coral Reefs* **18**: 381-392.

RUSHDI, A.I., BA'ISSA, A.A. & BABAGI, A. 1991. Preliminary investigations of oil pollution along the Red Sea coast of Yemen. *Proceedings of the Seminar on the Status of the Environment in the Republic of Yemen*. EPC.

RUSS, G. 1985. Effects of protective management on coral reef fishes in the central Philippines. *Proceedings 5th International Coral Reef Congress* **4**: 219-224.

RUSS, G. & ALCALA, A. 1996a. Marine reserves: rates and patterns of recovery and decline in abundance of large predatory fish. *Ecological Applications* **6**: 947-961.

RUSS, G. & ALCALA, A. 1996b. Do marine reserves export adult fish biomass? Evidence from Apo Island, central Philippines. *Marine Ecology Progress Series* **132**: 1-9.

SCHLEYER, M. & BALDWIN, R. 1999. Biodiversity assessment of the northern Somali coast east of Berbera. IUCN EARO Report EARO/75561/417. 42 pp.

SHEPPARD, C.R.C. 1995. The shifting base-line syndrome. *Marine Pollution Bulletin* **30**: 766-767.

SHEPPARD, C.R.C., PRICE, A. & ROBERTS, C. 1992. *Marine Ecology of the Arabian Region - Patterns and processes in extreme tropical environments.* Academic Press, London. 359 pp.

SHEPPARD, C.R.C. & SHEPPARD, A.L.S. 1991. Corals and coral communities of Arabia. *Fauna of Saudi Arabia* **12**: 3-170.

SHEPPARD, C.R.C. & WELLS, S. 1988. *Directory of Coral Reefs of International Importance. Volume 2: Indian Ocean Region*. IUCN, Gland and UNEP, Nairobi. 389 pp.

SHOKRI, M.R., HAERI-ARDAKANI, O., SHARIFI, A., ABDOULLAHI, P. & NAZARIAN, M. in press. Status of Coral Reefs around the Iranian Kish Island in the Persian Gulf. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region*. Abuzinada, A.H. ed: NCWCD, Riyadh.

SORENSEN, J. & MCCREARY, S. 1990. *Institutional Arrangements for Managing Coastal Resources and Environments.* Renewable Resources Information Series, Coastal Management Publication 1, National Parks Service, U.S. Department of Interior, Washington D.C.

SOULÉ, M.E. 1987. *Viable Populations for Conservation.* Cambridge University Press, Cambridge.

TIMMERMANN, A., OBERHUBER, J., BACHER, A., ESCH, M., LATIF, M. & ROECKNER, E. 1999. Increased El Nino frequency in a climate model forced by future greenhouse warming. *Nature* **398**: 694-697.

TURAK, E. & BRODIE, J. 1999. Coral and reef habitats. In: *Ecosystems of the Red Sea coast of Yemen.* DouAbul, A., Rouphael, T.S. & Marchant, R. eds: Protection of Marine Ecosystems of the Red Sea Coast of Yemen. Hassell & Assoc., AMSAT and UNOPS.

UNITED NATIONS ENVIRONMENT PROGRAMME. 1986. *Action Plan for the conservation of the marine environment and coastal areas of the Red Sea and Gulf of Aden.* UNEP Regional Seas Reports and Studies No. 81. 12 pp.

U.S. NATIONAL RESEARCH COUNCIL, COMMITTEE ON BIOLOGICAL DIVERSITY IN MARINE SYSTEMS. 1995. *Understanding Marine Biodiversity: A Research Agenda for the Nation.* National Research Council, Washington D.C.

VERON, J.E.N. 2000. *Corals of the World.* 3 Vols. M. Stafford-Smith ed: Australian Institute of Marine Science.

WATT, I. 1996. *Coastal habitat survey of the Gulf of Aden. Final Report Phase II: South Coast of Yemen.* European Union (ALA/91/22). MacAlister Elliott & Partners, UK.

WELLS, S. 1999. Tackling the Paper Parks problem. *Reef Encounter* **26**: 24-26.

WHITE, A.T., HALE, L.Z., RENARD, Y. & CORTESI, L. 1994. *Collaborative and Community-based Management of Coral Reefs. Lessons from Experience.* Kumarian Press, USA.

WILKINSON, C.R. 1992. Coral reefs of the world are facing widespread devastation: can we prevent this through sustainable management practices? *Proceedings 7th International Coral Reef Symposium* **1**: 11-21.

WILKINSON, C.R. 1998. *Status of Coral Reefs of the World: 1998*. Global Coral Reef Monitoring Network and Australian Institute of Marine Science. 184 pp.

WILKINSON, C.R. 2000. *Status of Coral Reefs of the World: 2000*. Global Coral Reef Monitoring Network and Australian Institute of Marine Science. 363 pp.

WILKINSON, C.R. & BUDDEMEIER, R.W. 1994. *Global Climate Change and Coral Reefs: Implications for People and Reefs. Report of the UNEP-IOC-ASPEI-IUCN Global Task Team on the Implications of Climate Change on Coral Reefs*. IUCN, Gland, Switzerland. 124 pp.

WILKINSON, C.R., LINDEN, O., CESAR, H., HODGSON, G., RUBENS, J. & STRONG, A.E. 1999. Ecological and socioeconomic impacts of 1998 coral mortality in the Indian Ocean: An ENSO impact and a warning of future change? *Ambio* **28**: 188-196.

WILSON, S.C. & CLAEREBOUDT, M.R. 2000. Seawater temperatures and bleaching events in Oman. In: *Proceedings of the International Workshop on the Extent and Impact of Coral Bleaching in the Arabian Seas Region* AbuZinada, A.H. ed: NCWCD, Riyadh.

WORLD BANK 1993. *Noordwijk Guidelines: For Integrated Coastal Management*. The World Bank, Washington D.C.

APPENDIX 1. Key goals for effective reef management

(After MIEREMET 1998, PERSGA 1998, KENCHINGTON in press)

1. Integrated coastal zone management, ensuring ecologically sustainable development of the region's coastlines;
2. A functional integrated network of MPAs;
3. Sustainable reef fisheries;
4. Strong national capacities for effective ICZM, MPA and fisheries management, including legislative frameworks;
5. A strong unified regional position in the implementation of global programmes such as those of ICRI, UNEP, UNDP and IUCN, and with major funding agencies, partners and stake-holders such as the World Bank (see e.g. LINTNER ET AL. 1996), Global Environment Facility (GEF) and Islamic Development Bank (IDB);
6. An effective network of managers and scientists with common goals, in regular communication through electronic mail and other media events (e.g. workshops, training courses);
7. Efficient, focused training and education programmes;
8. Standard management-focused approaches to research and monitoring of biological, ecological, socio-economic parameters and performance indicators of management effectiveness;
9. Efficient sharing and publicizing (including use of mass media) of relevant information, to raise public and governmental awareness both within the region and globally.

APPENDIX 2. Major issues to be addressed for successful reef management

(After MIEREMET 1998, PERSGA 1998, KENCHINGTON in press)

1. Rapid uncontrolled tourism development is causing degradation of reef resources in some areas;
2. Poorly controlled or uncontrolled commercial fishing, including poaching, is rapidly depleting the once rich fishery stocks and damaging reefs in some areas;
3. Inadequate operational standards for oil exploration, production and transportation are causing chronic pollution and can threaten the long-term viability of coral reefs and associated ecosystems;
4. Ship traffic and marine pollution threatens the function and structure of reefs;
5. Land-based pollution threatens the function and structure of reefs;
6. Many of the region's reefs fringe the coastline, placing them in particular jeopardy from poorly planned coastal developments and pollution;
7. Environmental Impact Assessment is rarely used *a priori* in the planning of coastal developments in the region;
8. With a few important exceptions, there is a critical shortage of trained reef researchers and associated lack of monitoring activities for provision of accurate information to managers, other government agencies and the public;
9. With a few important exceptions, there is a critical shortage of trained MPA managers in the region, resulting in low management capacity;
10. There is inadequate regional capacity to respond to reef degradation at both government and non-governmental levels;
11. Likely future climate changes will place increasing stress on the resilience of the ecosystems, manifested through increases in coral bleaching and death;
12. Local differences in oceanographic and other factors provide some reef areas with a degree of natural protection against these predicted changes - key sites for establishment of MPAs;
13. Key MPA sites have been identified in most countries, although gaps in knowledge remain, and development of a fully-functional integrated regional MPA network will require additional research;
14. There is an urgent need to ensure adequate and on-going resources and funding for development of the above capacities in research, monitoring and management.

APPENDIX 3. Integration of the RAP with other Programmes and Conventions

The RAP for the RSGA is in accord with major international Conventions including:

- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (Jeddah Convention),
- Convention on Biological Diversity (CBD),
- World Heritage Convention (WHC),
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES),
- United Nations Convention on the Law of the Sea (UNCLOS),
- International Convention for the Prevention of Pollution from Ships (MARPOL),
- International Wetlands Convention (Ramsar).

The RAP is also in accord with inter-governmental and non-governmental initiatives including those of:

- The United Nations Environment Programme (UNEP - Regional Seas),
- The United Nations Development Programme (UNDP),
- The United Nations Educational, Scientific and Cultural Organization - Intergovernmental Oceanographic Commission (UNESCO-IOC),
- The World Conservation Union (IUCN),
- The World-wide Fund for Nature (WWF),
- The International Coral Reef Initiative (ICRI) and Action Network (ICRAN).

APPENDIX 4. International collaboration with ICRI and ICRAN

Increasing impacts to reef ecosystems worldwide have focused international efforts for their conservation, with the formation of the International Coral Reef Initiative (ICRI, and see the ICRI "*Call to Action*" at http://coral.aoml.noaa.gov/icri/icri95.html and ITMEMS 1999). As part of the ICRI partnership, an Action Network (ICRAN) is being developed to assist in regional reef conservation efforts.

In its initial Action Phase ICRAN will focus on reefs of the Wider Caribbean, Eastern Africa, East Asian Seas and the South Pacific, but the overall approach also has applicability in the RSGA region. ICRAN proposes a three component regional approach in its Action Plan – Implementation, Assessment and Communication and information dissemination - founded in effective Integrated Coastal Management and development of Marine Protected Area networks. It is composed of the following major actions:

1. Assessment of threats through regional 'Reefs at Risk' analysis;
2. Assessment of reef distribution through regional reef mapping;
3. Assessment of larval dispersal among reefs;
4. Coral reef valuation by country;
5. Coral reef fisheries and mariculture analysis;
6. Coral reef policy analysis by country;
7. Coral reef monitoring and assessment;
8. Data storage and dissemination;
9. Communication and information dissemination;
10. Information networking, action and diplomacy.

Collaboration and information-sharing should enable rapid assimilation and application of technical and other advances, developed through ICRI, ICRAN and the RAP, and facilitate linkages with key partners as opportunities allow.

APPENDIX 5. Principles of implementation of the RAP in the Red Sea and Gulf of Aden

Successful implementation will benefit from the application of 12 general principles (after DE FONTAUBERT ET AL. 1996, BENITEZ ET AL. 2000):

1. Involve all stake-holders (from local communities to central government) in consultation and decision-making;
2. Harmonize resource use among stake-holders;
3. Strengthen institutions and implement appropriate legal instruments;
4. Alleviate poverty to reduce environmental degradation;
5. Collect and evaluate appropriate data on environmental and socio-economic status;
6. Develop flexible and adaptive management systems that respond quickly to new information;
7. Maintain consistency of approach across all spatial scales of implementation - local and national actions should be consistent with regional and global actions and co-operation;
8. Ensure high levels of information-sharing and technology-transfer across all scales of implementation, and among all participants;
9. Foster widespread education and awareness;
10. Ensure adequate and sustained financing;
11. Ensure effective integration of all Priority Action components and specific actions, making full use of positive feed-backs among components;
12. Adopt a precautionary approach to any future development issues affecting reefs and the coastal zone.

APPENDIX 6. Indicators of success of the RAP

The following set of indicators are based on those proposed in the ICRAN Strategic Plan, with the addition of several others with high applicability to the RSGA region:

1. Outcome Indicators

1. Demonstrable expansion in human resources capacity – increased numbers of managers and project staff;
2. Policy and legislative changes relevant to ICZM, MPAs, reef fisheries, shipping and marine pollution;
3. Demonstrable improvements in management efficiency in ICZM, MPAs, reef fisheries, shipping and marine pollution;
4. Expanded infrastructure and capital equipment;
5. Implementation of ICZM and EIA in planning;
6. Effective management of MPAs, concentrating initially on the demonstration sites;
7. Demonstrable sustainability of reef fisheries stocks;
8. Demonstrable minimization of threats from shipping and marine pollution, including improved navigation aids and pilotage, surveillance and enforcement capacities;
9. Demonstrable increase in research and monitoring capacity, through conduction of surveys, establishment of long-term monitoring sites and of regional "nodes" for data storage, analysis and dissemination;
10. Publications – manuals, atlases, multi-media kits, education and awareness materials etc.
11. Demonstrable increase in education, government and public awareness.

2. Impact indicators

1. Demonstrable improvement in stake-holder involvement in decision-making;
2. Stake-holder and user conflict resolution;
3. Demonstrable improvement in standard of living of coastal communities and other socio-economic benefits within the sphere of influence of the RAP;
4. No further degradation of reef condition, and improvement of degraded reefs;
5. Achievement of sustained financing from government and other sources.

APPENDIX 7. Techniques for raising awareness of coral reefs

1. Development and provision of teaching materials to schools, targeting different age groups;
2. Talks at schools and other interest groups;
3. Addition of coral reef subjects in school and college curricula;
4. Production of newsletters, information sheets and booklets;
5. Production of specific information materials for individual MPAs, provided to all visitors as part of the fee structure for MPA entry;
6. Development of public awareness campaigns (with potential for collaboration with ICRI, ICRAN and ICRIN);
7. Widespread use of the mass media – newspapers, radio, television and the WWW, with development of strong links with various mass media;
8. Production of videos and CDs – several excellent videos and CDs are already in wide circulation;
9. Production of target materials for the SCUBA diving communities and resort hotels near reefs;
10. Organization of seminars, workshops and conferences with invitations to the mass media, key government representatives and the general public;
11. Talks at coastal villages and towns with provision of free lectures, meetings and question-answer sessions;
12. Development of strong links and information networks with key government departments and agencies, with regular supply of updated materials;
13. Employment of public relations 'extension' officers – particularly useful where local communities are major stake-holders in MPAs (e.g. local fishing communities – Socotra Islands, Yemen, CHEUNG ET AL. in press).

APPENDIX 8. Criteria for demonstration MPA site selection

The ICRAN Strategic Plan provides 16 criteria to be used in the selection of MPA demonstration sites. These are appropriate for the region and are paraphrased below:

1. Representation of coral reefs and associated ecosystems;
2. Regional significance in providing habitat for a wide diversity of species, or of migratory, endemic or threatened species;
3. Presence of local coastal communities that make direct or indirect subsistence use of the reefs;
4. Presence of current or resolved issues and stake-holder conflicts;
5. Examples of participatory approaches to management, including planning and zoning;
6. Sites with well designed zoning plans or management plans that are being implemented;
7. Presence of investments and possibilities for partnerships with the private sector;
8. Accessibility to visitors (location, transport and communications infrastructure and facilities) and capacity for training and demonstrations;
9. Sites where the success of management has high potential for replication in other areas;
10. Sites that are contributing (or have potential to contribute) to the economy through their conservation and management (e.g. refuge, replenishment or nursery areas, tourism, subsistence for locals);
11. Sites reflecting different environmental and management challenges (e.g. biogeographic boundaries or areas on international boundaries);
12. Sites where social, political and community support are high;
13. Sites with a strong institutional and management framework;
14. Sites with available information and data relevant to management – including monitoring, assessment or evaluation;
15. Sites with established monitoring programmes – particularly those demonstrating success in biodiversity protection, increased fisheries, tourism or other benefits to the communities;
16. Sites that have cultural or traditional importance.

APPENDIX 9. Assessing management effectiveness in MPAs

The IUCN World Commission on Protected Areas has established a 'Management Effectiveness Task Force' to develop a system for verifying or assessing management effectiveness – including on-going management of existing MPAs and the location and design of new MPAs. The Task Force recommends use of generic 'outcome' indicators (e.g. measuring biodiversity conservation and socio-economic effectiveness). Principles for assessment of MPA effectiveness include the following (after WELLS 1999):

1. Assessment systems should be participatory at all stages, involving all relevant organizations and stake-holders;
2. Assessment should be 'transparent' and comprehensible to all participants, and be based on appropriate environmental and social science;
3. Management objectives must be clearly defined and understood by both managers and assessors;
4. Assessment should focus on the most important issues, threats and opportunities affecting achievement of management objectives;
5. MPA design, results and outcomes should all be considered;
6. MPA Effectiveness Indicators should identify critical aspects of ecological-environmental, socio-economic and other management issues, including the relationship of the MPA with its surroundings;
7. The assessment system must be able to demonstrate trends in management effectiveness over time, through repeated assessments;
8. Strengths and weaknesses should be identified and issues clearly separated into those within and outside the control of management;
9. Recommendations for improved management, including prioritisation of conservation effort, and limitations of the evaluation should be clearly identified.

Another approach is the assessment of overall MPA performance by scoring success in each of five broad categories:

1. Maintenance of living and non-living resources;
2. Market value of the MPA and its resources;
3. Social expectations;
4. Maintenance of ecosystem functions;
5. Management.

The use of standard MPA evaluation data-sheets and statistical software provides a standard means of comparison of management effectiveness among MPAs.

الهيئة الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن

خطة العمل الإقليمية لصون الشعاب المرجانية
فى البحر الأحمر وخليج عدن

الهيئة الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن، هي هيئة حكومية تهتم بالمحافظة على البيئات البحرية والساحلية في الإقليم

تستمد الهيئة قاعدتها القانونية من الاتفاقية الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن (1982). وقد تم إعلان إنشائها فى القاهرة فى سبتمبر 1995 حيث تتخذ من مدينة جدة مقراً لها. تضم الهيئة في عضويتها كل من الاردن ، جيبوتي ، السعودية ، السودان ، الصومال ، مصر واليمن .

عنوان الهيئة : ص ب 53662 جدة 21583 المملكة العربية السعودية
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لقد تم استخلاص وثيقة "خطة العمل الإقليمية لصون الشعاب المرجانية فى إقليم البحر الأحمر وخليج عدن" من الوثيقة الرئيسية بعنوان "خطة العمل الإقليمية لصون الشعاب المرجانية فى منطقة البحار العربية". وقد قام بإعداد أصل هذه الوثيقة الدكتور ليندون دى فانتير (المعهد الاسترالى للعلوم البحرية ، تاونزفيل ، استراليا) بموجب عقد مع الهيئة الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن وبالتعاون مع كل من الهيئة الوطنية لحماية الحياة الفطرية وإنمائها والمنظمة الإقليمية لحماية البيئة البحرية والمكتب الإقليمى لغرب آسيا التابع لبرنامج الأمم المتحدة للبيئة .

وقد جرى العمل لإعداد هذه الوثيقة ضمن أنشطة مكون صون المواطن الطبيعية والتنوع الحيوي فى إطار تنفيذ برنامج العمل الاستراتيجى للبحر الأحمر وخليج عدن والذى يموله مرفق البيئة العالمى بشركائه الثلاثة: برنامج الأمم المتحدة الإنمائى و برنامج الأمم المتحدة للبيئة والبنك الدولى .

إن الملاحظات التي تم إبداؤها في هذه الوثيقة تمثل وجهة نظر المؤلف وتحت مسئوليته الخاصة ولا تمثل بالضرورة وجهات نظر الهيئة ، أو الجهات التي ساعدت فى تمويل إعداد هذا التقرير . وكذلك لا يعبر عن أي وصف أو تفاصيل إجمالية وردت فى التقرير ، عن فكرة معينة تُنسب للهيئة أو لأي جهة مانحة ، فيما يتعلق بالحدود القانونية لأي دولة أو منطقة أو مدينة .

الصور الفوتوغرافية للدكتور فريد كروب

ملخص تنفيذى

لقد تم استخلاص هذه الخطة – والتى أعدت خصيصاً للبحر الأحمر وخليج عدن – من الوثيقة الرئيسية " خطة العمل الإقليمية لصون الشعاب المرجانية فى البحار العربية" والتى كانت نتاجاً للندوة العالمية حول تأثيرات ظاهرة ابيضاض الشعاب المرجانية فى منطقة البحار العربية . وقد استضافت الهيئة الوطنية لحماية الحياة الفطرية وإنمائها هذه الندوة تحت رعاية صاحب السمو الملكى الأمير سلمان بن عبد العزيز آل سعود وبمشاركة الهيئة الاقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن والمنظمة الإقليمية لحماية البيئة البحرية والمكتب الإقليمى لغرب آسيا التابع لبرنامج الأمم المتحدة للبيئة ، وبمساعدة مقدرة من الاتحاد الدولى لصون الطبيعة والبنك الإسلامى للتنمية وكل الدول التي شاركت فى الندوة .

إن خطة العمل الإقليمية توفر مجموعة من الإجراءات ذات الأولوية للصون والتنمية المستدامة للشعاب المرجانية فى البحر الأحمر وخليج عدن . فالإقليم يزخر بأنواع مختلفة من الشعاب والمواطن الطبيعية الساحلية ذات القيمة الايكولوجية العالية والأهمية العالمية للاستيطان والتنوع الحيوي . وبالإضافة إلى ذلك فإن الإقليم يزخر أيضاً بمدى واسع للموارد المتجددة للاستخدام البشري .

لقد تم تطوير هذه الخطة فى ضوء الأهمية الاقتصادية والايكولوجية والجمالية التي توفرها تلك النظم البحرية ، وكاستجابة للتهديدات التي تواجه هذه البيئات والمتمثلة فى التأثيرات السلبية المتزايدة الطبيعية منها والناجمة عن الأنشطة البشرية . وتتراوح هذه التهديدات من أحداث محلية إلى عالمية ومن بينها التنمية الساحلية غير المرشدة ، التلوث البحري والساحلى بأشكاله المختلفة ، طرق الصيد المدمرة والصيد الجائر ، الزيادة غير الطبيعية فى أعداد الحيوانات المفترسة ، التأثيرات السلبية لحركة السفن ، والاضطرابات المتوقعة مستقبلاً والمرتبطة بالتغير المناخى . ومن المعلوم أن الكثير من الشعاب فى الإقليم ينمو بالقرب من الحدود المناخية القصوى المطلوبة لنمو الشعاب ، ولذلك فهي على وجه الخصوص عرضة لأي زيادة فى مثل هذه الاضطرابات . وظاهرة ابيضاض الشعاب المرجانية التي حدثت خلال عامي 1997 و 1998 ، والتى تسببت فى موت الكثير من الشعاب المرجانية والحيوانات المرتبطة بها فى البحر الأحمر وخليج عدن ، خير شاهد على ذلك . وقد تتسبب أي زيادة فى اضطرابات يتنبأ بها خلال العقود العديدة القادمة فى تعطيل وظائف الشعاب المرجانية وفقدان الموارد المرتبطة بها للاستخدام البشري.

إن خطة العمل الإقليمية لإقليم البحر الأحمر وخليج عدن تحدد مجموعة من الإجراءات ذات الأولوية تتعلق بستة أهداف رئيسية تتجه نحو تحسين التأثيرات السلبية المتوقعة للشعاب:

1. **الإدارة المتكاملة للمناطق الساحلية** : إن الكثير من الشعاب فى الإقليم يحف الخط الساحلى ، وعلى وجه الخصوص فهي حساسة لأي تغيير فى نمط استخدام الأراضى الساحلية بما فى ذلك عمليات الردم والصرف الصحى غير المعالج ، وأشكال التلوث

الأخرى ، وتغيير نمط جريان المياه فى الأودية والمراسى . وقد أخذت معظم الأمم خطوات هامة تجاه الإدارة المتكاملة والفاعلة للمناطق الساحلية ، وتطوير استراتيجيات وخطط وسياسات وتشريعات وطنية . والأهداف ذات الأولوية هي قيام كل الدول المشاركة بتطبيق الإدارة المتكاملة للمناطق الساحلية لصون الشعاب الساحلية ، مدعماً بالتشريعات المناسبة ، والتخطيط لاستخدامات الأراضى ، والمشاركة فى تناول هذه القضايا ، وتقييم التأثيرات البيئية والاجتماعية/الاقتصادية ، والرصد والمراقبة وتطبيق القوانين .

2. **التعليم والتوعية العامة** : إن الإجراءات ذات الأولوية ، ولكي تكون أكثر فاعلية ، تتطلب دعماً متواصلاً عبر كل المستويات الحكومية وبين الحكومات الأخرى ومن الجمهور عامة . والأهداف ذات الأولوية هي زيادة التوعية العامة بالنسبة للحكومة والجمهور عبر تنفيذ برامج للتعليم والتوعية ؛ وينبغى أن تبث هذه البرامج عن طريق شبكات للاتصلات (بريد اليكترونى) لصانعي القرار ، والإعلام الجماعى ، المدرس ، والجامعات والمجتمعات المحلية .

3. المناطق **البحرية** المحمية: إن إنشاء شبكة من المناطق البحرية المحمية هو أمر حاسم بالنسبة لصيانة النظم البيئية للشعاب على المدى الطويل ، وبالنسبة لقابلية مجموعات الأنواع المستوطنة والنادرة والمهددة والمصادة للحياة والنمو . وقد أخذت معظم الأمم فى الإقليم خطوات هامة نحو تطوير مناطق بحرية محمية ، بالرغم من وجود اختلافات وطنية فى الإدارة والقدرات ؛ ولا شك أن بناء القدرات فى كل جوانب المناطق البحرية المحمية من الأولويات . والأهداف ذات الأولوية تكمن فى تطوير مناطق بحرية محمية كالأمثلة التالية لممارسة الإدارة الفاعلة للشعاب المرجانية فى الإقليم (من الشمال للجنوب):

- محمية العقبة الوطنية (خليج العقبة – الأردن)
- مضيق تيران (شمال البحر الأحمر – السعودية/مصر)
- محمية راس محمد الوطنية (شمال البحر الأحمر – مصر)
- جزر جفتون ومضيق قبل (شمال البحر الأحمر – مصر)
- جزيرة مكور (مقرسم) وخليج دنقناب (وسط البحر الأحمر – السودان)
- متنزه سنقنيب البحري القومى (وسط البحر الأحمر – السودان)
- المحمية البحرية فى جزر فرسان (جنوب البحر الأحمر – السعودية)
- منطقة بلحاف - بير على (خليج عدن – اليمن)
- جزر السبعات وراس سيان (خليج عدن – جيبوتى)
- مجموعة جزر سقطرى (خليج عدن – اليمن)
- جزر عيبات وسعد الدين (خليج عدن – شمال شرق الصومال)

وبازدياد القدرات فى إدارة المناطق البحرية المحمية خلال تنفيذ خطة العمل الإقليمية يمكن للناطق البحرية المحمية الأخرى الانضمام للمناطق المذكورة .

4. **الصيد المستدام ايكولوجياً لأسماك الشعاب المرجانية** : توفر مصائد أسماك الشعاب الاحتياجات الضرورية للصيادين التقليديين ومجتمعاتهم على طول الإقليم . كما تلعب هذه المصائد أيضاً دوراً متزايداً فى توفير كميات تجارية مقدرة من أسماك الشعاب والمنتجات الأخرى للتصدير للأسواق الوطنية والإقليمية والعالمية . وبما أن المخزون من أسماك الشعاب معرض للاستنزاف فلابد من إجراء معالجة وقائية للاستغلال المتواصل للموارد الأساسية حتى يمكن حماية المخزون وتكاثره . والأهداف ذات الأولوية تكمن فى تنفيذ الأمم المشاركة للتقييم الدقيق للمخزون والرصد والمراقبة ، والتشريعات الفاعلة لجهود الصيد من خلال التراخيص والطرق الأخرى ، وحماية المناطق التى يمنع فيها الصيد ، ومنع الصيد فى مواسم معينة حماية للمخزون لسد النقص ، والمسح وتطبيق القوانين .

5. **التأثيرات السلبية لحركة السفن والتلوث البحري** : يعتبر الإقليم أحد الممرات العالمية الرئيسية للملاحة البحرية ، كما يعتبر أيضاً من أكبر المناطق المنتجة والمصدرة للنفط والذى يتم تصدير غالبيته عن طريق البحر . هذه العوامل تضع شعاب الإقليم والنظم البحرية والساحلية الأخرى فى مخاطر جمة نتيجة للاضطرابات الايكولوجية من جراء جنوح السفن أو اصطدامها ، وإدخال أنواع دخيلة مع تصريف مياه التوازن من غير تحكم ، والأشكال الأخرى للتلوث البحري . والأهداف ذات الأولوية تكمن فى وفاء الأمم المشاركة بالتزاماتها تجاه الاتفاقيات الإقليمية والدولية ، تبنى اتفاقية تحكم الدولة فى الموانىء ، تحسين النظم الملاحية وقدرات مراكز الاستجابة لحوادث التلوث بالزيت (وعلى وجه الخصوص فى مناطق الشعاب الحساسة) ، بالإضافة إلى إجراء المسوحات وتطبيق القوانين .

6. **البحوث ، الرصد والمراقبة ، والتقييم الاقتصادى** : إن الإدارة الفاعلة للمناطق الساحلية والمناطق البحرية المحمية ومصائد أسماك الشعاب تتطلب معلومات دقيقة عن الوضع الراهن والاتجاهات المختلفة يتم جمعها من خلال البحوث والرصد والمراقبة ذات العلاقة . ومن العناصر الهامة الأخرى بالنسبة للرصد والمراقبة تقييم فعالية الإدارة نفسها . ولاشك أن التأييد الفاعل لصون وتنمية الشعاب المرجانية على المستوى الحكومي يساعد فى عملية المقارنة الواقعية للمنافع المكتسبة عبر المراحل المختلفة لتنفيذ الخطة ، سواء كان ذلك عن طريق مقترحات للتنمية أو وضع خطط للصون . والأهداف ذات الأولوية تكمن فى تنفيذ الأمم المشاركة ، بطرق معيارية ، لمسوحات وعمليات رصد ومراقبة بيولوجية/فيزيائية واقتصادية/اجتماعية ، تخزين المعلومات وتحليلها وإعداد التقارير ، وذلك بالاستعانة بالبروتوكولات الإقليمية للهيئة والبروتوكولات الدولية فى هذا المجال .