Editorial

Dear Reader,

Welcome to issue number nine! It seems no time at all since issue eight was rolling of the press and yet we appear to be missing our deadlines again. Luckily this is not the *Arab News* or the *Washington Post* or we would both be fired by now! Once again we bring you information on our current progress supplemented by specialist articles.

PERSGA is currently going through a period of dramatic change, a metamorphosis no less. New Lead Specialists have been hired to support the Strategic Action Programme together with the necessary support staff. The office space has been increased and redesigned. New equipment is beginning to make its presence felt and we are evolving from traditional Windows 95 users into hardened Windows 98 professionals!

In particular PERSGA welcomes Dr. Mohammed Abdulrahman Fawzi who takes up the position of Deputy to the Secretary General, see PERSGA portraits on page 2; Mr. Carlos Haddad, the new Procurement and Finance Specialist; Mr. Roderick Fleming who has taken up the post of Editor and Information Specialist, and Abdullah Alsuhaibany our first SAP Lead Specialist for Habitats & Biodiversity Conservation.

We hope you enjoy our latest contribution.

With best wishes,

Dr. Dirar Nasr & Roderick Fleming (Editors)

In This Issue of *Al Sambouk*:

Dr. Mohammed A. Fawzi

Dr. Fawzi was appointed to the position of Assistant Secretary General of PERSGA in January this year.

He was born in the city of Tanta, Egypt, is a family man with both a son and daughter.

D. Fawzi's initial training was in Applied Physics. He received his M.Sc. in 1966 and a PhD in Experimental Physics from West Germany in 1971. Dr. Fawzi began his academic career at the Faculty of Science, University of Ain Shams, where he became a Lecturer in 1974. Four years later he switched to the Arab Academy for Maritime Transportation. Here he moved up through various different positions from Senior Lecturer, to Head of the Academic Studies Department, to Deputy General Manager and finally to the post of Director of the Marine Environment Programme, where he stayed until 1991.

Having worked as a consultant for the Egyptian Environmental Affairs Agency for four years he joined the team as a National Expert for Coastal and Water Protection Projects for the period 1991-1995.

During his long and varied career Dr. Fawzi has been able to make an important contribution to marine environmental protection by serving on numerous national committees, authoring and presenting many articles/scientific papers on environmental issues, and assisting with the preparation of legal documentation.

For example, he was a member of the Leading Committee for the Development of Lake Bardaweel, a member of the National Institute for Oceanography, a member of the International Court for the Protection of the Mediterranean, and a member of the High Committee for the Protection of the Nile.

Dr. Fawzi's range of expertise has been used, with others, in the development of a variety of plans and programmes including for example: the National Plan for the protection of the Egyptian coast from pollution, technical studies for combating oil pollution in ports, implementation of waste reception facilities in Port Said, and EIAs for tourism development programmes in south Sinai and the Red Sea

Dr. Fawzi's research papers in the field of oil transportation, the control of pollution and protection of the marine environment have been presented at many international conferences and symposia.

PERSGA takes this opportunity to extend a warm welcome to Dr. Fawzi and is delighted that his talents will now be used to benefit the region as a whole.

Update on the SAP Recent Developments

Dr. Abdul Majeid Haddad
(UNDP Programme Coordinator)

The Launching Ceremony for the Strategic Action Programme

The SAP supports and facilitates the primary goal of PERSGA, which is the conservation of the environment of the Red Sea and Gulf of Aden. The aims of the SAP are to develop a regional framework for the protection of the environment and the sustainable development of coastal and marine resources.

In December 1998 SAP passed a significant milestone in its short history. A meeting at the Intercontinental Hotel in Jeddah was attended by the Ministers of the Environment of the PERSGA Member Countries together with representatives from the three Global Environment Facility (GEF) partners, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank. Speeches of support and encouragement for the protection of the marine environment were

given by Prince Fahd bin Abdulla Al-Saud (Saudi Arabia), Dr. Nizar Tawfiq (PERSGA), Dr. Klaus Töpfer (UNEP), Dr. Fawaz Fokeladeh (UNDP), Dr. Stephen Lintner (World Bank) and Mr. Farouk Yousuf Mustafa (Islamic Development Bank).

At this historic ceremony the SAP Project Document was officially signed, paving the way for the release of funds and the implementation of the programme.

Recruitment

Our primary task has been building up the Programme Coordination Unit (PCU) with its team of specialists, administrative support staff and necessary equipment. We are happy to report now that the recruitment process for the Regional Specialists has been concluded. After receiving applications from all over the region, carefully screening, reviewing, and short-listing, a PERSGA team conducted interviews with potential candidates in Egypt, Jordan, Saudi Arabia, Sudan and Yemen. To give the reader an idea about the scale of this operation, the total number of applications received and reviewed was around 100, and about 40 short-listed candidates were interviewed. It was an excellent chance for PERSGA to explore the pool of expertise available in the Region. It is reassuring to know how many proficient and well-qualified persons there are working in the Region, and PERSGA is very proud of them all. Regardless of whom we selected, this expertise will definitely be crucial for the successful future implementation of the SAP. The CVs that have been received will be the basis for establishing a list of consultants at PERSGA headquarters. The final list of Lead Specialists chosen is as follows:

Capt. Saeed Yafai (Yemen): Navigation Risk & Maritime Pollution Advisor

Dr. Ramzi Batayneh (Jordan): Specialist – Integrated Coastal Zone Management

Mr. Mohammed Younis (Sudan): Specialist – Marine Protected Areas

Mr. Abdullah Alsuhaibany (Saudi Arabia): Specialist – Habitat & Biodiversity Conservation

Dr. Khaled Hariri (Yemen): Specialist - Conservation and Management of Living Marine Resources

Within the same time period, applications for the National Programme Coordinators positions in Yemen, Sudan, Djibouti and Somalia were assessed. Dr. Mohammed Mahdi Abubakr was appointed as the NPC for Yemen, and Mr. Mahgoub Hassan for Sudan. The selections for the other two countries have not yet been finalised.

Appointments: The Task Force & Specialist Working Groups (WG)

We are in close coordination with PERSGA's focal points in each country to appoint the SAP Task Force members. It is anticipated that the first meeting for the Task Force will be at the end of October 1999.

A total of six Working Groups will have to be established for the various components of the SAP. The first task of the Lead Specialists is to start identifying their counterparts (members of the WG) in the participating countries. These groups will constitute the core of all programme activities and they are expected to contribute substantially to the successful implementation and achievement of the objectives of the Strategic Action Programme. Members of the working groups will conduct regular meetings, organize workshops and conferences to facilitate exchange of information and experience between member countries. The first WG meeting planned is for the Navigation Risks and Maritime Pollution component and will be held in September in Amman.

SAP launches in the region

A team from PERSGA and UNDP Somalia visited north-east and north-west Somalia during May 1999 to promote the SAP. The team met with relevant local authorities and presented the SAP, outlining the elements for the Somalia coast and the logistical requirement for the implementation of the project. The team also met with local NGOs and bilateral donors engaged in marine conservation to ensure effective coordination and sharing of information. Interviews were also conducted for the Programme Coordinators posts.

In July, three missions will go to Djibouti, Sudan and Yemen to establish the project offices, set up the national teams and launch the SAP.

Update on PERSGA activities

Third Council Meeting

The PERSGA Council held their third meeting at the Intercontinental Hotel in Jeddah, on Sunday 13th of December 1998 under the chairmanship of Mohammed Tahir Elaa the Minister of Environment and Tourism for the Republic of Sudan. The meeting was attended by their Excellencies the Ministers of the Environment from the PERSGA Member countries, or their representatives, together with interested Arab organisations. A preparatory meeting of experts was held before the Council meeting on the 8th and 9th of December.

The Council agreed on the following:

- Secretary General's financial report for 1997-98
- SAP plan for the Red Sea and Gulf of Aden
- general budget for the financial year 1999-2000
- financial rules and regulations for PERSGA and the rules and regulations for the employment of PERSGA staff
- Dr. Nizar Tawfiq's appointment as Secretary General of PERSGA for four years starting from 1st January 1999, Dr. Mohammad A. Fawzi as Deputy Secretary General and Dr. Dirar Nasr as Coordinator for the programme.

Training Programme

Under the remit of joint projects between PERSGA and ALECSO, a training programme will take place on 'The Environmental Impact of Development Projects'. This will be held in Hurghada, Egypt, in cooperation with the Egyptian Environmental Affairs Agency and the Red Sea Governorate, between 11th and 15th of September 1999. The countries in the region have nominated scientists and specialists to join this training programme and the staff at PERSGA headquarters is carrying out the necessary preparatory work.

New protocol

A specialized protocol is being developed to enhance regional cooperation in the protection of the marine environment from pollution arising from coastal activities. The first draft of this protocol will be sent to the countries of the region for their consideration and suggestions through October 1999. The protocol will be discussed and finalised at a meeting of scientific experts scheduled for 1st January 2000, prior to the following PERSGA Council meeting where it will be submitted for approval.

Environmental Impact Assessment in Egypt, an overview

Dr. M.A. Fawzi

Introduction

Pressure on Egypt's environment caused by rapid urbanization, increasing industrial pollution, inappropriate exploitation and tourism development has a reached critical level. Activities or development projects taking place, particularly in the coastal zone but also elsewhere, often compete with other local interests or have negative impacts upon them.

Being aware of these problems the Egyptian government has recently paid special attention to coordinating the need to protect the environment with the parallel need to support economic progress. The aim is to ensure sustainable development for present and future generations. As laid down in the Environmental Protection Law (No. 4/1994) the Egyptian Environmental Affairs Agency (EEAA) has developed an Environmental Impact Assessment system (EIA) so that the negative aspects of development can be identified and plans put forward for their mitigation at the planning stage.

An EIA is a systematic examination of the consequences of a development project. The purpose is to reduce, mitigate or eliminate negative consequences of the project on the environment and to capitalize on the positive ones. In practice, this means the study and analysis of the environmental feasibility of a proposed project in so far as the construction and

operation of the project affect the sustainability of the environment, human health and the well-being and conservation of natural resources.

Benefits of EIA

First of all the EIA process provides important information for project design, identifying changes that may improve the technological efficiency and economic feasibility of the project in the long term, apart from the environmental benefits involved.

By incorporating environmental concerns into the decision making process at an early stage it reveals potential future impacts before they occur and therefore prevents additional costs arising and delaying the project during implementation.

It is therefore not just an additional requirement costing investors time and money but an important management tool that benefits economic development while protecting human health, natural resources and the environment in general.

Law and procedure

The Law No.4 states that new establishments or projects as well as expansions or renovations of existing establishments must be subject to an EIA before a permit is issued. The Executive Regulations to the law identify which type of establishments or projects must be subject to an EIA. The system encompasses a flexible screening system that divides projects into three groups (white, grey and black) which require different levels of EIA according to the severity of possible environmental impacts.

White projects

This class includes developments likely to cause minor impacts on the environment and which can normally be approved on the basis of a simple Environmental Screening procedure. This class includes both textile factories that do not dye cloth and leather or shoe factories if located in certified industrial areas; factories producing less than 1000 tonnes of smoked fish per year; and expansions of irrigation systems less than 10%.

Grey projects

Projects in this class are likely to cause significant environmental impact so a more elaborate Environmental Screening is required. Small capacity iron and steel factories, glass manufacturing plants and factories for the production and assembly of vehicles, sugar refineries, short pipelines, hospitals and landfill developments are all included here.

Black projects

This class includes establishments/projects which due to their potentially severe environmental impacts need a full EIA study. Examples would include factories for the production of pesticides, oil refineries, lead factories, large industrial complexes and new hotels and tourist facilities in environmentally sensitive areas.

A detailed account of the classification system and the requirements is provided in Arabic and English in an EIA package available from the Competent Administrative Authorities.

The scope of an EIA study report

When studying the impact on the environment made by a proposed project, the physical/ chemical, biological/ ecological, social/ cultural and economic/ operational aspects must all be considered. Due to this variety of aspects the study needs to be prepared by a multidisciplinary team.

The EIA report should include:

1. Executive summary
2. Description of the proposed project
3. Description of the surrounding environment (baseline study)
4. Determination of the potential impacts of the project
5. Alternatives to improve the proposed project
6. Development of a management plan to mitigate negative impacts
7. Development of a monitoring plan
8. Public participation considerations

Appeals

The owner of an establishment may appeal the decision of the authorities by writing to a Permanent Appeals Committee. However the classification of projects according to their potential impact cannot be appealed.

The Appeals Board is made up of representatives from the EEAA, the Competent Administrative or Licensing Authority, the owner of the establishment or his competent representative together with three independent experts. A Councillor from the State Council chairs the Committee.

Sustainable Fisheries in the Framework of Integrated Coastal Zone Management

Dr. Ahmed A. Barrania

Introduction

Current estimates suggest that about 60% of the world's population lives in a 60 km-wide belt alongside the oceans and it is expected that this percentage will rise to 75% by the year 2025. Population growth in this coastal zone is estimated at 2.4% compared to a global average of 1.7%. These joint statements, which indicate that accelerated development will take place in the region that is already the most densely populated, should cause those concerned with planning and environmental protection to be concerned. Many people live in coastal areas because they provide good conditions for life and economic development. This increase in growth will inevitably lead to a parallel increase in pressure on valuable national economic and environmental resources.

The situation in the Arab world does not differ significantly from anywhere else. In fact the situation is more pronounced as desert occupies more than 80% of Arabian land, squeezing the population towards the coast. Each kilometre of the coastline serves, on average, between 500 and 700 square kilometres of the interior. Valuable living marine resources are found along the coast, regarded as the source of life for local communities and inland areas. Economic activities based on trade, industry, agriculture, rural development, tourism, recreation, and transportation all find homes in the coastal zone.

Conflicts between the dynamics of natural resources and of economic development have become obvious in Arab countries in recent years. The activities taking place are not integrated and friction occurs between different users of the available coastal resources.

At the same time the sea has been used as a reservoir for human and industrial refuse and overexploitation of the resources in some areas threatens its sustainable development. The accumulation of pollutants, the degradation of the coastal habitats and accelerated loss of biodiversity are problems resulting from a failure to give the environment due consideration in coastal area development.

Taking Egypt as an example, the coastal area is known for natural habitats such as lagoons, sabkha, sand dunes, mangroves and coral reefs. The population of the Egyptian coastal zone, within 60 km of the sea, is about 8 million and it is expected to rise at 3.5%. About 40% of Egyptian industry will soon be found in coastal areas along with tourist facilities, rural development activities, land reclamation, ports, and national security installations. Several problems already resulting from this pressure include coastal erosion, water pollution, pressure on natural resources and the over-exploitation of fish stocks.

Conservation of the 'environment' means the conservation of 'environmental systems' so that they can respond to human needs. The conservation of natural living marine resources is therefore crucial in development plans.

The deterioration of the situation in coastal areas of the world has led various international organisations to call for new measures to be established. In 1995 GEF insisted on the need for integrated sectoral planning for coastal development in the general framework of integrated coastal zone management (ICZM). This includes plans for the control of development activities and other human activities that affect the state of natural economic resources and the quality of the environment in coastal areas - in other words, integration between economic development on the one hand and conservation of natural resources on the other.

ICZM

Coastal areas are used extensively for a large number of activities:

- Rural settlement

- Industrial projects
- Agriculture
- Waste disposal, (sewage, agricultural, industrial)
- Coastal defence
- Port construction and maritime transport
- Roads transport and infrastructure
- Marine fisheries
- Aquaculture
- Oil exploration
- Tourism and recreation
- National security

Rarely are any of these activities integrated, on the contrary they are usually planned independently and conflicts arise between them. Many of these activities have a negative impact on components of the natural environment and hence on economic fishery resources. The most important impacts are from water pollution, (sewage, agriculture, or industrial) pollution by oil, landfill and dredging, coastal construction, recreation and tourism projects.

The objective of ICZM is to ensure coordination between developmental activities to reduce conflicts and ensure that the ecological systems are not impaired so that sustainable use of natural resources can continue.

ICZM Planning

Initially there must be a focus on defining the goals for ICZM. Long-term goals should be integrated as essential components of the general strategic development plans for each country. These objectives will include:

- Maintaining good quality coastal environments
- Protection of marine species of value
- Conservation of sensitive habitats (coral reef, mangrove etc)
- Conservation of ecological processes
- Rehabilitation of ecological systems

ICZM planning is then accomplished by means of several collective operations:

1. Identification of the coastal area likely to be affected

In general terms, the coastal zone could be defined as the area of land that borders the sea. However its width depends on a variety of different considerations. It could extend to the limits of maritime influence, to a political boundary, or an economic, ecological, or legal one. Sometimes the most important limit depends on a special issue that needs resolution through ICZM. Accordingly, the limits for ICZM differ not only from country to country but also from area to area depending upon the nature of the issues and their local priority.

2. Identification of the issues and problems facing coastal areas

This includes collecting information on renewable coastal resources such as fisheries and agriculture, identifying the current users of coastal resources and determining the impact of these activities on ecological systems. This can be done from previous studies or by initiating new research. From an analysis of such information it is possible to define the priority issues which will be considered by ICZM. For example, the result could show that the most important issues in a certain area are erosion, or water pollution and degradation of the natural resources and habitats.

3. Defining the Institutional Framework

A basic objective of ICZM is coordination between government agencies responsible for various developmental sectors in coastal areas, the purpose being to conserve natural resources and their sustainable use. This necessitates a framework or institutional skeleton that has authority over or within the different sectors. The shape and size of this institutional framework may differ from one country to another, e.g. it could be a single new Ministry or power could be invested in a Ministry already in existence.

ICZM requires a high level of integration between various institutions. It needs high-level horizontal integration between institutional sectors in the planning phase, and a high level of vertical integration between these institutions in the implementation phase of plans or programmes.

At the national level, a general policy on coastal management that defines the level of environmental protection for coastal areas needs to be established. This may include the use of planning directives that require regional,

provincial or local authorities to implement the agreed development policies.

As a general rule, the Authority that will take the responsibility for ICZM should have the means of affecting the Ministries or agencies that currently have control in the coastal zone and it is expected that this Authority will have the full power to implement the management plan.

4. Legal support

The implementation of coastal zone management must be supported by the necessary legislation. Some countries have already approved ICZM legislation that includes institutional measures, property rights, user rights, and arbitration procedures in addition to the necessary financial means for coastal area planning.

However in most countries there is sectoral legislation for the environment and separate legislation concerning activities such as maritime transportation, fisheries and local government. All the existing legislation needs to be reviewed and the conflicts between existing legislation and possible new legislation resolved to allow for the implementation of ICZM plans.

5. Funding

The necessary funds need to be supplied for the preparatory and implementation phases of ICZM plans. This includes the initiation of the information system and means for reviewing and analysing various projects, infrastructure components, the control of pollution and the means of environmental conservation.

6. Provision of human resources

Scientists, researchers, technicians and administrators are necessary for the preparation and implementation of the plans and programmes. Suitable personnel may be found in universities and scientific research centres. Training programmes may be required for various specialised topics when local expertise cannot be found.

Conclusion

In conclusion, ICZM is both a process and an institutional framework. It involves the establishment of a legal structure within which cross-sectoral planning takes place at a national and a local level. The planning process itself involves data collection, analysis and the establishment of national, regional and local development guidelines. When integrated into the national framework, the cooperation and coordination between different sectoral agencies with competing interests in the coastal zone, will allow for the development of plans that reduce conflicts. This will enhance sustainable development while protecting the country's natural resources and habitats.

Coral Reefs and Invertebrate Survey in Djibouti

Dr. David Obura and Nasser Djama Abdi

A recent GEF funded project was undertaken in Djibouti. Dr. David Obura and Nasser Djama led a team of national counterparts in a coral and invertebrate survey, aimed at drafting a strategy for the conservation of biodiversity.

In December they surveyed a number of areas including the reefs around the islands of Musha and Maskali, two sites off-shore from Maskali, Khor Ambado, Les Trois Plages, Sable Blanc, Ras Duan, Sept Frères, Recif d'Ambouli (near the Djibouti port), and one site off-shore from Tadjourah. This survey will complement the PERSGA/ALECSO survey carried out in April 1998.

Coral, *Dendrophyta* sp.

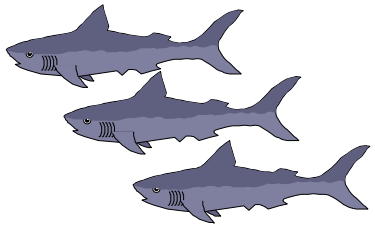
Using a circular plot survey system the number of hard and soft corals and percentage cover was investigated. A total of 162 different species of corals were recorded. The distribution pattern however, was irregular. Only 10% of the species were found at all locations, 40% at several sites with the other 50% of species found in only one or two places. Trois Plages and the Sept Frères

exhibited the highest percentages of live hard-coral cover. The latter site was found to be in pristine condition. The corals at Khor Ambado and Maskali showed degradation, especially of *Acropora* species. The condition of the former site may be due to the high visitor pressure the reef experiences. The Recif d'Ambouli, near the port, shows signs of stress from shipping operations and local land-filling activities. Conditions for soft-coral growth are particularly good at the Seven Brothers due to the presence of uprising cold water.

The fish populations showed a similar distribution pattern to the corals. Butterfly-fish species, which are indicators of healthy corals, were particularly numerous at the Trois Plages; the Red Sea Raccoon, the Arabian butterfly-fish, the Vagabond butterfly-fish and the Orange-face butterfly-fish all being present. There is a wide diversity of habitat type at the Seven Brothers and a high potential for sustainable fisheries due to uprising cold water rich in plankton. Illegal shark fishing is currently taking place in these waters which may lead to a collapse of stocks.

The abundance and diversity of large invertebrate species was low. At Khor-Ambado, an *Acropora* coral showed the effects of a recent encounter with a crown-of-thorns starfish. Many sea urchins were found at Sable Blanc, an indication that the reef is currently under stress.

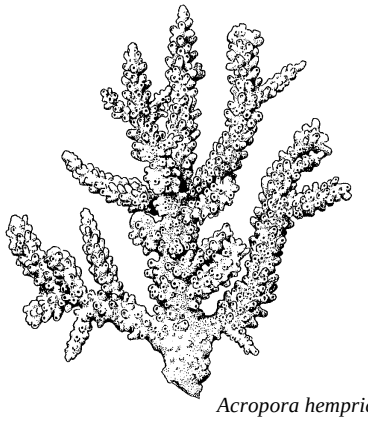
Marine Biology is still in its infancy in Djibouti. The SAP proposes the creation of an 'Institute of Marine Biology and/or Oceanography' that would work with other departments involved in the marine environment such as Maritime Affairs, Fisheries, Environment, The Port and the Tourism Authority. This new Institute would carry out the scientific research necessary for the future management and protection of the marine environment.



Coral Reefs in the Red Sea and Gulf of Aden Threatened by Bleaching and Mortality

Dr. Fareed Krupp

Coral reefs are amongst the most productive and biologically diverse ecosystems on earth. They are a critical habitat for an immense number of plant and animal species which find food and shelter in the reef, settle on or attach to corals or burrow into their skeletons, creating a complex and dynamic ecosystem. Corals form the largest colonies within the animal kingdom. They are able to do so, because they derive energy and nourishment from symbiotic zooxanthellae,



Acropora hemprichi

microscopic algae which inhabit their tissues. Due to their photosynthetic activity, zooxanthellae provide the bulk of the corals' energy requirements. They also support the corals in generating their limestone skeletons, which form the framework structure of the reef. Since this process is temperature dependent, reef-building or hermatypic corals are largely restricted to tropical seas. Reefs are of outstanding economic importance as a valuable source of food and various medicinal compounds, they also attract large numbers of diving and snorkeling tourists that are a major source of revenue for many coastal countries, and they protect the coastline from erosion. Due to their sensitivity towards temperature change they are among the first systems to respond to global warming and form important ecological indicators.

The Red Sea and Gulf of Aden lie within the most arid part of the Indian Ocean. High seasonal fluctuations in temperature and elevated salinity levels result in a naturally stressful environment for coastal and shallow subtidal biological communities, many of which exist close to their physiological limits. On the other hand, hard substrates are abundant in shallow waters and freshwater influx is very limited, resulting in exceptionally clear water, even in nearshore areas. These are favourable conditions for coral growth and fringing reefs, barrier reefs, patch reefs and atoll-like structures are widespread. About 250 species of stony corals are known from the Red Sea and Gulf of Aden, which is the highest species richness in any section of the Indian Ocean. An almost continuous band of coral reef fringes the shorelines of the northern and central Red Sea, including the Gulf of Aqaba. One of the largest fringing reefs in the world occurs along the coast of Saudi Arabia. Coral assemblages in the shallow Gulf of Suez are less well developed. In the central Red Sea corals colonize a series of narrow banks about 3 to 10 km offshore, forming a large barrier reef running parallel to the coastline. Further south, the continental shelf becomes broader and shallower, soft bottom substrates prevail and turbidity increases, resulting in a decrease in the extent and complexity of coral reefs. Fringing reefs gradually disappear in this part of the Red Sea, while offshore patch reefs and coral assemblages fringing islands become more numerous. It had been assumed that corals were rare in the Gulf of Aden due to a seasonal upwelling of cold water, however recent studies have revealed that the Gulf of Aden is rich in diverse and complex reefs and other coral assemblages.

Reefs worldwide are in a state of rapid decline and it is estimated that, on a global scale, 60 % of the coral reefs are threatened. Throughout the Red Sea and Gulf of Aden, reefs are damaged by coastal development and other human activities. The “Strategic Action Programme for the Red Sea and Gulf of Aden” has identified the following causes of reef degradation and destruction:

- Landfill for urban expansion, industrial facilities and tourism development
- Construction activities altering water circulation patterns
- Limited use of environmental impact assessments for developments and low level of enforcement of existing laws and regulations
- Release of insufficiently treated or untreated sewage, resulting in proliferation of algae that may smother the reef
- Increased siltation from sources as diverse as construction activities and overgrazing, resulting in reduced light levels
- Destructive fishing methods on and near reefs
- Uncontrolled activities by divers, such as anchoring on the reef and coral breakage
- Insufficient awareness about the importance of coral reefs and their sensitivity

When corals are stressed, the delicate balance that maintains the symbiotic relationship between the zooxanthellae and their coral hosts is put at risk. The algae are lost from the coral or die in their tissue. The polyp then turns transparent and the underlying white skeleton becomes visible. This process is called “bleaching”. Tissue growth and skeletal accretion are markedly reduced or stopped and reproduction is suspended, since the coral has lost its major source of energy. The causes of bleaching include low or high temperature and/or salinity, elevated levels of solar radiation, exposure to air during extremely low tides, siltation and pollution.

In 1998 reefs around the globe suffered the most extensive and severe bleaching ever recorded, resulting in high coral mortality. Bleaching particularly effected branching corals of the genus *Acropora*, which are widespread throughout the Region. Reefs in shallow waters suffered the greatest losses. Once the corals die off, the skeleton becomes colonized by numerous other organisms. As long as the structure of the reef is maintained, it still provides shelter to fishes and other marine life. However, if eroded and reduced to coral rubble these organisms disappear, affecting fisheries and tourism alike, and exposing the shoreline to erosion. The socio-economic consequences are very severe. Even sublethal temperature stress may make corals highly susceptible to diseases, which result in

increased mortality. Besides corals, bleaching effects other organisms which have symbiotic zooxanthellae.

Since the start of temperature recording 150 years ago, the 1990s were the warmest decade and in 1998 sea surface temperatures were higher than ever before. Last year also had the strongest El Niño event ever observed. In many parts of the world, sea surface temperatures were 3-6 °C above normal. Satellite-derived sea surface temperature records by the US National Oceanic and Atmospheric Administration (NOAA) show a significant correlation between large-scale bleaching and high sea surface temperatures.

Our knowledge of the extent and severity of coral bleaching in the Red Sea and Gulf of Aden is very limited. According to preliminary and largely unpublished observations, the Gulf of Aqaba and much of the northern Red Sea are amongst the few areas in the world which have largely escaped bleaching. In the central Red Sea there are patches of bleached corals but further south the situation becomes more severe and large areas of coral reef have died off. Here mortality obviously started before the disastrous 1998 global bleaching event. In the Gulf of Aden some areas are severely affected while others hardly show any signs of bleaching.

Corals usually recover from short-term bleaching, but if temperature stress prevails over prolonged periods it causes irreversible damage and eventual mortality. Recovery, through larval settlement and new growth, will only occur if the environment is free from chronic stress. This process requires a considerable amount of time, in most cases at least one to two decades. During the recovery phase the reef is particularly sensitive to all forms of stress, natural and human induced.

Natural recovery must be supported by resource management. However, a meaningful management is only possible, if all major components of a specific reef ecosystem are known and its dynamic processes are fully understood. Coral reefs of the Arabian Region are still the least known within the entire Indo-Pacific realm, which hampers the Region's participation in recent international coral reef initiatives. Priorities of applied research include the determination of the extent and severity of the bleaching, its ecological and socio-economic consequences, and paths for recovery. PERSGA is in the process of developing a Regional Action Plan for the Management and Conservation of Coral Reefs.

Further reading:

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Translation by Dr. Dirar Nasr.

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