

2. STATUS OF CORAL REEFS IN THE RED SEA-GULF OF ADEN

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ABSTRACT

The status of coral reefs bordering the Red Sea and Gulf of Aden is generally good, with live hard coral cover averaging 20-50%. There are predominantly fringing reefs bordering the coasts of Djibouti, Egypt, Saudi Arabia, Sudan, and Yemen. Atolls and pinnacle reefs occur mainly in the Central and Southern Red Sea. However, technical reports, personal observations and comparative data show recent decreases in live coral cover. Fish populations are also declining and there have been several small outbreaks of the crown-of-thorns starfish (COTS), some local bleaching events and an increase in bioeroding organisms such as the urchin *Diadema setosum* and the coral eating gastropods *Drupella* and *Coralliophila*. Threats to coral reefs differ within the region, and are continuously increasing with the increasing rate of coastal development. The major threats are land filling, dredging, sedimentation, sewage discharge and effluents from desalination plants. In major tourism areas, there is physical damage by tourists and boat anchors. Fishing pressure is constantly increasing throughout the region to satisfy demands of growing and more affluent populations.

Most countries have legislation for reef conservation and additional national laws and multinational agreements have been adopted by the countries with assistance of the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). However, the implementation of these laws is difficult and completely lacking in remote areas. There is a need for enforcement of national and international laws, development of public awareness programs and the adoption of sustainable management strategies to reverse the current trend in deterioration of the environment.

INTRODUCTION

This report is the result of the first standardised survey of the coral reefs of countries (Djibouti, Egypt, Saudi Arabia, Sudan, and Yemen) bordering the Red Sea and Gulf of Aden, organised and funded by the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) and focused on the members of the Arab League. The Reef Check methods and protocols were used in April/May 2002 to:

- to obtain an initial picture of the health of the coral reefs using a standard and rapid method throughout the region; and
- to train local teams to conduct these surveys using standard techniques.

GEOGRAPHICAL SETTING AND REEF COVERAGE

The Red Sea extends 2270km from 30°N in the Gulf of Suez to 13°N at Bab-el-Mandeb in the southeast. It is a narrow (maximum 350km wide) and deep (maximum 2920m) desert enclosed sea. The shallow 130m deep sill at the Bab-el-Mandeb Straight restricts water exchange between the Red Sea and the Gulf of Aden. The land surrounding the Red Sea is mostly hot and dry with minimal freshwater inflows and high evaporation. Therefore surface waters enter the Red Sea from the Gulf of Aden to compensate for evaporation losses, but even so the salinity varies along the length of the Red Sea from 36.5ppt (normal seawater) at the southern entrance to more than 41ppt in the northern Gulf of Aqaba in summer. Water temperatures and nutrient concentrations decrease in surface waters towards the northern end, where the water is generally clearer. Coral reefs are well developed along the Red Sea, with fringing reefs lining most of both shores and into the Gulf of Aqaba. Towards the south around latitudes 18-20°N there are fringing reefs around islands away from the shore. The only breaks in the fringing reefs are in front of wadis (dry river beds), which can carry large amounts of water and sediment.

Pinnacle reefs and atolls are mainly found in the Central Red Sea, and the coastal reefs are greatly reduced further south, but there are still healthy reefs with high coral cover further from the shore in cleaner water. The Red Sea has high biodiversity, with at least 266 coral species in Saudi Arabian waters, and 160 species in the Gulf of Aqaba.

Reef distribution is patchy and not well developed in the Gulf of Aden, except for the Socotra Archipelago, which is fringed by extensive reefs. Further details on the extent and development of coral reefs in several countries of the Red Sea are summarised in the Chapter 2 in 'Status of the Coral Reefs of the World: 2000' and the 'World Atlas of Coral Reefs'.

STATUS OF CORAL REEFS – BENTHOS AND FISH

This report focuses on recent Reef Check surveys throughout the region. Other surveys were reported previously in the 'Status 2000' report.

Djibouti

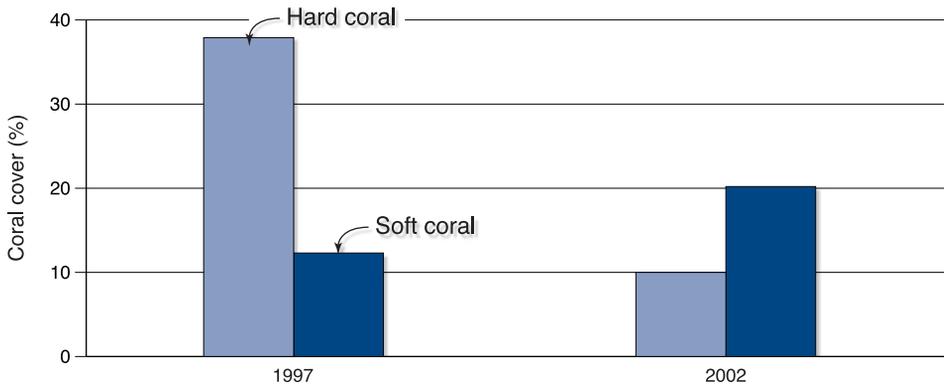
The cover of live hard corals in the Gulf of Tadjoura ranged from 12% in south Maskali to over 60% off Sable Blanc with an overall average of 36%. This is virtually unchanged since the previous report by PERSCA in 2000. However, several sites off Maskali Island were deteriorating, with previously healthy coral reefs being largely covered with algae. There were also reef-flats covered in rubble from eroding table corals around Maskali, and the mortality has been attributed to the 1998 bleaching event, and large numbers of the crown-of-thorns starfish (COTS) seen in 2000. These damaged sites were not included in the above average coral cover. In addition, increased numbers of the coral-eating gastropods (*Drupella* and *Coralliophila*) were seen at most sites, and the bioeroding urchin *Diadema* averaged 12 individuals per 100m². Human pressures include increasing coastal construction, dredging and land filling, and shipping impacts around the port of Djibouti (the major harbour for Ethiopia). Anchor damage and tourism impacts are increasing in Djibouti with little increase in environmental awareness in the population.



Egypt

Living hard coral cover was significantly higher in the Red Sea than in the Gulf of Aqaba. Cover ranged from 16-67% at 5m depth, with an average of 45% in the Red Sea, and 35% in the Gulf of Aqaba. There was an average of 10% soft coral cover. The coral cover was significantly lower at 10m depth, with an average of 26% (Red Sea 33%; Gulf of Aqaba 20%). A comparison of two sites surveyed in 1997 and 2002 in the Gulf of Aqaba show that coral cover decreased from 37% to 13%, probably due to repeated outbreaks of COTS during 1998. There have also been major decreases in giant clam populations between 1997 and 2002, with many of the small clams seen in 1997 not surviving through to 2002. This is attributed to sediment from major constructions in South Sinai over the last 5 years.

Butterflyfish have decreased in the Gulf of Aqaba and the Red Sea proper, with an average of 9.7 butterflyfish per 100m² in 1997, and only 5.2 per 100m² in 2002, and sweetlip populations dropped by 69%. Abundance of groupers and parrotfish remained stable in the Gulf of Aqaba, but decreased in the Red Sea. There is better enforcement of no-take zones and fishing regulations in South Sinai and Gulf of Aqaba than in the Red Sea, where fish poaching is evident. Some solid wastes were seen, but there was little anchor damage.



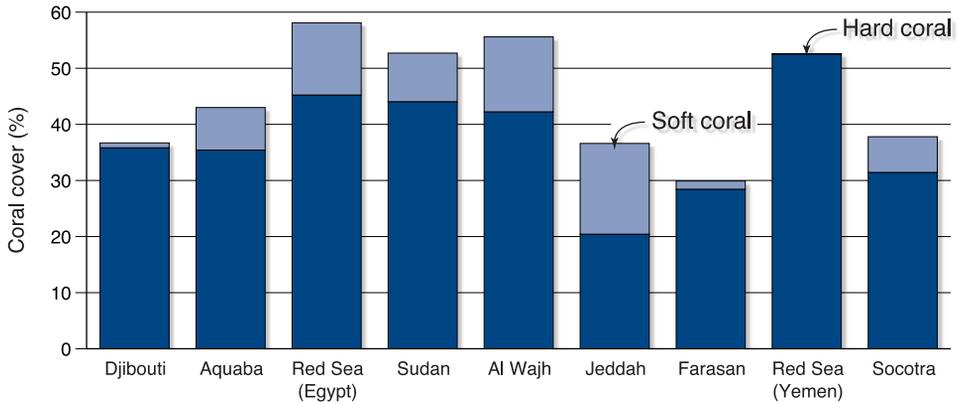
There has been a significant decrease in hard coral, but an increase in soft corals along the Sinai coast of the Gulf of Aqaba between 1997 and 2002.

Environmental awareness has increased in Egypt, due to activities of the Egyptian Environmental Affairs Agency and several NGOs, especially the Hurghada Environmental Protection and Conservation Agency, and increased interest from the Governor of the Red Sea. The installation of hundreds of mooring buoys and support from dive boat skippers at dive sites on Sinai and in the Red Sea has markedly reduced anchor damage. However, tourism development is increasing along much of the coast and this is adding to the difficulties in enforcing reef conservation laws. These developments are affecting the Egyptian coral reefs through damaging construction, sedimentation, and pollution, as well as the physical impacts of divers and snorkellers (more than 50,000 per year visit some sites), and increasing demand for seafood and illegal curios. There are attempts to improve the quality of tourism developments, encourage ecotourism, and to increase public awareness. The legal framework for the protection of coral reefs is excellent and is implemented in several areas, however, improved legal enforcement is needed over the whole tourism sector.

Saudi Arabia

The highest coral cover of the 3 sites surveyed in Saudi Arabia was on the Wajh Bank in the north, with an average of 40% cover at 5m. On the Jeddah reefs in the centre, there was 20% average cover at 5m and 28% cover on the reefs off Farasan Island in the south. Wajh Bank also had the highest cover at 10m, but the decrease in living coral between 5m and 10m was much higher than in the other regions, probably due to higher turbidity. Soft corals averaged 15% cover in the northern parts, but were low on Farasan Island. Fish counts were high for parrotfish, snappers and groupers, with the highest numbers of parrotfish seen at Wajh Bank (29 fish per 100m² compared to 2 per 100m² in the other regions), whereas the highest numbers of snappers were at Farasan Island (83 per 100m² vs. 3 per 100m² elsewhere).

Human disturbance to reefs in Saudi Arabia is generally low, but higher around several large cities. The reefs off Jeddah are influenced by the growing city which now has 2



Cover of hard and soft corals at 5m depth in 9 sites along the length of the Red Sea. At each site there were 4 replicate transects each 20m long and assessed using the Reef Check protocols. This shows relatively healthy coral populations in most sites.

million people along with increases in pollution, domestic and industrial sewage, construction, dredging for the construction of marinas, sedimentation and effluent from desalination plants. Local and foreign tourism is increasing with the accompanying boating and diving which results in direct impacts to the coral reefs. The Al Wajh and Farasan Islands regions have few human pressures, although there is increasing fishing pressure in more remote waters away from the of the Coast Guard patrols. Some destructive fishing has been reported e.g. bashing corals to drive the fish into nets. Despite this fishing pressure, snappers, groupers and parrotfish were observed in relatively high numbers.

Sudan

The average live coral cover was 44% at 5m water depth and 34% at 10m (ranges between 15% and 57%). There was also abundant cover of dead standing coral that indicated significant recent coral mortality. There was, however, less than 1% of recently killed coral indicating that there has been no new mortality events. Anchor damage and solid wastes were minimal. The abundance of several target fish species was average to low in Sudan compared to the other countries (groupers and snappers each less than 1 per 100m², parrotfish about 2 per 100m²), however, the fish seen were generally larger. Several humphead wrasse (*Cheilinus undulatus*) were seen, but only one humphead parrotfish (*Bolbometopon muricatum*) was seen at Tala Tala, Southern Sudan compared to all the surveys of the Red Sea. The coral reefs near the ports of Port Sudan and Suakin suffer some shipping, construction and dredging damage, and tourism related threats are mainly from anchors and breakage by divers. Tourism is not highly developed in Sudan, but is a growing industry. There is low public awareness about coral reef conservation and the legal framework for coral reef protection is minimal.

Yemen

Live coral cover averaged 53% with a maximum of 69% on the Red Sea coast of Yemen. Cover on Socotra Island had an average of 31%, with the average cover being 27% at 5m

depth and 36% at 10m. Hard coral cover on reefs off the Yemeni coast ranges from 15% cover in Mukalla to 69% in Belhaf at 2m depth where there was 2% of recently killed coral at several sites. Despite this apparent high coral cover, the surveyed reefs seem to have declined recently.

The reefs around Kamaran Island are severely degraded. Collecting of aquarium fish is increasing in Yemen, especially near Kamaran and there are reports of destructive fishing at some sites. Despite the increasing local and foreign fishing pressure, the abundance of indicator fish was among the highest in the Red Sea. Butterflyfish averaged 9 per 100m² (maximum 20), snappers were abundant averaging 100 per 100m² (range 24-2,000) and large schools of snappers were seen on many reefs. Socotra Island also had high numbers of snappers, butterflyfish and groupers.

Most of the reefs surveyed in the Red Sea and on Socotra were in relatively good condition, despite increasing human impacts. However, there are increasing signs of deterioration on the coral reefs. High numbers of coral-eating gastropods were found and COTS were seen consistently. There are also large populations of bioeroding sea urchins (average 29 per 100m² on Red Sea sites; 18 per 100m² on Socotra). Such sightings should cause alarm as these urchins can rapidly undermine corals and cause them to collapse. Public awareness about coral reef conservation is low in Yemen and the legal framework for reef protection is weak. The exception is Socotra Island, which is a National Park and receives international funding and research attention.

REGIONAL SUMMARY

The first obvious comparison is that the water is clearer in the north compared to the south: water visibility in the Gulf of Aqaba and Egypt is 40-50m; on the Wajh Bank, Saudi Arabia in the centre it is 30-35m; and visibility less than 5m at some transects in the Southern Red Sea. This poor visibility in the south is reflected in lower coral cover at 8-12m compared to 3-6m. The highest coral cover is in the Red Sea of Yemen, despite the reefs being relatively poorly developed, compared to more complex reefs in the northern Red Sea. However, some of the most damaged reefs were seen in Yemen and Djibouti in the south, where there were more COTS and *Diadema* sea urchins damaging the corals. Edible sea cucumbers are currently being fished in most countries for export to Southeast Asia. Densities averaged between 3 and 5 individuals per 100m² respectively in Yemen (Red Sea and Socotra) despite the increasing trade.

The numbers of indicator fish differed markedly between regions; the highest numbers of snappers were in Yemen and in Farasan Islands (an order of magnitude higher than elsewhere) with large schools recorded. The largest fish, however, were found in Sudan, including the now rare large groupers and humphead wrasse (*Cheilinus undulatus*) and the only humphead parrotfish (*Bolbometopon muricatum*) were also found in Sudan. The lowest numbers of butterflyfish were found on Jeddah reefs which correlates with increasing pollution and fishing pressure from the city.

CONCLUSION AND RECOMMENDATIONS

The Red Sea showed comparatively low levels of human impact, as most of the coastline is sparsely populated. However, there is increasing development of many coastal areas and problems are becoming evident for the reefs. The impacts are most obvious around the larger ports and major tourist resorts. Deterioration was also found away from coastal developments, where it is probable that COTS and other natural disturbances have damaged the reefs.

All countries have a legal framework for coral reef conservation, and the scope of the laws and the degree of implementation differs widely between and even within the countries of the region. Stronger enforcement of national and international laws, the development of public awareness programs and the adoption of sustainable management strategies are all needed for coral reef conservation to improve and for the current trend in deterioration of the environment to be reversed.

ACKNOWLEDGEMENTS

This survey was organised and funded by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). We would like to thank Mr. Abdullah Alsuhaibany, for his continuous support throughout the mission. We could not have conducted the surveys without the active participation of scientists or without the help of the National Program Coordinators of PERSGA in each country. In particular we would like to thank the following people: Djibouti: Nabil Mohammad, Nasser Djama Abdi, Hussein Rirach, Moussa Omar and Alexandre Galandrin; Egypt: Essam Saad-Allah, Ayman Mabrouk, Tamer Kamal El-Den, Ali Ahmed, Saied El-Sayed and Tamer Monir; Saudi Arabia: Khaled Hizam and Ehab Abo el Adel; Sudan: Mahgoub Hassan, Sheikheldin El-Amin and Eihab Omer; Yemen: Malek A. Abdal-Aziz, Aref Hamoud, Zahir Al-Agwan, Fouad Nasseb, Thabett Khamis and Mohammed Ismail. We would also like to thank Simon Wilson and Jeremy Kemp for their valuable input and information of previous surveys.

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SUPPORTING DOCUMENTATION

Pilcher N, Alsuhaibany A, 2000. Regional Status of Coral Reefs in the Red Sea and the Gulf of Aden. In: Status of coral reefs of the world: 2000. Wilkinson, C. Ed. Australian Institute of Marine Science, Townsville: 35-54.

Spalding MD et al. (2001). World Atlas of Coral Reefs. Berkeley, University of California Press.

CORAL REEFS IN THE GULF OF AQABA

The Gulf of Aqaba is the northern-eastern extension of the Red Sea bordered by Egypt (200km of coastline), Israel (12km), Jordan (27km) and Saudi Arabia (150km). It is a semi-enclosed basin that is separated from the Red Sea at the Straits of Tiran. Fringing reefs, with 138 hard coral species, are found in the Gulf of Aqaba. Rapid surveys at 5 sites in the Gulf showed that live hard coral cover ranges from 13% at an industrial site to 22% in the marine reserve. Other coastal habitats include seagrass beds and mangroves. These coastal habitats provide food and shelter for 362 species of fishes, one damselfish is endemic and may be considered 'vulnerable' by the IUCN. The coral reefs in the Gulf of Aqaba are vulnerable to human impacts such as urban and industrial pollution, shipping and port activities as well as tourism. Until 1995, 6 million cubic meters of sewage per year from Eilat flowed freely into the Gulf of Aqaba. Today, sewage from Eilat and Aqaba is not discharged into the Gulf, instead it is treated and re-used for irrigation. This practice can also have negative impacts on coral reefs in the long term. Shipping is another threat and the port in Aqaba is the third largest in the Red Sea. The high amount of shipping increases the risk of accidents and there have been several recent ship groundings on the coral reefs of the Egyptian coast. The Port activities have increased impacts on adjacent coral reefs from sedimentation, nutrient input, coral destruction and increased heavy metal concentrations. This has caused changes in the fish communities through a reduction of total fish abundance by 50% and a shift in the trophic structure towards herbivore and detritivore fishes. Coral diseases have increased by a factor of 10, especially the number of coral colonies infected with black band disease. Tourism is generating increasing pressures on the coral reefs in Egypt, Israel and Jordan by coastal construction, sewage, solid waste and recreational activities, such as swimming, snorkelling and diving. Recreational SCUBA diving can have a severe damaging impact on coral reefs. In Eilat 250,000 to 300,000 dives are carried out each year, the highest number worldwide in a small area. Marine reserves have been established along the coast of the Gulf of Aqaba. The complete Egyptian coastline, including some terrestrial areas, is protected and divided in use and non-use zones. The 'Coral Beach Nature Reserve' covers 4km of the coastal waters on the southern Israeli coast and in Jordan and is protected as the 'Red Sea Marine Peace Park' with assistance of a US-funded bilateral project between Israel and Jordan. Despite political problems in the Middle East, international scientific programs have been carried out in the Gulf of Aqaba, bringing together local scientists from Egypt, Israel, Jordan and Palestine. The multilateral 'Red Sea Programme' (1995-2001) and the 'International Red Sea Cruise of the *RV Meteor*' (1999) were coordinated by the Centre for Tropical Marine Ecology in Bremen and funded by the German Ministry of Research and Technology. These multinational research projects are obtaining important baseline data for a joint environmental management by the countries bordering the Gulf of Aqaba. Contact: Marc Kochzius, Centre for Tropical Marine Ecology, Bremen, Germany, kochzius@uni-bremen.de