Strategic Action Programme
for the
Red Sea and Gulf of Aden

Status of the Living Marine Resources in the Red Sea and Gulf of Aden and Their Management

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

PERSGA

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The documentation for the Strategic Action Programme includes three complementary publications: (a) Strategic Action Programme - Volume 1 - Main Report, published in 1998; and (b) Strategic Action Programme - Volumes 2 and 3 - Supporting Studies. Volume 2, the Country Reports for Djibouti, Egypt, Jordan, Saudi Arabia, northern coast of Somalia, Sudan and Yemen, was published in March 2001. Volume 3a, the Navigation Risk Assessment and Management Plan for the Red Sea and Gulf of Aden, was published in July 2001. This is Volume 3b, the Status of the Living Marine Resources in the Red Sea and Gulf of Aden and Their Management. The Strategic Action Programme has also prepared a wall map that shows major environmental features of the PERSGA Region.

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Abbreviations and Acronyms

ABS	Agricultural Bank of Sudan
ACPM	Association Coopérative des Pêches Maritimes (Djibouti)
AFSED	Arab Fund for Social and Economic Development
CACB	Cooperative and Agricultural Credit Bank
CFC	Coastal Fisheries Corporation (Yemen)
CIDA	Canadian International Development Agency
CPUE	Catch per unit effort
DANIDA	Danish International Development Assistance
DEP	Direction de l'Elevage et des Pêches (Djibouti)
EC	European Commission
EEC	European Economic Community
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPC	Environmental Protection Council (Yemen)
ESD	Ecologically Sustainable Development
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FICO	Fisheries Investments Company (Yemen)
FMAC	Fisheries Management Advisory Committee
FMDC	Fisheries Manpower Development Center (Yemen)
FTCC	Fisheries Training and Commercial Center (Somalia)
FTI	Fisheries Training Institute (Yemen)
GAFRD	General Authority for Fish Resources Development (Egypt)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GNP	Gross National Product
GPS	Global Positioning System
GRP	Glass Reinforced Plastic

GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH
HACCP	Hazard Analysis Critical Control Point
IDA	International Development Agency (of the World Bank)
IsDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
IOTC	Indian Ocean Tuna Commission
IQF	Individually Quick Frozen
IUCN	World Conservation Union
JICA	Japanese International Cooperation Agency
MARPOL	International Convention on the Prevention of Pollution from Ships
MAW	Ministry of Agriculture and Water (Saudi Arabia)
MCS	Monitoring, Control and Surveillance
MEMAC	Marine Emergency Mutual Aid Center
MEP	MacAlister Elliott and Partners Ltd.
MEPA	Meteorological and Environmental Protection Administration (Saudi Arabia)
MEY	Maximum Economic Yield
MFRC	Marine Fisheries Research Center (Sudan)
MFW	Ministry of Fish Wealth (Yemen)
MOFNE	Ministry of Finance and the National Economy (Saudi Arabia)
MPA	Marine Protected Area
MPC	Marine Pollution Center (Yemen)
MRC	Mariculture Research Center (Yemen)
MSRRC	Marine Science and Resources Research Center (Yemen)
MSY	Maximum Sustainable Yield
mt	Metric Tons
n.a.	Data not available
NCSFM	National Corporation for Services and Fish Marketing (Yemen)
NIOF	National Institute of Oceanography and Fisheries (Egypt)
NGO	Nongovernmental Organization
OBM	Outboard Motor
ODA	Overseas Development Administration (United Kingdom), now DFID, Department for International Development
PDRY	People's Democratic Republic of Yemen
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
R/V	Research vessel
SAP	Strategic Action Programme for the Red Sea and Gulf of Aden
SDP	Sudanese Pound (1 USD = ca. SDP 1500 in Nov. 1996)
SFC	Saudi Fisheries Company
SMCC	Sudan Marine Conservation Committee
SAR	Saudi Arabian Riyals
TAC	Total Allowable Catch

UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
VMS	Vessel Monitoring System
WWF	World Wide Fund for Nature
YAR	Yemen Arab Republic
YFC	Yemen Fishing Corporation
Y_{opt}	Optimum Sustainable Yield (or OSY)
YER	Yemeni Riyal (1 USD = ca YER 130 in 1999)

Executive Summary

The Red Sea has a number of unique marine habitats, including seagrass beds, saltpans, mangroves, coral reefs and saltmarshes. The Gulf of Aden is a region of oceanic upwelling, resulting in high productivity of fish resources, particularly in the eastern part of the Gulf of Aden. The Socotra Archipelago constitutes a separate ecosystem; the importance of its unique environment and endemic biodiversity is on a par with the Galapagos Islands.

The fisheries of the Red Sea and Gulf of Aden are of considerable socio-economic importance to the member states of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), in terms of national food security and income generation for rural communities. Fisheries resources are exploited by artisanal subsistence fishermen, local commercial fisheries and foreign industrial fisheries targeting invertebrates, demersal finfish and pelagic finfish. Many species cross national boundaries and are essentially shared stocks.

The Red Sea artisanal sector comprises at least 29,500 fishermen and 9,000 vessels. The Gulf of Aden artisanal sector comprises at least 28,000 fishermen and 6,400 vessels. Artisanal fishermen use a range of gears, including long-lines, hand lines, gill nets, trawls, trammel nets, tangle nets, set nets, traps and spears.

The Red Sea industrial sector totals at least 7,500 fishermen and 1,600 industrial vessels. The Gulf of Aden industrial sector comprises at least 450 fishermen and 65 vessels. Industrial vessels utilize purse seine, trawl, long-line and vertical drop-line gear.

The artisanal and industrial fisheries in the Red Sea and Gulf of Aden produced around 17,096 metric tons of invertebrate species and 194,844 metric tons of finfishes in 1998. These figures indicate a considerable increase in the Region's production of 7,951 metric tons and 135,904, respectively, in 1988.

In 1998 Yemen accounted for 56 percent of total production of invertebrates, Saudi Arabia 32 percent and Egypt and Somalia around 5 percent each. Sudan, Eritrea and Djibouti together accounted for less than 2 percent. Important commercial invertebrate species include penaeid shrimps in the Red Sea and cuttlefish and rock lobsters in the Gulf of Aden.

In 1998 Yemen accounted for 52 percent of total finfish production, Egypt 26 percent and Saudi Arabia 11 percent. Jordan, Sudan, Eritrea, Djibouti and Somalia together accounted for around 11 percent of the Regional total. Pelagic finfish catches are dominated by sardine, Indian mackerel, Spanish mackerel and yellowfin tuna. The demersal catch is dominated by species of snapper, jack, emperor, lizardfish, grouper, seerfish, rabbitfish and sea bream.

Artisanal fisheries are under-exploited in Djibouti, Sudan and Somalia. Declines in catches

are reported for several fisheries such as Indian mackerel, kingfish, shark, cuttlefish, shrimp, rock-lobster and trochus. Fish collecting for the aquarium trade is significant in Saudi Arabia and Yemen. Saudi Arabia has at least seven aquarium fish exporters in operation. Marine aquaculture in the Region includes shrimp farming in Egypt and Saudi Arabia and pearl oyster farming in Sudan. Turtles are caught by fishermen throughout the southern Red Sea and Gulf of Aden. Turtle meat and eggs are eaten and oil collected along the coasts of Sudan, Djibouti, Yemen and the Socotra Archipelago, and Somalia. Local recreational use of beaches results in nesting turtles being disturbed or killed at Dhobba, Shihr and Ras Sharma in Yemen.

The shark resources of the Region are heavily fished, especially in Sudan, Djibouti, Yemen and the Socotra Archipelago, and Somalia, where there is evidence of depletion. This is attributed to a lack of control over national shark fisheries and also an increase in illegal fishing by fishermen working outside their normal territorial boundaries for the southeast Asian shark-fin market. Sharks are caught with gill nets and long-line which also damage reefs. Carcasses are habitually discarded once the fins are removed. The shark-net fishery and shrimp trawl fisheries have very high bycatch rates of fish, turtles and dolphins, which are discarded.

The efficiency of fisheries data collection, analysis and dissemination systems varies throughout the Region. Egypt, Djibouti and Saudi Arabia have systems in place to monitor catch by species at major landing sites. In Sudan and Jordan data collection is ad hoc, and in Somalia very little reliable information is available. Data for the industrial fleets is generally of better quality than artisanal fleets, but the greater socio-economic importance of artisanal fisheries underlines the fact that improved monitoring of artisanal activities is urgently required. Current data collection systems are designed to record catch at landing sites for the production of annual catch summaries. Biological information is not generally recorded. Fish processing information is also unrecorded. National authorities do not have access to data of sufficient quality to allow stock assessment or economic evaluation of fisheries activities. The Egyptian and Yemeni fishing fleets have modernized and expanded in the past 10 years, but there is not enough information with which to examine sustainability of current effort.

Applied fisheries research and stock assessment throughout the Region has been neglected in the past two decades. In most countries, no stock assessment has been undertaken since the cessation of collaborative research programmes undertaken during the 1970s and 1980s by the former Soviet Union and international organizations such as the Food and Agriculture Organization of the United Nations (FAO). Only Djibouti undertook significant assessment of demersal and pelagic stocks in the 1990s, with German assistance. Consequently most national authorities do not have reliable recent resource information regarding stock status, population parameters, estimates of potential biological yield or comprehensive and reliable catch and effort statistics even for the commercially important stocks. Such information is required on which to base rational management plans, monitor the effectiveness of management strategies and assess the socio-economic value of the fisheries.

The absence of effective control, surveillance and enforcement of regulations has resulted in widespread poaching and habitat destruction by foreign and national vessels, especially off the Gulf of Aden coast of Yemen and Somalia. Illegal fishing by vessels operating outside their national waters is commonplace. Lack of management has resulted in concerns of overfishing on some stocks. The northern Red Sea coast, from al-Lith to the Jordanian border on the Saudi Arabia side and the areas in and around the Gulf of Suez appear to be fully exploited. Concentration of Jordanian fishing effort within the limited national waters in the upper Gulf of Aqaba has reportedly led to a reduction in the number and diversity of fish caught. Over-exploitation in localized areas of Djibouti (Doralé, Khor-Ambado, Arta Plage, the islands of Musha, Maskali, Waramous) by sport and artisanal fishing is further compounded by habitat destruction. Catches and average size of rock lobster and cuttlefish off Yemen's southern coast have declined in recent years possibly indicating growth overfishing and recruitment over-

fishing.[1] Uncontrolled expansion of industrial trawling has led to a decline in shrimp catches in the Red Sea. The large number of licences issued to foreign industrial trawlers to fish in Yemeni waters has caused major habitat destruction, including damage to coral reefs, seagrass beds, spawning grounds for cuttlefish and depletion of resources. These vessels compete with artisanal fishermen whose gear they regularly damage, and conflicts are common.

The legal framework providing for fisheries management and development is weak in many states. Penalties for infringements are too low to act as an effective deterrent and encourage compliance by fishermen. Enforcement is virtually non-existent in most of the Region. Internationally accepted models for management have not been adopted, such as the principles laid down in the FAO Code of Conduct for Responsible Fisheries. However, some states are acting to strengthen the national legal framework through higher penalties, provisions for habitat/biodiversity conservation and clearly defined powers for management authorities and enforcement officers.

National institutional structures lack the administrative and technical capacity to formulate and implement realistic and effective fisheries management policies and strategies. A generic problem throughout the Region is the lack of financial and material resources allocated to those authorities responsible for fisheries research, management and development. Weak systems for integrated planning and management have allowed rapid growth of unplanned settlements and increased pressure on coastal resources. Integrated management and coordination between ministries does not exist in most countries because of the strong sectoral nature of government. Institutional capacity needs to be strengthened in the areas of regulatory policy, fisheries management and environmental conservation. At the regional level greater cooperation between states in data sharing, research and management issues lead to improved and cost-effective monitoring, control and surveillance (MCS). Indeed, research and management of transboundary stocks requires a regional approach. Greater harmonization of national legislative frameworks for fisheries and the environment, data collection, research and MCS operations and procedures would provide a better basis for cost-effective management.

A lack of awareness of the need for and benefits of effective fisheries management by stakeholders in the fisheries sector is a critical problem throughout the Region. Insufficient resources are allocated to human resource development in both the public and private sectors throughout the Region. Greater training opportunities for fisheries managers, fisheries scientists, MCS personnel, personnel for maintaining shore facilities, extension services, cooperative staff and fishermen are required.

Access to affordable terms of credit is a major constraint for fishermen wishing to maintain their operations or equip themselves for entering new, less exploited fisheries. An exception is Yemen where the Cooperative Agricultural Credit Bank (CACB) operates a highly effective soft loan arrangement for fishermen. In the absence of other more amenable forms of credit, many vessel owners in Egypt and Sudan depend on fish merchants for loans to finance operations, gear, maintenance etc., often at high rates of interest. These loans are provided on the basis that the fishermen then sell their catch to the particular merchant. This 'informal credit system' often leaves the fisherman at a disadvantage with regard to pricing structure.

Shore based facilities in the Region are relatively well developed in Egypt, Saudi Arabia and along Yemen's Gulf of Aden coast. Most artisanal catches are marketed fresh, chilled on ice. However a lack of ice machines, cold storage, fish processing and marketing infrastructure in many rural areas in Sudan, Somalia and Yemen's Red Sea coast limits the expansion of artisanal catches and often results in poor quality and, consequently, reduced earning potential for rural fishermen. Large stretches of Sudan's coastline are without even basic facilities. The lack of infrastructure,

1. Growth overfishing: a level of fishing in which young recruits entering the fishery are caught before they grow to an optimum marketable size; a level of fishing beyond that required to maximise yield (or value) per recruit. Recruitment overfishing: A level of fishing in which the adult stock is reduced to the extent that recruits produced are insufficient to maintain the population.

especially ice and road communications in Sudan has led to increased pressure on resources such as trochus, pearl shell and bêche-de-mer. Most of Somalia's shore facilities were destroyed during the civil war in the 1990s. Consequently fishing pressure on sharks has increased for the production of sun-dried meat and fins.

Exports of fish products from the Region are small; only Yemen is a significant exporter. Saudi Arabia and Egypt are net importers of fish products. Although investment in shore infrastructure on Yemen's Gulf of Aden coastline has enabled a wide range of fisheries products to be exported, Yemen is currently suffering from the loss of its European market as a result of failure to comply with European fish quality and hygiene standards.

Threats to the Region's coastal and marine habitats are posed by a number of factors. These include habitat destruction due to coastal development, pond construction for shrimp and fish culture, mangrove destruction, damage to coral reefs through unsustainable fishing practices, removal of coral for the tourist trade, and physical damage caused by tourist divers. Overfishing, illegal fishing and non-compliance with national fisheries laws and regulations pose a significant threat to the longer-term sustainability of living marine resources. The Region is a major oil producer and transportation route for crude oil. The risk of oil tankers running aground and discharges from vessels, as well as continued oil exploration and oil terminal construction, pose significant threats to fisheries and coastal resources. Industrial activities and urban development pose threats in the form of industrial and urban pollution, waste disposal, surface and groundwater usage and saltwater intrusion to aquifers. Agricultural threats include increased sedimentation and run-off of pesticide and fertilizer residues.

The Region requires assistance to address these problems. The emphasis for future assistance should be on greater management and control rather than stimulation of fishing activities. This will require training, equipment and finance for improved fisheries and environmental MCS. Improved infrastructure, especially in the form of cold storage and handling facilities, coupled with more assistance in improving quality control would result in greater utilization of fisheries resources and increased revenues from domestic and export markets.

1

Introduction

Background

The Red Sea and the Gulf of Aden region, referred to as the 'Region' throughout this document, has always been a vital maritime trade-route linking the Middle East with the other continents of the Old World. Over the course of the past few decades, the oil industry and marine transportation of oil has increased the significance of the Region. This has placed it frequently at the center of the geopolitical strategies of the industrialized countries. At the same time an increasing interest in the Region's living marine resources and their habitats has developed both at the local and international levels. Early studies on the Region's living marine resources can be dated back to the collections of flora and fauna, particularly fish, made by the Swedish naturalist Peter Forsskal in 1761-1762. Most recently, projects funded by the Global Environment Facility (GEF) and other donors aim to help in the conservation and sustainable management of the biodiversity of the Region.

The relative socio-economic importance of the fisheries sectors in member countries of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) varies in magnitude from one country to another. The contribution of the fisheries sector in each country may be assessed by considering the amount of fish supplied to the population, the employment generated by fishing and other related activities, and the foreign exchange earned from exports of fisheries products.

The importance of the living marine resources of the Region is reflected in several ways. The Region displays a high degree of genetic, species and ecosystem biodiversity. Many living marine resource species are endemic: of the vast number of its fish species 17 percent are found only in the Region.

The Region is characterised as an arid/semi-arid zone with no significant major rivers. It displays a wide range of habitats (with the obvious exception of riverine estuaries). The coral reef systems of the Region are the world-renowned, particularly spectacular colorful fringing reefs of the Red Sea with their complex and diverse associated fauna. Mangrove systems have developed in the conditions prevailing in the relatively nutrient poor (or oligotrophic) waters of the Red Sea, characterised by high salinity, high temperatures and low oxygen concentration, which limit faunal diversity. The Red Sea mangroves provide a major ecological service through accumulation and retention of sediments and prevention of coastal erosion. Mangroves are well developed especially in the southern part of the Red Sea, contributing their high primary productivity to the ecosystems of the area and providing important nursery grounds for a wide range of marine and terrestrial fauna. Sandy beaches provide important nesting grounds for sea turtles. Seagrasses constitute the only group of higher plants

to have adapted to a sub-aquatic habitat; they inhabit shallow water areas with soft benthos, in depths usually between the mid-tidal level to about 70 meters depth. The Region's seagrass areas are highly productive ecosystems where many species of living marine resources abound. For example, in the Khor Umaira lagoon in the west of the Gulf of Aden, *Halodule* spp. provide important feeding grounds for the green marine turtles *Chelonia mydas*, and many species of sea cucumbers, that form the basis of important artisanal fisheries. The oceanographic characteristics of the Region offer considerable potential for scientific research and investigations for example, to oceanographers, the Red Sea is a nascent ocean and essentially a product of the divergence of the African and Arabian plates. Further research is needed to fully understand its development. The Gulf of Aden's abundance of fish species is due to upwelling in the Arabian Sea, a phenomenon that has not been studied in any detail to date;

The socio-economic importance of artisanal and industrial fisheries to the national economies and rural communities in the Region is significant in all the PERSGA states, with the exception of Jordan, which has minimal fisheries in the Red Sea. However, despite the importance of fishing as a source of income and national food supply, the direct effects of fishing on fish stocks, especially vulnerable species such as shark, cuttlefish, shrimp and rock lobster, as well as indirect effects on the marine environment are largely unknown. The main reason for this is a lack of reliable information on fisheries and environmental interactions throughout the Region.

The relatively small area in which fishing takes place means that most important fisheries resources can be considered as shared stocks. Many are truly highly migratory, for example the tuna and small shoaling pelagic species of the Region. However, overfishing by industrial trawlers in the Gulf of Aden nearshore waters during the 1970s and 1980s has depleted some valuable resources, such as cuttlefish and deep sea lobsters. These stocks have not fully recovered, due primarily to a lack of effective fisheries management. In the Red Sea, there are signs that industrial trawl fisheries for penaeid shrimps are placing considerable pressure on shrimp stocks. The large but unrecorded bycatch of non-target species taken by shrimp trawlers, which is dominated by juveniles, is having an unknown impact on the recruitment of other living marine resources. Non-fish resources including marine turtles, mammals and sea birds are important species in the biodiversity of the Region and also require proper management measures.

Although most of the coastal areas and the waters of the Region are considered still to be in a pristine state, this situation is changing. The accelerated growth and expansion in urban coastal centers during the 1980s and 1990s, coupled with a wide range of human activities, have increased the risk of environmental degradation, depletion of fisheries resources and loss of the invaluable amenity of the Region's precious coastal and marine habitats and ecosystems.

In view of the importance of the Region and the threats it faces, a Strategic Action Programme (SAP), is being executed by PERSGA. It is funded by the GEF and other donors, such as the Islamic Development Bank (IsDB). The SAP is a continuous, consultative and cooperative process among the coastal states,[1] of the Region (PERSGA, 1998). The report presented here is one of a series produced as part of the SAP.

It should be noted that data on fisheries in Eritrea is provided by FAO in the report by Reynolds and others in 1993. Although not a member state of PERSGA, Eritrea accounts for approximately twenty per cent of the Red Sea coastline and is therefore included only to complete the regional fisheries picture. However, the report shall by no means be interpreted as an official statement of PERSGA on the status of fisheries in that country.

Objectives, Scope and Report Structure

The objective of this work is to present an overview of the current status of fisheries in the Region and identify particular problems in regard to the sustainability of fisheries and their effect on the environment. The last such review of fisheries in the Region was prepared by Food and Agriculture Organization of the United Nations (FAO)

1. The PERSGA member states are: Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan, and Yemen.

(Sanders and Morgan, 1989). This reviewed the state of the living marine resources that form the basis of fisheries in the Region up to 1987, and was of considerable value to national authorities for planning fisheries development, research and management activities.[2] The scope of the present study focuses on the period 1987-1998 and includes consideration of environmental health and biodiversity conservation.

In 1998, PERSGA held a regional meeting in Jeddah, attended by fisheries specialists from the PERSGA member countries where the structure and format of the present report was agreed. Much of the data presented has been provided by national authorities in their national status reports on fisheries, national fisheries statements, direct communication with national personnel and institutions, plus information available through the Internet and lending libraries.

Fishing in the Region is dominated by small-scale, artisanal activities. As is the case throughout the world, such fisheries are by their nature notoriously difficult to monitor, due to the large number of small craft and fishermen, and the wide range of landing sites used. Reliable data are therefore often very difficult to obtain on a national basis, and comparisons of equivalent data between countries are difficult to undertake with precision.

The information available on the PERSGA member states is given in Chapters 2-10 and is organized in the following manner. Chapter 2 provides an overview of available information on the main living marine resources in the Region, including stock assessment studies, identification of major demersal and pelagic finfish, and invertebrates that support significant fisheries. Of particular note from an environmental perspective is the identification of spawning/nursery areas, and issues related to the management of stocks that range across geographical boundaries and are consequently targeted by more than one members state. Chapter 3 provides an overview of fishing activities in the Region, including the structure and size of artisanal and industrial fishing fleets. It summarizes available information on catches, landing sites and shore infrastructure available to fishermen, post-harvest processing of catches and marketing. Chapter 4 focuses on post-harvest matters, including availability of landing sites, onshore facilities and processing activities in the Region.

Chapter 5 provides a brief overview of the dominant socio-economic and cultural conditions facing the fisheries communities. The role of fisheries cooperatives and societies, and the economic contribution of the fisheries sector in member states is briefly reviewed. Chapter 6 presents the institutional structure in the member states, the current legal framework and national capacity for undertaking fisheries and environmental management research. Chapter 7 presents specific information on fishing for the aquarium trade. Chapter 8 outlines ongoing and planned mariculture projects, mariculture production figures and focuses on the potential threats to the environment posed by mariculture. Chapter 9 indicates the threats posed to coastal and marine habitats and resources arising from fishing, including over-exploitation/non-sustainable practices, environmentally harmful fishing practices and illegal fishing activities. Finally, Chapter 10 reviews ongoing and planned fisheries projects aimed at improving management and development of the sector at national level.

The foregoing chapters are discussed in Chapter 11. Conclusions are made regarding appropriate future action that might usefully be taken to improve fisheries and environmental management in the Region. Relevant reference material is cited in Chapter 12. Information and data are provided as tables throughout the text and also in the Appendices.

Throughout the document, financial information is expressed in terms of the relevant national currency. It is not possible for US Dollar equivalents

2. Throughout this document, any reference to 'fisheries management' is meant to encompass: monitoring (the continuous measurement of fishing effort, catches, operational data etc.), control (the regulatory conditions, that is, laws, regulations, licence conditions under which fishing may be conducted legally), and surveillance (the degree and types of observations required to maintain compliance with the controls imposed on fishing activities), known collectively as MCS. Enforcement of regulatory conditions, prosecution of those who disregard them, and stock assessment research (essentially stock status, population dynamics, yield, and the effect of management regimes applied to the fisheries) completes the fisheries management function.

to be given in each case, however, because some of the countries in the Region face very high inflation rates.

2

Resource Base

Physical Features of the Red Sea

The Red Sea is a long narrow basin approximately 2,000 kilometers long, with an average breadth of 280 kilometers. Its maximum breadth is 306 kilometers in the south, narrowing to 26 kilometers near its entrance to the Gulf of Aden at Bab-al-Mandab. Its continental shelf area to 200 meters depth is around 180,000 square kilometers, or 41 percent of the total area of about 440,000 square kilometers. A semi-enclosed body of water, it is characterised by high water temperatures and high salinity. There are no major river inflows and water lost through evaporation far exceeds precipitation. The loss of water through evaporation is replenished through the inflow from the Gulf of Aden through the Strait of Bab-al-Mandab. Primary productivity is relatively low due to poor surface circulation in the absence of strong wind systems. Productivity is greatest in the south where it is stimulated by the inflow of nutrient-rich Indian Ocean water. The north of the Red Sea is divided into the Gulf of Suez, a shallow sea less than 100 meters depth, and the Gulf of Aqaba, a deep rift basin reaching 1800 meters in depth. The two gulfs are similar in size and shape. The geographical separation of the Red Sea from the Gulf of Aden is via a 100 meters deep sill about 125 kilometers north of Bab-al-Mandab.

Much information on the coastal resources of the Red Sea has been produced in by the World Conservation Union (IUCN) in collaboration with national environmental authorities (see for example MEPA 1987, 1989, 1989a, 1989b, 1994, 1995).

In general, four physiographic zones are recognized based upon species distribution (Sheppard and others, 1992):

- The Gulf of Aqaba is characterised by its geographical isolation and the relatively high number of species that are either restricted to or restricted from the area. The extreme north of the Gulf contains species found nowhere else in the Red Sea.
- The Northern Red Sea is characterised by the seagrass *Thalassodendron ciliatum* which is found in this zone and the Gulf of Aqaba but rarely elsewhere in the Red Sea. Temperature may be a determinant factor for many species distributions.
- The Central Red Sea, including the outer Farasan Bank, contains many species absent from the north and south. There is some evidence that coral abundance is important in explaining species distribution as well as temperature in this zone.
- The Southern Red Sea has many species suited to its waters which are laden with sediment from land based sources and undergo water mixing across the wide shallow coastal shelf. The highest sea temperatures are found in this zone and coral development is restricted. There is a lack of deep water habi-

tat. The types of fisheries habitats in the Red Sea are determined mainly by the interaction between seawater intrusion, terrestrial freshwater aquifers and tidal activities.

The coral reefs of the Red Sea are among the most spectacular in the world. Most are situated along the coast and surrounding offshore islands and are in relatively good condition. However, reefs along some stretches, such as the eastern coast around Jeddah and the industrial city of Yanbu, are becoming increasingly affected by development.

Five areas along the Saudi coast are noted for their extensive coral reefs: the Tiran Island area, Wajh Bank, the area north of Yanbu, the coastline between Obhur and Tuwwal north of Jeddah; and the outer Farasan Bank. Coral reefs play an important role in the coastal ecosystem. They provide habitats for a wide variety of marine species and protect coastal lands from erosion and storm damage. In the Red Sea, coral reef communities generally form extensive and productive reef flats which create protected habitat for many juvenile species as well as lagoons which also serve this purpose. Corals also create a protected environment for the development of coastal vegetation such as seagrasses and saltmarshes.

Typical features of the western coast of the Red Sea are coastal lagoons and sheltered bays (or marsas), which form natural harbours and fish landing places. Several of these lagoons are fringed by mangrove (Khalil 1994, Khalil and Krupp 1994, Wilkie 1995). The black mangrove, *Avicennia marina*, is the only species occurring in the area and forms extensive cover in some areas. Seagrass beds are frequently found in the shallow waters of marsas and in lagoons between the coast and the fringing reef.

The Egyptian and Sudanese coasts are characterised by the most diverse reefs of the Red Sea. Most of the coast is bordered by fringing reefs 1 to 3 kilometers wide, separated by deep channels from a barrier reef of 1 to 14 kilometers width. The outer barrier drops steeply to several hundred meters depth. One of the most unique reef structures of the Red Sea is Sanganeb Atoll (Krupp 1990). Its steep slopes rise from a sea floor of more than 800 meters depth. Coral reefs of the Red Sea are described in more detail by Betz and Otte (1980), Schröder and others (1980), Vine and Vine (1980), Schröder (1981, 1983), Schröder and Nasr (1983), Mergner and Schuhmacher (1985), Sheppard and Wells (1988), Musa (1991), Abdellatif (1993), El Hag (1994), and Krupp and others (1994, 1995).

Mangroves generally grow in the waterlogged and saline soil of the intertidal zone and are often associated with areas of runoff. Only two species have been recorded along the Saudi Arabian Red Sea coast, *Avicennia marina,* which is widespread, and *Rhizophora mucronata,* found at only six sites. They are found in such areas as broad coastal plains, protected shores, over shoals and spits, and in lagoons. While mangroves are found scattered along much of the Red Sea coast, the major concentration is in the southern Red Sea where factors such as increased sediment create an environment more conducive to their development. This increased development in the south also coincides with areas of greatest agricultural potential.

Agricultural development, properly planned and managed, could be beneficial to certain coastal habitats such as mangroves. Mangroves have a variety of values: they provide food in the form of detritus, shelter for numerous organisms (such as molluscs, crabs, shrimp, and fish), fodder for camels and goats, and fuel for human use. Mangroves are also important nesting sites for several species of birds. Development of coastal recreation facilities and 'Coastal Villages' in the Ras Hatiba area north of Jeddah and shrimp aquaculture along the southern Red Sea coast have contributed to the decline of coastal mangroves.

Seagrasses are fairly widespread along the Red Sea coast although they are more common in the southern Red Sea. They tend to be concentrated in shallow water areas such as lagoons, sharms (drowned wadi mouths), and marsas (shallow embayments) because of the soft bottom sediments found in these areas. Of the eleven seagrass species in the entire Red Sea, ten have been recorded along the Saudi Arabian coast. As seagrasses are one of the most productive habitats in coastal environments, their abundance along the coast of the Red Sea is indicative of a highly productive ecosystem.

Sabkhas or saltpans are broad expanses of seasonally inundated mud flats, often encrusted with salt. These areas support significant microalgal growth when flooded, which may contribute to the overall productivity of the Red Sea. However, relative to other forms of coastal vegetation, these areas are less important ecologically.

Saltmarsh halophytes and freshwater-dependent vegetation such as date palms are also found along the Red Sea coast. In the far north, saltmarsh halophytes usually occur in a band 1-3 meters above the high water mark and are sparse and stunted due to the arid climate. The best developed and greatest variety of halophyte communities grows in the central region of the Red Sea. Some of the offshore islands also support dense stands of halophyte vegetation. In areas of plentiful freshwater supply, date palms develop.

Much of the Red Sea coastal area is dominated by a flat, low lying desert or semi-desert plain. This is known as the Tihama and separates the mountains from the sea. On a typical shoreline, this plain ends abruptly and becomes a narrow, gently sloping beach, often backed by halophyte vegetation.

The bays, sharms, and marsas of the Red Sea provide an important environment for mangroves, seagrasses, and saltmarshes. These ecosystems support a large variety of marine life including fish, shrimp, turtles, dugong, and birds (Gasperetti and others, 1993). Maintenance of the complex relationships among species found in these environments is dependent on the conservation of various habitats. Although bays, sharms, and marsas are scattered all along the coast, they are more common in the central region.

Islands of the Red Sea are important sanctuaries for a variety of marine life, seabirds and turtles that feed or nest on and around islands. Many fish and invertebrates are supported by the reefs around these islands. Some of the Farasan Islands are inhabited and support fishing communities.

Physical Features of the Gulf of Aden

The Gulf of Aden extends geographically eastward from the Red Sea, to Ras Fartak on Yemen's south coast and Ras Asir on Somalia's northeastern coast, including the Socotra Archipelago. Its continental shelf area to 200 meters depth is around 50,000 square kilometers. The area is heavily influenced by the Indian Ocean monsoon system. The winds blow from east to northeast during the northeast monsoon, October to April, and from the southwest during the southwest monsoon, May to September. The strongest winds, and associated water currents, occur in July and August.

The water column in the Gulf of Aden is characterised by a well mixed surface layer, separated from the sub-surface waters by a highly stable thermocline at about 100 meters depth. The surface layers have high temperature and salinity and oxygen contents above saturation levels. The sub-surface waters are much cooler, low in salinity and have extremely low oxygen levels. During the southwest monsoon, the thermocline becomes more marked and rises to less than 25 meters from the surface. This upwelling stimulates primary production of phytoplankton and ultimately creates an increase in the abundance of pelagic fish. The northeastern part of the Gulf of Aden and the area south of Socotra are among the most productive marine areas in the world, with productivity levels comparable to those off the coasts of Peru and West Africa.

The surface water temperature in the Gulf of Aden varies considerably. Maximum temperatures occur in May-June and September-October. The minimum temperatures in July and August, during the peak of the upwelling, are 7-10 ºC lower than the highest in May.

The coastline consists of a series of sandy beaches, broken at intervals by rock outcrops that often extend into the shallow waters. There are no fringing coral reefs because of the seasonal occurrence of cold and turbid water from areas of upwelling. The seabed slopes steeply from the coast and the continental shelf is relatively narrow. The only shallow water banks are adjacent to, and east of, Aden and extend to about 30 kilometers offshore. Offshore islands are limited to Perim Island and the Socotra Archipelago.

Gulf of Aden waters are characterised by a large variety of species, but with relatively few commercially important ones. The abundance of pelagic species is strongly influenced by seasonal varia-

tions due to the monsoon seasons. Demersal finfish and crustacea are more stable and relatively unaffected by the monsoon seasons in terms of abundance.

The Socotra Archipelago, located in the Arabian Sea at the entrance to the Gulf of Aden, constitutes a separate marine ecosystem. The islands' inaccessible location has spared them from modern intrusions and today the archipelago represents an undisturbed, pristine environment with a unique biodiversity. It has been described by the World-Wide Fund for Nature (WWF) as an 'Indian Ocean version of the Galapagos' (UNDP/GEF, 1997).

Status of Fish and Shellfish Stocks

Fish and shellfish stocks in the Red Sea and Gulf of Aden support artisanal, semi-industrial and industrial fisheries fleets of Djibouti, Egypt, Saudi Arabia, Somalia, Sudan and Yemen. Jordan has only a very small presence in Red Sea fisheries. Eritrea, although not a PERSGA member, is included here since it has sizeable fishing fleets and is an important country in the Region in regard to exploitation of living marine resources. However, as noted above, this information shall by no means be interpreted as an official statement of PERSGA on the status of fisheries in that country.

A large number of fish stocks are exploited. The most important commercial species/groupings in terms of both monetary value and national food security are detailed in Appendix A. Of the vast number of fish species in the Region, only around sixty-five are currently considered to be of economic importance, in addition to sharks, rays, shrimps, lobsters, crabs, molluscs and sea cucumber (Sanders and Kedidi 1984a-f; Mishrigi 1993). In the artisanal fisheries, eight taxa account for the majority of catches: tunas and mackerel (family Scombridae), coral trout (*Epinephelus* spp., *Plectropomus* spp.), snappers (*Lutjanus* spp*, Aprion* sp.), emperors (*Lethrinus* spp.), jacks/trevallies (family Carangidae), leatherjackets (such as *Naso unicornis*), mullets (*Valamugil seheli*) and sharks (mainly species of *Carcharhinus* spp. and *Sphyrna* spp.).

Very few large-scale resource surveys and stock assessments have been conducted on major species on a regional basis since the late 1980s, when a UNDP/FAO project on development of fisheries in areas of the Red Sea and Gulf of Aden was concluded in 1988. In 1989 FAO produced a summary report on published and unpublished material relating to stock status and assessment covering the preceding two decades (Sanders and Morgan, 1989). These authors note that the total potential yield of fisheries resources for the Red Sea has been calculated at 360,000 metric tons (Gulland, 1971) and 267-414,000 metric tons for the Gulf of Aden, but excluding meso-pelagic resources (Kesteven, and others, 1981).

Badawi (1996) provides a summary of stock assessment research in Red Sea fisheries. There is only scattered, unreliable information regarding species composition and no scientific attempts have been made to estimate the maximum sustainable yield (MSY) or maximum economic yield (MEY) of any of the individual species.

Despite the importance of shark and miscellaneous large pelagic species such as kingfish (Spanish mackerel), cobia and barracuda, no research has been undertaken on these stocks in the Region. In the Gulf of Aden, it is only cuttlefish, exploited by industrial trawlers, and rock lobster, exploited by artisanal fisheries, that have received continuous, though sometimes limited attention. The industrial trawler fleets of Yemen, Somalia and Egypt have exploited large quantities of demersal fish in the Gulf of Aden over the years but surprisingly there has been little applied research carried out.

The lack of fish stock assessment research in most countries of the Region can be attributed to the following reasons:

- Lack of funds and equipment.
- Insufficient skilled technical staff.
- Limited commitment to regional cooperation on fisheries research due to the costs involved in relation to perceived benefits.
- Civil unrest in some countries in the Region since the late eighties has hindered scientific research and fisheries management in general.
- For some countries in the Region marine fisheries are of minor importance, for example, Jordan has very limited jurisdiction over fish-

eries in the Red Sea; Egypt and Sudan depend more on inland freshwater fisheries.

- Political influence of fishermen in each country in the Region is negligible due to the very low percentage they represent in the whole population.
- The absence of a regional fisheries organization that could act as a vehicle for facilitating data collection, analysis, sharing and harmonization of national management and development plans.

Despite these constraints, some national efforts on fish stock assessment in the Region have continued since 1988 with support from bilateral donors.

Between 1989 and 1995 FAO undertook a general survey of fisheries in Egypt's Gulf of Suez, Ghardaqah to Ras Banas and Foul Bay (Project: RAB/83/023/02). In 1996 the Institute of Fisheries in Egypt undertook a fisheries survey in the Gulf of Suez. This concluded that all Gulf of Suez fisheries were overfished. Recommendations included effort reductions.

The only country in the Region where significant stock assessment research has been conducted in recent years is Djibouti. In 1996, assessments of pelagic and demersal resources were conducted in four areas: (a) Loyada in the south to Ghoubbet; (b) Ghoubbet to Obock; (c) Obock to Godoriya; and (d) Godoriya to Bab-al-Mandab on the Djibouti-Eritrean border (Künzel and others, 1996). Using a swept-area methodology, abundance, distribution and potential yields were calculated by species. One hundred and ninety two species of fish were sampled. Total biomass of demersal species in all four areas sampled was calculated as 26,260 metric tons, with an optimum sustainable yield (Y_{opt}) of 15,214 metric tons. Total biomass of pelagic species was estimated to be 74,500 metric tons, with a Y_{opt} of 32,625 metric tons. The combined pelagic and demersal resources were estimated to be 100,760 metric tons and Y_{opt} of 47,839 metric tons. A number of surveys have also been undertaken by French research vessels, but details are not available.

In Yemen each year since 1990 the national Marine Science and Resources Research Center (MSRRC) undertakes pre-fishing season surveys of cuttlefish resources in Gulf of Aden Exclusive Economic Zone (EEZ), using its fisheries research vessel, R/V Ibn Majid, or by hiring a commercial stern trawler. The results of these surveys are used to set the Total Allowable Catch (TAC) for the cuttlefish fishery.

INVERTEBRATES

Shrimp

In the case of Yemen's Red Sea waters, only the shrimp resources have been studied to some extent (Esseen, 1996b). The potential sustainable yield of shrimp in the Red Sea has been estimated at 1,000 metric tons, based on an analysis of available stock assessment results (Sanders and Morgan, 1989). The catch was assumed by researchers to have been taken with a shrimp trawler effort of 400 boat-months. The predicted yield compares well with a scientific estimate of 800 metric tons made a decade earlier and with the commercial production, 900 metric tons, of a private company in the early 1970s. The most common species is *Penaeus semisulcatus* but there are also smaller quantities of *P. monodon, P. indicus* and *P. japonicus*. The resources are concentrated in the areas of Ras Xatib, Taij, Harounia, Salif and al-Luhayyah. There have been no surveys, research or stock assessment work conducted for this resource since the termination of the FAO regional project for Development of Fisheries in Areas of the Red Sea and the Gulf of Aden in the early 1980s.

Rock Lobster

Commercial exploitation of rock lobster (principally *Panulirus homarus*) occurs off the eastern coast of Somalia and the south coast of Yemen (MEP 1992; 1994b).

In Yemen, commercial exploitation began around 1975. Because of the high export value of the lobster, the resource is relatively well researched. This work has been facilitated by the availability of reasonably accurate catch and effort data due to the buying and marketing monopoly of a state-run company, the Coastal Fisheries Corporation (CFC). Rock lobsters are abundant in shallow

waters along the coast between Mukalla, Hadhramaut Governorate in the west, and the Oman border, al-Mahara Governorate, in the east. The heaviest concentrations are found off al-Mahara Governorate (Esseen 1997a). Potential yields have been estimated by several scientists at different times. They vary between 300 and 1,000 metric tons. The most recent study covering the entire fishery resulted in an estimate of 700 metric tons (Valle and others, 1993).

A recent MSRRC study (Subeir and others, 1997) reveals that the catch in the western area dropped from 340 metric tons in 1992-1993 to 120 metric tons in 1994-1995 without any increase in the fishing effort. The catch per unit effort (CPUE) therefore dropped by two thirds during this period. According to the same study, the fishing effort increased dramatically during the 1995-1996 season (by 80 percent) resulting in slightly higher production (160 metric tons) but, of course, in a further reduction of the CPUE.

Cuttlefish

Commercial exploitation of cuttlefish (*Sepia pharaonis*) in the Gulf of Aden is centerd off the south coast of Yemen. The fishery commenced in 1966. The virgin stock was large and because of its high export value, assessment of the cuttlefish stock and estimation of potential yields have been attempted more or less continuously since the start of exploitation. Resource assessments have been based on catch and effort data, population dynamics modelling, trawl mesh selectivity trials and resource surveys conducted by fisheries research vessels and commercial trawlers.

The first estimates of MSY were on the order of 10,000 metric tons and a standing stock of around 100,000 metric tons. In the late 1970s, the MSY was revised to 5,000-20,000 metric tons. It was also believed at that time that the yield in any particular year was largely dependent upon environmental factors believed to influence spawning and recruitment and that significant fluctuations could be expected. The most recent estimate, in an internal MSRRC report (Valle and Ahmed, 1993), suggests that a catch of about 3,000 metric tons is sustainable.

The cuttlefish resources off Yemen's southern coast are located east of Ras Qusayir in Hadhramaut Governorate, with highest densities found between Ras Sharwain and Ras Fartak. Cuttlefish are found to a depth of 120 meters, although most of the fishing is carried out in waters of less than 50 meters.

Deep Sea Lobster and Deep Sea Shrimp

Deep Sea lobster (*Puerulus sewelli*) and deep sea shrimp (*Parapenaeopsis* sp.) resources inhabit the slope of the continental shelf at 200-600 meters depth in the Gulf of Aden. In Yemen, the industrial trawl fishery for these species is seasonal, from November to April, mainly because of a preference to deploy vessels during other months to catch cuttlefish. As in the case of cuttlefish, very little research has been done on these resources and the estimates of potential yield that have been made have a weak scientific foundation. In an analysis made by Soviet scientists, it was estimated that these resources could each yield about 1,000 metric tons per year.

Judging by actual catches, it appears that the Soviet estimates were optimistic. Deep Sea lobster catches reached a peak of 1,500 metric tons in 1976-1977 off Yemen's Gulf of Aden coast and those of deep sea shrimp peaked at 500 metric tons in 1983. The landings have since been very small, on the order of 100 metric tons of lobster and a similar volume for shrimp. The recorded landings in 1995 were just a couple of metric tons for each species and about 65 metric tons in 1996. The low catches must be a result of reduced effort but this, in turn, could also be a result of lower resource abundance. It is suggested that the total potential sustainable yield for both species together would be much lower yields than the above estimates, perhaps around 500 metric tons.

Sea Cucumber

It was reported in the mid-1980s that sea cucumber (or bêche-de-mer) was exploited by artisanal fisheries in two areas west of Aden, Yemen. Main species include *Holothuria scabra* and *Actinopyga* sp. A survey indicated that the potential yield of valuable species was in the order of 55 metric tons of dried product that would be equivalent to about 550 metric tons wet weight. It was

therefore concluded that there was little commercial potential for this fishery in Yemen. Export figures for 1996 indicate that 10 metric tons of bêche-de-mer were exported from Yemen, reportedly collected from Ras al-Ara, Bir Ali, Burum and al-Hami. Traditional fisheries for bêche-de-mer exist in Somalia and Sudan, but have declined during the 1990s, primarily because of marketing problems in Somalia and over-exploitation in Sudan.

Trochus and Pearl-Shell

Artisanal fisheries targeting trochus (*Tectus dentatus*) and pearl shell (*Pinctada margeritifera*) are particularly important in Sudan, where they offer income generating potential for coastal fishermen who are unable to exploit and market fresh fish due to a lack of ice and other infrastructure. No stock assessment studies have been conducted on these resources. Data are only available from export records. The average size of shells has reportedly decreased. Total production has declined from 1,078 metric tons in 1966 to around 554 metric tons in 1998. There is management in place for the fishery.

Pelagic Finfishes

Very little quantitative and scientific information is available on the pelagic fisheries resources of the Gulf of Aden. As noted above, most of the past research work was undertaken 15-25 years ago through externally supported development projects, in many of which FAO played a prominent role.

In the period 1975-1984, the small pelagic species in the Gulf of Aden were surveyed by acoustic methods during seven cruises undertaken with R/V Dr. Fridtjof Nansen under the auspices of FAO (Sanders and Morgan, 1989; Aglen and others, 1981). The estimates of potential yield were on the order of 130,000-150,000 metric tons. Besides this, very little scientific work in terms of resources assessment has been undertaken on the abundant small pelagic fish resources off the south coasts of Yemen and Somalia. The sardine resource has received some attention because of its potential value as raw material for a fishmeal industry. Large pelagics, including yellowfin tuna, shark, kingfish, etc. have not been studied at all.

Yellowfin Tuna

The most important large pelagic species caught in the Gulf of Aden is yellowfin tuna (*Thunnus albacares*). It is available all year round, but with a peak season between March and April when the fish appear in large quantities in the Gulf of Aden where it is exploited by artisanal boats using hook and line, trolling or by baited drop-line, primarily off the Hadhramaut Governorate in Yemen, and Spanish and French flag industrial long-liners and purse seiners operating off the coast of Somalia. Since yellowfin is a highly migratory species, the fish present in the waters of the Gulf of Aden are almost certainly part of the larger Indian Ocean stock rather than a separate, resident stock. The potential yield is therefore influenced by the catch taken in other Indian Ocean countries that share the stock. The Yemeni catch currently appears to be limited only by the number of vessels operating and the types of gear employed, not resource abundance. Little information is available on tuna fisheries from Somalia, although shark fisheries are better documented.

Annual yellowfin production in the western Indian Ocean currently amounts to around 300,000 metric tons (figures from the Indian Ocean Tuna Commission-IOTC). The regular appearance in waters off Yemen and Somalia, the ease with which it can be caught close to the shore and the sharp increase in landings in recent years indicates that the fishery may have considerable further potential, especially if post-harvest processing can be improved and more lucrative markets offering better financial returns can be tapped. This assumes that the yellowfin resource does not become collectively over-exploited by other countries in the Region where higher effort and more efficient methods are employed.

Shark

In the Gulf of Aden sharks (mainly *Carcharhinus* spp.) are caught all along the coasts of Yemen and north Somalia using similar methods as in the Red Sea. Again, many of the species are migratory, over long distances, while others may well form resident stocks. No data or research has been undertaken on which estimates of potential yield can be made. The potential of the oceanic shark could be quite high but, as in the case of yellowfin,

it depends on the catches by other countries within the Region.

It should be stressed that a more cautious approach to managing shark fisheries is required due to their relatively low reproductive rate and slow growth. Reports from fishermen on Socotra Island off Yemen's south coast indicate that catches are noticeably declining, indeed an ongoing GEF/UNDP project focuses on shark fishery management for this reason. Collapse of the Socotra shark fishery would have catastrophic consequences for local communities there, as they rely very heavily on sharks for food and a source of economic prosperity (Saeed, 1999). Fish markets throughout the Region often offer large numbers of very small sharks for sale. The practice of finning larger sharks at sea and dumping the carcasses overboard is widespread.

Despite the lack of reliable information, it is clear that shark resources in both the Red Sea and Gulf of Aden are facing ever increasing levels of fishing pressure. Sharks have high commercial value for their meat, fins, skin and jaws (valuable to the tourist trade), and are a major component of the diet and income earning potential for many rural fishing communities throughout the Region and their decline or collapse would have catastrophic consequences for the livelihood of many coastal communities in Somalia and Yemen. A programme of shark resource assessment for both the Red Sea and Gulf of Aden coasts, including the Socotra Archipelago is urgently required, and management plans should be formulated and put into effect in the short term.

Sharks of the genus *Carcharhinus* are also highly important to all the Red Sea artisanal fleets. They are caught using long-lines, drift nets and hook and line. There are no data or research information at all from the Red Sea on which estimates of potential yields can be made. Fish markets throughout the Region often offer large numbers of very small sharks for sale. The practice of finning larger sharks at sea and dumping the carcass overboard is widespread. Although information available does not allow a reliable estimate of total landings, it is believed that shark landings in the Red Sea are far greater than in the Gulf of Aden.

Indian Mackerel

Indian mackerel (*Rastrelliger kanagurta*) is abundant throughout the Gulf of Aden and Red Sea. It is caught by artisanal boats using round-haul seine nets and gill nets by artisanal fishermen. It is particularly abundant in the western part of the Gulf. No assessments have been conducted and there are no estimates available on the size of the stock or the potential yield. The species forms a very important basic, low cost protein food source throughout the Region.

Sardines

The main sardine species in the Gulf of Aden is the Indian oil sardine, *Sardinella longiceps*, and *Sardinella fimbriata*. These small pelagics are abundant in the nearshore waters of Yemen, around Socotra Island and the north and east coasts of Somalia, where large concentrations occur off Cape Guardafui. Traditionally, it was caught by cast nets and later by small purse seines or surrounding nets. In connection with the attempts to establish a fishmeal industry in the 1970s, several exploratory fishing trials were undertaken using larger purse seiners, but these proved unsuccessful. Assessments of the stocks of sardine, based on commercial data from the area between Mukalla and Ras Sharma (off the coast of Yemen) indicated that the stocks were heavily exploited. Landings were about 18,000 metric tons against an estimated yield of 21,000 metric tons (Sanders and Morgan, 1989).

Pacific Mackerel and Scads

The most abundant pelagic species in the Gulf of Aden is the Pacific mackerel (*Scomber japonicus*) which is also called chub mackerel. It was caught in the past by Soviet vessels in the Gulf of Aden using mid-water trawls during the winter season, October to April. It is believed that this mackerel is migratory and that the resource is shared by Oman, Yemen and Somalia. A Russian estimate of the potential yield gave a figure of 16,000 metric tons but the research findings on which this is based are not readily available.

Also of importance, according to available estimates, are the scads or horse mackerels, *Trachurus* sp. and *Decapterus* sp. According to Soviet esti-

mates, the potential yield of these species is 8,000 metric tons.

Anchovy

Anchovies (*Stolephorus* sp.) are abundant in the Gulf of Aden. As in the case of mackerel and scad, very little or no research has been done on anchovy resources. Soviet scientists estimated the potential yield to be as high as 10,000-22,000 metric tons. Anchovy does not appear in the landing records since the 1980s.

Meso-pelagics

Past acoustic surveys undertaken in 1975, 1976, 1979 and 1983 by R/V Dr. Fridtjof Nansen have indicated a very large resource of meso-pelagic fish in the Gulf of Aden in depths greater than 150 meters, comprised mostly of lantern fishes (family Myctophidae). *Benthosema pterotum* is reported as the most abundant species, although occasionally it was surpassed by *B. fibulatum, Symbolophorus evermanni, Myctophum spinosum* and *Diaphus* sp. The estimated biomass for the inner Gulf of Aden varied from 12 million metric tons in the spring and autumn of 1975 to two million metric tons in the summer of 1976. The range in the outer Gulf of Aden was between 28 million metric tons (spring 1975) and 2 million metric tons (summer 1979).

No commercial exploitation of meso-pelagic resources has taken place. They are also not likely to be exploited in the foreseeable future since it is not economically feasible given their low market value and relatively high production costs.

Miscellaneous Large Pelagic Species

This category includes a large variety of species that are widespread in the Gulf of Aden and Red Sea including kingfish (*Scomberomorus commersoni*), jacks (family Carangidae), billfish (sailfish and marlins), cobia (*Rachycentron canadum*), dolphin fish (*Coryphaena hippurus*), queen fish (*Scomberoides* spp.) etc. Kingfish, together with yellowfin tuna, represent two of the most important commercial pelagic species in the Gulf of Aden targeted by both artisanal and industrial fisheries.

Tuna species other than yellowfin are common, for example, skipjack tuna (*Katsuwonus pelamis*), bonito tuna (*Eythynnus affinis*) and frigate mackerel (*Auxis thazard*). No stock assessment research has been attempted on any of these stocks. Very little reliable data, even on basic landing statistics, are available. Some of these stocks are definitely migratory over large areas but others might be resident in coastal waters. Nothing about this appears to be known. These species are commonly caught all along the coasts of the countries bordering the Gulf of Aden but it is not possible to quantify the amount landed.

DEMERSAL FINFISHES

In the Gulf of Aden, the first estimates of the potential yield of demersal fish resources were made in the early 1970s shortly after the start of industrial exploitation, and suggested an MSY of 70,000 metric tons in Yemeni waters. In the decade that followed, the resources were heavily exploited by vessels from Japan and the former Soviet Union. Large quantities of fish were caught and much was discarded as bycatch. This resulted in a drop in catch rates and a change in the species composition of the catches. In the mid-1980s, analyses based on surveys undertaken by the fisheries research vessels R/V Dr. Fridtjof Nansen and Yemen's R/V Ibn Majid, resulted in sustainable yield estimates of 10,000-15,000 metric tons from a stock of about 120,000 metric tons. About one third of the catches consisted of low value or non-commercial species. The estimates made by Soviet experts in the late 1980s were also on the order of 10,000-12,000 metric tons for commercial species and twice that amount if low value and inedible species were included.

The most common commercial trawl species are bream (*Nemipterus* spp.), emperor (*Lethrinus* spp.), snapper (*Lutjanus* spp.), grunt (*Pomadasys* spp.), ribbonfish (*Trichiurus* spp.) and lizardfish (*Saurida* spp.) The composition varies by area, season and water depth and species such as barracuda (*Sphyraena* spp.) and jack (*Caranx* spp.) may sometimes also constitute significant portions of the catch.

In the Red Sea, Egypt's main surveys for demersal stock assessment research were undertaken by the

UNDP/FAO Regional Project mentioned above, over the period 1979-1983, the conclusions of which are summarized in Sanders and Morgan (1989). In 1996, the National Institute of Oceanography and Fisheries (NIOF) undertook a survey of fisheries in the Gulf of Suez. Catch samples were taken during 1989-1990 and 1993-1994 from trawl, purse seine and hand line fisheries and MSY estimates calculated. The major conclusion was that all Gulf of Suez fisheries are overfished and recommendations were presented to reduce fishing effort.

It is understood that there is virtually no recent detailed information on the status of the principal commercial stocks in the Egyptian Red Sea. Studies by Sanders and Kedidi (1981) reviewed area yield estimates for different fishing methods in the Red Sea, which provide some indication of the present levels of exploitation. These estimates are based upon very incomplete data and the authors advise caution in interpreting the results. General Authority for Fish Resources Development (GAFRD) landing figures contain an unknown proportion of fish caught outside of Egypt's Red Sea waters. Without detailed information on the catches within Egyptian waters it is impossible to correlate present landings with the potential yield figures given above. Improved data collection is required before any form of rational management plan for the sustainable exploitation of fisheries within the area is possible. Desegregation of landings as to the gear used, the fishing grounds and further detail on species breakdown is essential as a first step.

In Saudi Arabia, the most recent MSY estimate was 45,000 metric tons for all fisheries based on studies conducted in 1979 by the United Kingdom's White Fish Authority (Sanders and Kedidi, 1984f). A number of other assessments on single species have also been conducted over a 1-2 year time frame and over limited areas, focusing on artisanal target species; they are considered by Saudi officials to be of minimal value for management. No assessment of the important shrimp and rock lobster resources has been attempted.

No significant stock assessment has been conducted in Sudan's waters. However, work by United Kingdom Overseas Development Administration (ODA) indicated a total MSY of around 35,000 metric tons. In comparison to current annual total national catch of around 1,400 metric tons, Sudan considers its marine fish resources to be lightly exploited. The effect of illegal fishing on Sudan's fish stocks is not known.

Eritrea's fisheries resources were estimated to have an MSY of 50,000 metric tons/year (Reynolds and others, 1993) although these authors noted that there were no recent reliable stock assessment figures available.

With support from Germany and technical assistance from the Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), Djibouti has conducted an evaluation of the fisheries resources and exploitable yields in national waters. The project recorded a total of 192 fish species and estimated the average total annual biomass at 28,000 metric tons for demersals, 56,000 metric tons for small pelagics, and 18,000-19,000 metric tons for large pelagics. The potential MSY of exploitable fish species in Djibouti's continental shelf areas was estimated at 15,000 metric tons for demersals and 23,000 metric tons for pelagics. However, only 1,300 of demersals and 3,200 metric tons of pelagics comprise species of commercial value.

In Yemen, estimates of the potential yield of demersal and pelagic fish from the Red Sea again come from surveys conducted during the 1970s and early 1980s. These were based on trawl surveys, commercial trawling data and on the production of the artisanal fisheries. Estimates varied from about 20,000 metric tons to 31,000 metric tons. The estimates from trawl surveys may not be relevant to the current fisheries due to changes in the population structure of the resource and the physical conditions prevailing on the trawling grounds. No other, more recent, stock assessment efforts appear to have been made. A Fisheries Sector Review conducted in 1997 under the auspices of the Fourth Fisheries Project provided estimates of potential yield and current levels of production for fish resources in Yemeni waters off the Red Sea and Gulf of Aden coastlines (MEP, 1999).

In summary, there is a general lack of knowledge regarding the status of fish stocks, their potential yields or indeed the current levels of harvest they

support, throughout the Region. Much of the fisheries production (as much as 90 percent in the case of Yemen) is taken by artisanal fisheries, targeting resources for which the level of sustainable catches is not known. Statistics collection for the industrial fisheries is better, at least in the case of Sudan, Yemen and Egypt, but again data collection systems cannot be described as well developed even in these countries.

Highly Migratory and Shared Stocks

Information on migration patterns and population dynamics of shared and highly migratory stocks in the Region is not available. Obtaining such information is possible through tagging experiments, which are costly and require a high degree of technical ability and regional cooperation.

Sanders and Morgan (1989) note that attention to fish stock assessment as an ongoing activity in many countries in the Region is very recent. This fact, coupled with the general lack of an adequate time series of detailed landings and effort statistics, has meant that the precision of most resource assessments undertaken to date could be much improved. In addition, little is known regarding the distribution and interdependence of many of the major commercial species.

While assessments of fish resources have been carried out at a national level, consideration needs to be given to the interactions between stocks on a regional level. Unfortunately, insufficient data exists to allow this to be done; the assessments undertaken during the 1970s and 1980s do not address the question of interaction between stocks within the Region. It is not clear whether it is appropriate to assume that the fisheries resources within the territorial waters of each country can be assessed and managed independently of other neighboring states. As awareness grows in the PERSGA member states to increase knowledge of stocks in support of improved fisheries management, such interactions will need to be addressed and regional cooperation in management of the stocks initiated. Such cooperation is likely to be of significant importance in the assessment and management of some of the pelagic stocks of the Region such as the various species of *Sardinella*, Indian mackerel (*Rastrelliger kanagurta*), horse mackerel (*Trachurus indicus*), tunas (especially yellowfin) and many of the shark species.

It could be argued that many of the species/stocks described above can be considered to be shared stocks, given the relatively close proximity to one another of the sea areas over which jurisdiction is claimed by the PERSGA members. Despite this, few of the countries have formal mechanisms for communicating on fisheries management issues, or for working together to facilitate a regionally harmonized approach to management. Even for those species that are not highly migratory, such as demersal finfish and invertebrates, the relatively small area of the Red Sea means that the eggs and larvae are distributed by water currents within the Red Sea as a collective whole. Consequently the fishing activities of one state almost certainly have a definite impact on recruitment, which ultimately affects neighboring fisheries.

Highly migratory species, in particular yellowfin, *(Thunnus albacares)*, Spanish mackerel (*Scomberomorus commersoni*), Indian mackerel, Pacific (or chub) mackerel (*Scomber japonicus*) and various shark species are most likely part of larger Indian Ocean stocks rather than separate, resident stocks. The future of the Region's fisheries are therefore influenced by the catch taken in other Indian Ocean countries which share the stock. A regional organization, the IOTC, serves to assist member states to better manage their shared tuna and tuna-like fish resources. Yemen and Somalia would benefit from closer involvement in the activities of this body. Yellowfin tuna and Spanish mackerel have formed the basis of long-established but small-scale tuna fishing operations in Yemen and north Somalia (in Somalia, tuna was until the outbreak of civil war the basic raw material for the now defunct canneries of Laas Qoray, Xabo and Qandala). Yellowfin and Spanish mackerel appearances in the coastal waters of the Gulf of Aden peak during spring (March to May) and autumn (September to November).

Although not migratory, the rock lobster (*Panulirus homarus*) also constitutes a shared resource by these three countries. The highly valuable rock lobster fisheries in each country operate in isolation of each other. There is no communication and

dialogue on joint management of rock lobster, even between close neighbors Yemen and Oman. The Omani rock lobster fishery suffered a dramatic decline during the 1970s and early 1980s due to unsustainable levels of fishing and ecologically unsound fishing practices (removal of egg-bearing females, removal of undersize specimens, use of immature females as 'teasers' in traps and the use of trammel/tangle nets). Yemen could benefit from closer dialogue with Oman that would help in management of this highly valuable resource. Somalia's rock lobster fishery is still reportedly healthy, since the civil war has disturbed the artisanal fishing sector for many years.

Major Spawning/Nursery Areas of Important Commercial Species

Due to the topography and geomorphology of the Red Sea (maximum depth over 2,000 meters) and the limited development of the continental shelf, coastal benthic communities are not extensive. They are restricted to mangrove areas, soft substrates of the shallow water bays and the coral reefs. These can be regarded as critical habitats, as they are often important spawning, nursery and feeding grounds for the majority of the important commercial species of the Red Sea.

Spawning sites provide the correct environmental conditions for reproduction. Many of these, such as day length, water temperature, lunar cycles etc. are not necessarily linked to particular sites, but others, such as substrate type (for burrowing and egg attachment), protection against predation etc. are site specific. Little is known about the precise and individual requirements of the commercial Red Sea fishes for spawning, nor the location and timing of such events. It is likely that sheltered, shallow lagoon areas behind reef flats (such as the marsas) are likely be important spawning and nursery areas. Nursery habitats, which are better known, are characterised by productive mangrove, seagrass and coral areas that provide shelter, abundant epifaunal grazing areas and stable substrates for settlement. It is understood that a number of previous studies have already provided some detail of the spawning and nursery grounds on the Egyptian Red Sea coast.

Data on the location of spawning grounds for major species in the Gulf of Aden is not readily available. In Yemen, the MSRRC has developed marine charts indicating the precise location of hard substrate shallow water areas where cuttlefish spawn. Unfortunately, these locations are well known to the industrial trawling fleet, who target the spawning aggregations, resulting in damage to egg masses and severe overfishing of the spawning stock biomass. This has been the major reason for collapse of this stock in past decades.

The northern coast of Somalia consists of massive rocky shorelines in the east and fairly exposed beaches in the west with no lagoons or large creeks that penetrate into the land to form favorable habitats for spawning. The Khor Xabo and Khor Butiyalo areas are the largest of several tidal beaches along the coastline. These and other smaller natural habitats form the primary/major spawning areas of the north Somalia coast. In general, except Khor Butiyalo, which is considered to be an important spawning area for penaeid shrimps, no other major spawning areas of either commercial or other aquatic animals are known. The sandy mostly unpopulated beach between Qandala and Buruc is also believed to be a nursery for marine turtles.

3

Fisheries Activities

Artisanal Fisheries

An overview of the numbers of fishermen, vessels, and principal gear types in the artisanal fisheries in the Region is given in Appendix B.

One of the problems facing national administrations in the Region in trying to collect accurate data on artisanal fisheries is the mobility of the fleet, with a large number of boats moving to different areas at different times depending on the weather, availability of fish and market outlets.

Jordan's short coastline (27 kilometers) has a very small artisanal fishery based at Aqaba. In 1999, around 230 fishermen were licensed, operating around 100 artisanal vessels. The gear and vessel characteristics are similar to those of Egypt. Target species include snappers, groupers and emperors. No stock assessment studies have been conducted in Jordanian waters.

In Egypt's artisanal fisheries, hand lines, longlines and to a lesser extent, gill- and trammel nets are employed. Most vessels are locally made of wood, 6-7 meters in length with petrol outboard motors (OBMs) of 8-20 horsepower. A fleet of larger artisanal vessels of 10-15 meters operate with 50-150 horsepower inboard diesels. Beach seining is also important. Fishing currently employs around 16,300 persons on the Egyptian Red Sea. Based on discussions with GAFRD, approximately 9,000 (53 percent) are predominately artisanal fishermen (using hook and line and set nets), 5,600 (33 percent) use trawling and 1,700 (10 percent) use purse seiners. On the other hand, based on the number of vessels in operation, GEF figures suggest that these may be substantial overestimates and must therefore be used with caution. Data from GAFRD, summarized in Table 1 below, indicate a slightly higher number of total artisanal and semi-artisanal fishermen. The majority of fishermen are active in the Suez region.

TABLE 1: FISHERMEN ACTIVE ON THE EGYPTIAN RED SEA COAST

Area	Suez	
Area	No.	%
No. fishermen	13,376	75
Suez	13,376	75
Ghardaqah	2,022	11
El Quseir	1,227	7
El Tour	831	5
Total	17,918	

Source: GAFRD

Results from GEF baseline fisheries reports show that fishing gear usage is characterised by the substrate type and depth. In the Gulf of Suez and Foul Bay trawling and purse seining are possible on the uniform sand substrate, while the coral-rich southern Red Sea means that hook and line fishing for demersals and reef-living pelagics such as jacks predominates, together

with shore based set nets, trammel and gill nets. Important species in the Egyptian artisanal catch include grouper, emperor and longspine bream in the Gulf of Suez and Ghardaqah.

Saudi Arabia's fisheries were exploited exclusively by artisanal sanbuks of up to 20 meters in length until the 1970s. Today, the artisanal fleet ranges from 5-18 meters and mainly uses hand lines, gill nets and traps. The Farasan Bank is among the main fishing grounds. Target species are grouper (family Serranidae), emperor (family Lethrinidae), snapper (family Lutjanidae) and sea bream (family Sparidae). In the south, ring nets are used to take Indian mackerel (*Rastrelliger kanagurta*) and troll lines are used to take pelagics such as Spanish mackerel (*Scomberomorus* sp.) (PERSGA, 1997j).

Eritrea's artisanal fishermen employ a wide variety of gear, including beach seines, hand lines, gill nets, trolling, and shark long-lines. Catches are dominated by small pelagics, such as goldspot herring (*Herklotsichthys punctata*) and anchovy (*Stolephorus heterolobus, Thrissina baelama*). Snappers and emperors are also taken (*Lutjanus* spp., *Lethrinus* spp.).

Sudan's Red Sea artisanal fleet is comprised exclusively of locally made wooden boats. Boatbuilding continues to be an important activity along the coast, especially near Suakin. Non-mechanized dug-out canoes, mechanized huris and sanbuks using OBMs and inboard diesels are used. Methods include hand lines, bottom-set and pelagic gill nets, surrounding nets, trolling, cast nets and traps. Handlining accounts for over 80 percent of catches. The most productive areas are the inner edges of the offshore reefs. Main species taken by the hand line fisheries include groupers, emperors, coral trout, snapper (especially *Lujanus bohar*). Pelagic species include Spanish mackerel, barracuda and jacks. Gill nets are employed to take rabbit fish (*Siganus rivulatus*), unicornfish (*Naso unicornis*), grey mullets, trevallies and wrasses (*Cheilinus undulatus*)

Hand diving for trochus shell or 'kokian' (*Tectus dentatus*), *Trochus virgatus* and black mother-of-pearl shell (*Pinctada margaritifera*) is also important for income generation in the coastal areas where lack of ice and other shore and road infrastructure constrains the marketing potential of fresh fish for the domestic market. Traditionally, the Suakin area has been the center of kokian fisheries, but production has recently shifted to Mohammed Gol and Dongonab Bay (Anon, 1988; Eltayeb 1999 (in prep.). The shells are collected by free diving from huris (4 meters long with sails), felukas (6-8 meters long with engines) and launches (8-12 meters long with engines). The season is generally May to December; it is dependent on the monsoon season rather than any legislative control.

A former ODA-funded project introduced the exploitation of sea cucumber (bêche-de-mer) along the Sudanese coast. Production was based on two species (*Holothuria* sp. and *Actinopyga* sp.). In 1981, 15 metric tons of dried sea cucumber were exported. Thereafter, production stopped because of low prices on export markets and collection difficulties in collecting. However, in the present situation where fish and kokian landings are in decline, sea cucumber exploitation has resumed in the Marsa Ashat area south of Suakin.

In Djibouti, the artisanal fleet comprises some ninety fishing boats. Most are small, open boats, 6-8 meters long and powered by OBM. Each boat operates with an average of three fishermen. Some 15 percent of the boats are equipped with inboard engines. They are 10-14 meters. long and carry an average of five fishermen per boat. The small boats undertake one day trips while the larger boats usually stay out for four days. The principle fishing areas are to the north and south of the Gulf of Tadjoura. The northern area is both most productive and least exploited, because of a lack of cold storage and other shore facilities and its distance from Djibouti City, the main population center.

Gear includes ring nets, hand lines, trolling, gill nets and cast nets. Species include snappers, jacks, Spanish mackerel, barracuda, grouper and tunas, especially skipjack (*Katsuwonus pelamis*) and little eastern tuna *(Euthynnus affinis*) Fishing operations vary seasonally, with most activity in May and the least in February. Many Djiboutian fishermen operate at the subsistence level and fishing effort is generally low. The main fishing gear used is hook and line and to a lesser extent gill nets and

throwing nets. Lobster fisheries are also important, with some 4 metric tons per year collected by hand by free diving.

In Yemen, artisanal fisheries are of considerable importance to rural communities for employment and also to the national food supply. In 1997 the estimated number of fishermen in the Gulf of Aden was 19,700 (Esseen, 1997b). Some 40 percent operate between Mukalla and Qusayir. Fishing is concentrated on the continental shelf, within 40 kilometers of shore. The number of artisanal vessels has more than doubled since 1992. Most boats have a crew of about three persons, but those employing surrounding nets have larger crews. A sanbuk has a crew of around ten. Small glass reinforced plastic (GRP) boats are normally owned by one of the three fishermen operating it but joint ownership by two or more fishermen is common. Non-fishing boat owners are rare. The vast majority of the boats used on the Gulf of Aden coast are 7-9 meters long, slender and shallow, and made of GRP. The traditional classification of wooden craft as huris and khadifas has lost its significance. Wooden boats are hardly used any longer and the GRP hulls are of hybrid designs. The boats are driven by OBMs of 15-40 horsepower, with fishermen increasingly preferring to use 40 horsepower motors. According to the agent of the dominant brand, Yamaha, 40 horsepower outboards account for 50 percent of total sales. Many boats carry two OBMs when fishing, often of different horsepower, keeping one in reserve in case of mechanical breakdown. All artisanal boats are engaged in single-day fishing only and nowhere along the coast do they carry ice onboard.

Fishing is conducted as far out as the drop-off, where oceanic species such as yellowfin tuna and billfish are targeted, perhaps 10-20 miles offshore. As is common in artisanal fisheries elsewhere in the Region, a variety of different fishing gear is used:

- The most common gear, used everywhere, is hook and line for catching large pelagic species and high value demersals. In the Mukalla-Shihr area, nearly all boats use trolling line and drop-line with live bait to catch yellowfin. Most of these boats have a small built-in water circulation tank for carrying live sardine as bait which are caught using cast nets.
- Along the eastern part of the coast, particularly from Sayhut eastwards, the dominant gear is surrounding nets and cast nets for sardine and wire mesh traps for rock lobster.
- In the rock lobster fishery, rock lobster boats owned by CFC each operate 30-50 traps, while the number of traps among the private fishermen is generally lower and varies considerably. The traps are usually emptied every 24 hours.
- Entangling drift nets for tuna, kingfish and carangids, and surrounding nets for Indian mackerel, little tuna and skipjack are most common along the western stretches of the south coast towards Aden. The size of a surrounding net is approximately 240x25 meters.

The Gulf of Aden fishing fleet also includes some 100 sanbuks, 15-20 meters in length, made of wood and driven by 40-75 horsepower inboard diesel engines. They are mainly located in Aden, Mukalla, al-Hami, al-Qarn and Qusayir. Most of them are engaged in shark fishing using nets and long-lines. Shark meat is salted onboard and the fins are removed and dried. The fishing trips last for 1-3 weeks depending on the catch rate. This fleet is supplemented, from March to October, by about 50 sanbuks from Socotra, operating mostly from Mukalla, Qusayir and Nishtun. In the Aden area, sanbuks use surrounding nets (500 x 60 meters) for small pelagics. Some sanbuks, possibly from the Red Sea, land iced fish at the dockyard market in Aden.

In the Socotra Archipelago, fishing is the main occupation for coastal inhabitants. Sharks are targeted using long-lines, gill nets, and hook and line techniques. The annual production of sharks is estimated at 7,283 metric tons, and average CPUE is estimated at 54 kilograms per boat and day. It is estimated that the boats fish for shark 160 days of the year (Saeed, 1999). The predominant species are *Carcharhinus albimarginatus*, *Carcharhinus sorrah* and *Sphyrna lewini*. In the catches at landing sites along the southern coast of Socotra Island (the Nogid area), species such as *Carcharhinus melanopterus*, *Carcharhinus sealei* and *Galeoc-*

erdo cuvier have been identified. Catches of the blackspot shark (*Carcharhinus sealei*) reached 3,000 fishes, or 7.5 metric tons per day in May 1999. During the monsoon season, fishing decreases due to the high wind speeds and wave swells. Fishing effort is also limited by the lack of marketing paths for all products except for dried shark fins and limited amounts of shark meat. A lack of fisheries services, in terms of availability of fishing gear and of maintenance workshops for outboard engines and GRP boats, additionally limits any increase of fishing effort.

On Yemen's Red Sea coast, at least 16,000 fishermen are working in boats that are traditionally classified in two types, huris and sanbuks:

- The huri was originally a small, slender shallow craft for inshore use. Today, larger huris are built and used for offshore fishing. They are therefore found in a wide range of sizes from 5 meters to 20 meters. What they have in common is that they are all powered by OBMs. Larger huris are still being built of wood but most of the smaller ones are now made of GRP. The smallest craft have one OBM of 15 horsepower while the larger ones have up to two 75 horsepower motors. The number of huris is estimated to be about 1,610.
- The sanbuk is a large traditional Arabian-style wooden craft varying in length from 12 to 26 meters. They are powered by inboard diesel engines in the range of 40-150 horsepower. It is estimated that there are about 620 of them.

From the point of view of measuring the fishing effort, the above classification is not particularly appropriate. The reason is that the larger huris have an operational pattern similar to sanbuks, that is, they carry ice and stay out fishing for several days at a time. The fishing effort may therefore better be divided into single-day huris and multi-day huris. A third category comprises sanbuks trawling for shrimp.

Most of the huris, perhaps 80 percent, are 5-9 meters long and are engaged in single-day fishing. They do not carry ice onboard to preserve the catch. The most common fishing gear includes (a) drift nets of different mesh sizes, mainly used for kingfish and Indian mackerel but also for species such as barracuda and tuna and (b) hand lines for different types of demersal species. Other gear used includes trolling line for large pelagic species and cast nets for catching baitfish and smaller pelagics. Single-day huris usually carry a crew of 2 to 4 persons. Their fishing areas are generally close to shore, within a range of about 20 nautical miles. Small huris are spread along the entire coast and can be seen anchored, or lying on the beach, at all fishing centers. However, their operation is restricted during the winter season, October to December. The sea is then too rough to allow the boats to be launched and landed on the open beaches.

An unknown number of large huris, but probably in the range of 200-400, have built-in insulated fish holds enabling them to carry ice and therefore engage in multi-day fishing. The capacity of the fish hold varies with boat size, but the largest can carry up to 2.5 tons of iced fish. The duration of a fishing trip is about a week. These craft target both pelagic and demersal species and employ a variety of gear such as drift nets and trolling lines for large pelagic fish, long-lines for shark and, very importantly, hand lines for demersal fish. All gear is handled manually and there is a large crew for this consisting of about 10 fishermen. The multi-day huris are operated around the year, with a peak season of May to September. They are operated primarily from al-Hudaydah and other major landing centers. Their range of operation is the entire EEZ of Yemen and beyond. The number of trips in a year is probably around 35, which is the equivalent of 245 fishing days. Fishing intensity is lower during the period from October to December.

Sanbuks are engaged in fishing operations similar to those of the larger huris. The sanbuks differ from the multi-day huris with regard to capacity, size of crew and duration of fishing trips. The capacity of the fish hold is about 5 tons of iced fish. They carry larger quantities of fishing gear and they have a crew of about 15 men. The duration of fishing trips is about 10 days but may be extended up to two weeks. They make about 25 trips per year.

A national vessel registration scheme seems to be working well in Yemen. At al-Hudaydah on the Red Sea, approximately 95 percent of boats in

1997 had a registration number painted on the bows. In other areas the registration scheme did not appear as successful, although one report said that the vessels were registered, but the numbers had been obscured when the boats were repainted.

During the period from September to April, about 120 sanbuks trawl for shrimp. Two small otter trawls are generally used, one on each side of the boats, towed from a wooden beam lashed on the hull and projecting outboard on either side. The nets are hand-hauled by a crew of 8-10 fishermen. The trawling is done during the day from dawn to dusk but it is reported that some boats have recently started to operate during the night also. Trawling is usually conducted in shallow waters of 5-10 meters depth but may extend to 20 meters. Most of the bycatch is discarded at sea and only the larger fishes are brought ashore for sale or for consumption by the crew. The main areas from which these sanbuks operate are al-Hudaydah, Khobah and Salif. The main landing center is al-Hudaydah, to which catches are trucked from other places for auctioning. Considerable effort is expended outside of Yemen's recognized waters, especially in Eritrean waters.

In Somalia, artisanal fisheries have a long tradition and are a major economic activity on which the bulk of coastal communities depend. Main fisheries centers are Alula, Qandala, Bosaso, Laas Qoray, Berbera, Lughaye and Zeila. Though under-developed today, they are essential for a large proportion of the coastal inhabitants, although fishing is considered inferior to farming and clerical employment. Eight thousand fishermen are employed either full or part-time on 6-8 meters GRP vessels, usually powered by 8-22 horsepower inboards. Some traditional wooden vessels and fiberglass canoes are also seen. The predominant gear is nylon shark nets. Hand Lines, long-lines (again for shark fishing and other large pelagics) gill nets, trolling and traps also used. Traditional artisanal tuna fishing has been practiced for many years, for local consumption and also production of dried tuna for export to Arab states. The fisheries for many years supplied raw material (mostly yellowfin and skipjack) to canneries at Alula, Qandala and Xabo, until the civil disturbances destroyed these facilities. Other important pelagic species include longtail tuna (*Thunnus tonggol*), little eastern tuna, Spanish mackerel and sharks. Night fishing with lights for small pelagics targets sardinellas, round herring, scad and horse mackerel. Demersal species are caught mainly on inshore grounds around Xabo and Qandala. The catch is dominated by species of grouper, snapper, emperor and shark. Shark fishing is of major importance; with salt-drying of meat and dried shark fins providing significant income for artisanal fishermen.

Commercial/Industrial Fisheries

An overview of the numbers of fishermen, vessels, and principal gear types in the industrial fisheries in the Region is given in Appendix C.

Egypt has an industrial fleet comprised of 20-30 meter vessels, based on the Mediterranean style of fishing craft. These utilize heavier gear such as purse seines, trawls and hand lines. Ice is taken to sea. Pelagic species are landed by purse seiners, trawlers, and artisanal vessels. Catches are taken mostly by purse seining. All fishing grounds are either fully exploited or overfished, especially in the Gulf of Suez. Major pelagic stocks include horse mackerel, round herring, Indian mackerel and sardines. Demersal species supporting trawl fisheries include shrimp, golden snapper, striped snapper, lizardfish, red mullet and threadfin bream (Barrania, 1997). With the exception of seasonal sardine catches in the north, Egypt's Red Sea fisheries are dominated by reef fish landings, mostly the high value grouper (Serranidae) and emperor (Lethrinidae). There is a marked differentiation in catches down the coast, due primarily to different habitats, but also different gear usage and market demands. A brief analysis of fish landings from 1978 to date in Ghardaqah suggests that overall catches have increased almost twenty-fold. However the proportion of high value reef species (such as the emperors) has fallen, possibly as a result of habitat degradation or over-exploitation.

Saudi Arabia's industrial fisheries commenced after 1980 and have grown consistently. The fisheries are dominated by the Saudi Fisheries Company (SFC), which lands around 1,500 metric tons of shrimp and around 1,500 metric tons of finfish, from both the Red Sea and Gulf coasts. The inner passage trawl ground of Farasan Bank and the area

around Jizan are important trawling areas. Red Sea industrial production in 1995 was estimated at around 7,400 metric tons (4,800 metric tons finfish, 2,100 metric tons shrimps, 260 metric tons crab and 250 metric tons molluscs). Saudi Arabia's Red Sea industrial fleet comprises vessels of 12-20 meters, using trawls almost exclusively in the south part of the country to target shrimp primarily and also lizardfish, emperor and Indian mackerel.

In Eritrea, inshore trawl grounds exist in Hargigo Bay. Offshore trawl grounds are located between Massawa and Assab. Although a trawling fleet operated during the 1960s, targeting lizardfish, threadfin bream, and penaeid shrimps, there are no national industrial fisheries today.

Sudan's industrial fisheries are currently underdeveloped. There are some 800 square kilometers of trawlable grounds off the southern coast of Sudan, mainly in the Tokar Delta and Gulf of Aqiq areas. In the early 1990s an industrial fleet of trawlers operated under Egyptian-Sudan joint venture arrangements. Lizardfish (family Synodontidae) accounted for 75 percent of the catch. Shrimp and cuttlefish were also caught. Six shrimp species of potential commercial importance have been recorded: *Penaeus semisulcatus*, *P.latisulcatus*, *P.japonicus, P.monodon* and *Metapeneus monocerus* and *M. stebbingi*. The projected annual shrimp catch has been calculated at 30 metric tons. However most joint venture trawlers have ceased operations because shrimp catches, the major target group, were considered too low. Only Egyptian trawlers have remained in the area fishing for lizardfish for the Egyptian market.

There is however commercial potential for purse seine fisheries. Fishing grounds are mainly in the northern areas, including Foul Bay near the border with Egypt. A present day fleet of purse seiners, 13-30 meters in length, targets pelagic fish. Five fishing companies, including a semi-public one, are currently operating as fish traders. They lack experience in fisheries operations and their contribution to developing Sudan's national fishing capacity has been slow to deliver results. An improvement in fishing methods and management style is required in order to raise catch rates. Most fishing companies, however, hire local artisanal fishermen with minimum investment. In some cases, such as in Mohammed Gol, they monopolize the market, benefiting from their 'zero competition' status. Most fish landed is exported. 'Najil' (*Plectropomus maculatus*) is a key export market species (Anon, 1993).

Djibouti has no domestic industrial fleet, owing to the lack of shelf area that would permit trawling or other industrial operations.

In Yemen, the structure of the industrial fisheries as of 1998 consisted of: (a) companies operating 78 industrial vessels in the Red Sea and 65 in the Gulf of Aden; mainly freezer trawlers targeting demersal fish, cuttlefish and shrimps; and (b) a nationally-owned body, the CFC, which fishes for rock lobsters along the south coast.

In Somalia, the continental shelf is rarely more than 5 kilometers wide. Thus trawling areas are very limited and a domestic industrial fishing has not developed. However, foreign vessels operating under licence off the northern coast prior to 1990 reported high catch rates of tuna, demersals and cuttlefish. Between 1982 and 1985 catches of foreign industrial vessels are recorded as 3,900-11,940 metric tons. No significant industrial domestic fisheries operated during 1990-1998, other than foreign vessels operating under access arrangements.

Statistics on Catches and Landings Since 1988

Data Held by FAO

Official production figures for landings of finfish and invertebrates for 1988-1998, as compiled by the relevant national authorities and forwarded to FAO for inclusion in the FAO world fisheries statistics database (FAO, 2000), are given in Appendix D. These data are considered to be the best available for indicating major species caught and trends in production over time. National catch statistics, where available, are discussed below. It should be noted however that in some cases FAO database figures differ from estimates provided by national experts. Also, the FAO data for Saudi Arabia includes catches taken in the Gulf and data for Somalia include catches taken from the Indian Ocean (southern) coast.

The data in Appendix D are summarized in Tables 2 and 3 below for all countries, showing total

TABLE 2: FAO DATA ON CATCH (MT) OF INVERTEBRATES BY COUNTRY, 1988 AND 1998

Country	1988	% of total	1998	% of total
Jordan (Red Sea)	0	0%	0	0%
Egypt (Red Sea)	532	7%	822	5%
Saudi Arabia (Red Sea)	2,658	33%	5,513	32%
Sudan (Red Sea)	-	0%	13	0%
Eritrea	-	0%	238	1%
Djibouti	8	0%	-	0%
Yemen	3,526	44%	9,560	56%
Somalia	1,227	15%	950	6%
PERSGA Region and Eritrea	7,951	100%	17,096	100%

Source: FAO statistics. The FAO statistics for Saudi Arabia have been divided by 2, since roughly half the catch was taken in the Gulf.

TABLE 3: FAO DATA ON CATCH (MT) OF FINFISH BY COUNTRY, 1988 AND 1998

Country	1988	% of total	1998	% of total
Jordan (Red Sea)	2	0%	120	0%
Egypt (Red Sea)	27,918	21%	50,538	26%
Saudi Arabia (Red Sea)	20,209	15%	21,574	11%
Sudan (Red Sea)	1,200	1%	5,500	3%
Eritrea	-	0%	1,562	1%
Djibouti	446	0%	350	0%
Yemen	69,630	51%	100,400	52%
Somalia	16,500	12%	14,800	8%
PERSGA Region and Eritrea	135,904	100%	194,844	100%

Source: FAO statistics. The FAO statistics for Saudi Arabia have been divided by 2, since roughly half the catch was taken in the Gulf.

recorded catch according to FAO for 1988, compared with 1998, first for invertebrate catches and second for finfish catches.

Of the total invertebrate catch for the Region, Saudi Arabia and Yemen together accounted for over 70 percent of landings in 1998. In the case of Saudi Arabia, this is due to the domestic shrimp fishery. In the case of Yemen, this is due to landings of cuttlefish.

With regard to finfish landings, Egypt, Saudi Arabia and Yemen together accounted for 89 percent of landings in 1998. Yemen's finfish landings alone account for nearly half of the regional total. These three countries therefore have the most active fisheries sectors in the Region.

Species contribution of the catch in 1998 for each country based on FAO data is summarized in Table 4, overleaf.

DATA FROM NATIONAL CORRESPONDENTS

The FAO data conforms reasonably well with information provided by the SAP regional working group on living marine resources. This is summarized in Table 5 below.

TABLE 5: SUMMARY OF NATIONAL MARINE CATCH DATA FOR 1998 (MT)

	Production	% of total
Jordan (Red Sea)	450	0%
Egypt (Red Sea)	58,000	26%
Saudi Arabia (Red Sea)	26,000	12%
Sudan (Red Sea)	1,500	1%
Djibouti	446	0%
Yemen	128,600	59%
Somalia	4,000	2%
PERSGA Region	218,996	100%

Source: Living Marine Resources Regional Working Group: Workshop on standardisation of fisheries data, held at the Fisheries Training Institute, Aden, Yemen, 29 April-2 May, 2000. Data for Somalia is an estimate for production in the Gulf of Aden only

In Jordan, collection of fisheries statistics ceased in 1985 due to the closure of access to fishing grounds in neighboring Egypt and Saudi Arabia, which resulted in a sharp decline in the size of Jordan's artisanal fisheries. Available production figures come from university researchers. Production in 1999 was estimated at around 450 metric tons, mostly comprising various tuna and small shoaling pelagics (*Decapterus macarellus*, *Scomber japonicus*, *Trachurus* sp.) and Spanish mackerel (Khalaf, 2000). Fish production in 1998 was estimated at 120 metric tons. Available data indicate catches are increasing, although modestly. In 1966 total catch was recorded at 194 metric tons.

TABLE 4: FAO CATCH DATA BY SPECIES (MT) IN 1998

Species/group	Jordan	Egypt	S. Arabia	Sudan	Djibouti	Yemen	Somalia	Eritrea	Total	% of total catch
Pelagics:										
Horse mackerel	-	-	-	-	-	1,400.0	-	-	1,400.0	0.59
Indian mackerel	-	652.0	2,078.0	-	-	4,350.0	-	0.3	7,080.3	2.96
Indian oil sardine	-	-		-	-	4,200.0	-	-	4,200.0	1.76
Pacific/chub mackerel	-	810.0	-	-	-	-	-	-	810.0	0.34
Sardinella	-	4,973.0	2,329.0	-	-	-	-	-	7,302.0	3.06
Shark	-	135.0	1,531.0	-	-	4,970.5	-	17.0	6,653.5	2.79
Spanish mackerel	-	9,933.0		-	-	-	-	22.0	9,955.0	4.17
Tuna - yellowfin	-	-		-	-	820.0	-	-	820.0	0.34
Tunas - misc.	70.0	841.0	633.0	-	15.0	3,521.0	-	115.0	5,195.0	2.17
Other pelagics	20.0	-	8,234.0	-	40.5	63,010.0	-	247.5	71,552.0	29.95
Demersals:										
Emperor	2.0	557.0	9,751.0	-	-	2,490.0	-	104.0	12,904.0	5.40
Grouper	-	722.0		-	105.0	1,770.0	-	117.0	2,714.0	1.14
Lizardfish	-	7,994.0	215.0	-	-		-	0.5	8,209.5	3.44
Seabass	-	36.0		-	-		-	-	36.0	0.02
Seabream	-	1,282.0	3,101.0	-	-	2,550.0	-	1.0	6,934.0	2.90
Seerfish	-	-	5,491.0	-	60.0	510.0	-	-	6,061.0	2.54
Snapper/jobfish	-	8,784.0	2,391.0	-	80.0	1,490.0	-	363.0	13,108.0	5.49
Other demersals	25.0	1,002.0	6,578.0	-	40.5	9,360.0	-	206.5	17,212.0	7.20
Unidentified mar. fish	3.0	12,797.0	817.0	5,500.0	10.0		14,800.0	212.0	34,139.0	14.29
Invertebrates:										
Crab	-	149.0	448.0	-	-	-	-	-	597.0	0.25
Cuttlefish	-	237.0	1,561.0	-	-	8,440.0	550.0	3.0	10,791.0	4.52
Octopus	-	-	0.5	-	-	-	-	-	0.5	0.00
Pearl oyster	-	-	-	13.0	-	-	-	-	13.0	0.01
Rock lobster	-	-	701.0	-	0.5	470.0	400.0	2.0	1,573.5	0.66
Sea cucumber	-	-	-	-	-	60.0	-	-	60.0	0.03
Shrimp	-	436.0	8,316.0	-	-	590.0	-	9.0	9,351.0	3.91
Squid	-	-	-	-	0.5	-	-	0.5	1.0	0.00
Trochus	-	-	-	-	-	-	-	224.0	224.0	0.09
Total	**120.0**	**51,340.0**	**54,175.5**	**5,513.0**	**352.0**	**110,001.5**	**15,750.0**	**1,644.3**	**238,896.3**	

Source: Derived from FAO's FISHSTAT database. Data for Saudi Arabia includes catches taken in the Gulf, accounting for around 50 percent of Saudi Arabia's total production. Data for Somalia includes catches from the Indian Ocean coast. Data for Sudan are incomplete in regard to trochus and pearl shell production.

Catch statistics for Egypt's Red Sea fleets indicate that between 1989 and 1995 annual purse seine landings have been about 34,600 metric tons. The majority of purse seine catches are taken in the Gulf of Suez, where the main species include horse mackerel/scad (*Decapturus marudsi, Trachurus indicus*), round herring (*Etrumeus teres*), sardinellas (*Sardinella gibbosa*). In Foul Bay, purse seiners take mainly spotted sardinella (*Sardinella sirm*), Indian mackerel (*Rastrelliger kanagurta*), gold-stripe sardinella (*Sardinella gibbosa*) and horse mackerel/scad. Trawling vessels, operating mostly around the Gulf of Suez, take around 10,000 metric tons. Main species taken by trawling include lizardfish (*Saurida undosquamis*), stripped snapper (*Lutjanus lineolatus*), threadfin

bream (*Nemipterus japonicus*) and shrimp (*Penaeus semisulcatus, P. latisulcatus, P. japonicus*). Artisanal catches between 1989 and 1995 were about 4,900 metric tons per year on average. Groupers dominated, representing 35-40 percent of landings, and comprised mostly of *Epinephelus chlorostigma*, *E. areolatus* and *E. summana*. The spangled emperor *Lethrinus nebulosus* is responsible for up to 22 percent of catches. Breams were also important (*Argyrops spinifer, Erynnis cardinalis, Sparus major*). Total landings in 1995 were 47,257 metric tons with 88 percent landed in Suez that is, 41,594 metric tons while Quseir had the least, only 0.6 percent (278 metric tons). Another 3985 metric tons, or 8 percent, were landed in Ghardaqah.

Barrania (1997) provides the following catch statistics for Egypt's Red Sea fleet (Table 6):

TABLE 6: EGYPTIAN RED SEA CATCHES (MT), 1998-1995

Year	Total Marine Catch
1988	42,000
1989	44,000
1990	39,900
1991	42,000
1992	43,000
1993	51,000
1994	48,300
1995	47,300

Source: Barrania, 1997.

The Red Sea marine catch in 1995, valued at EGP 161.3 million, was approximately 11.6 percent of the 407,000 ton fisheries production for that year including aquaculture, Nile, Mediterranean, northern lakes and inland fisheries. As noted above, the majority came from Gulf of Suez based vessels, with only 4,632 metric tons or 9.8 percent of the total marine catch from the Red Sea proper. It should be noted that much of the Suez-landed trawler catch is likely to have been from outside Egyptian waters. Ghardaqah is the main landing center, with a 1996 landed catch of 5,865 metric tons (GAFRD, unpublished figures), although GEF estimates suggest that this may be overly optimistic, with the actual figure as low as 1,618 metric tons. Catches over the past five years have been relatively steady, with any inter-annual variation due mainly to fluctuating small pelagic catches. This continuity is puzzling, since by 1995 vessel numbers had declined to 76 percent of the 1990 number, although average horsepower had more than doubled from 75 to 160 horsepower over the same period. Such a change in fishing patterns, designed to increase access to the southern Red Sea, is likely to have changed the landing volume and structure. This has not been reflected in the GAFRD data. Total production for 1998 was around 58,000 metric tons (Barrania, 2000).

Saudi Arabia has one of the best data sets on fish production in the Region. Table 7 below summarizes artisanal and industrial production between 1988 and 1997.

TABLE 7: SAUDI ARABIA RED SEA FISH PRODUCTION (MT) 1988-1997

Year	Artisanal Fisheries	Industrial Fisheries
1988	26,918	4,131
1989	27,345	5,303
1990	24,601	4,674
1991	24,626	5,656
1992	25,458	6,045
1993	27,272	5,939
1994	26,585	6,874
1995	15,490	7,399
1996	15,406	7,131
1997	17,420	8,405

Source: MAW, 1998.

Saudi Arabia's landings from Red Sea waters in 1995 amounted to around 22,500 metric tons representing 50 percent of the total national production of 45,692 metric tons (including catches taken in the Gulf), of which 15,490 metric tons were from the artisanal fisheries targeting finfish. The industrial fleet caught 7,399 metric tons from Red Sea waters in 1995, including 4,788 metric tons of finfish, 2,105 metric tons of shrimp, 256 metric tons of crab and 250 metric tons of molluscs (PERSGA 1997e).

Although Saudi Arabia has some of the best fisheries data in the Region, the statistics show anomalies between various sources, indicating a need for greater standardization in the type of data collected and the format in which it is collected. A significant problem is that the statistics historically have been aggregated for both the Red Sea and the Gulf fisheries. It appears however that since 1998 separate fisheries statistics are maintained for the Red Sea and Gulf coasts. Various studies discuss data issues in relation to the development of appropriate strategies for fisheries management (Sanders and Morgan 1989; MAW 1987, 1996; Kedidi and others, 1984 and Peacock and Alam 1980). It is however recognized that a reliable long-term series of catch and effort, required for specific management decisions, is not available at present. Table 8 below presents recent data on the species composition of Red Sea landings in Saudi Arabia.

TABLE 8: SPECIES COMPOSITION OF SAUDI ARABIAN RED SEA LANDINGS IN 1985 AND 1995

Species	% of total landings:	
	1985	**1995**
Spanish mackerel	30.4	16.2
Jack	12.0	10.7
Cutlass fish	3.0	2.1
Cobia	0.1	0.1
Indian mackerel	3.0	15.1
Emperor	13.9	12.4
Grouper	13.0	10.6
Snapper	8.0	4.9
Barracuda	7.0	3.9
Miscellaneous	4.4	10.5
Shark	2.0	1.8
Mullet	2.0	1.9
Parrotfish	1.0	3.0
Wrass	0.1	0.8
Sea bream	0.03	1.2
Surgeon fish	0.02	0.6
Rabbit fish	0.02	4.0
Goat fish	0.01	0.2

*Source: MAW 1986; MAW 1996. Species in **bold face** are pelagic species that migrate across national boundaries.*

Since the Gulf War, Saudi Arabia's Red Sea fisheries have become more important than Gulf fisheries, which now account for around only 46 percent of national catches. The Ministry of Agriculture's figures for catches in 1997 indicate production from the Red Sea, the Gulf and international waters at 25,825 metric tons, 22,875 metric tons and 695 metric tons, respectively (MAW, 1998).

In Sudan artisanal catches decreased from 1,107.8 metric tons in 1989 to 1,047 metric tons in 1995. According to Sudan's Fisheries Administration, the estimated MSY of artisanal fisheries amounts to 10,000 metric tons per year. In 1975 artisanal production was estimated at around 555 metric tons, this rose to 1,490 in 1984 but dropped to 1,050 metric tons in 1995 (O'Riordan, 1982; Mishrigi, 1990-93; 1993). Reasons given for this include the termination of FAO and ODA funded development projects that the national government has been unable to continue, increased production costs (especially for fuel, ice, and gear), reduced availability of spare parts, and a lack of available credit on affordable terms.

Production figures for the kokian fishery are not available but average exports for 1980-1997 indicate a reduced amount of 289 metric tons/year. This still means that Sudan is the third largest producer of trochus shells, behind the Solomon Islands at 578 metric tons/year and New Caledonia at 349 metric tons/year over the same period. Sudan is however by far the largest producer of trochus outside the Pacific Ocean (Eltayeb, 1999 – in prep.). Pearl oyster, *Pinctada margaritifera,* and ornamental seashells or 'surumbak' (mainly *Strombus* and *Lambia* species) are also produced. Recent production data are given in Table 9 below.

The industrial trawler fleet in 1990-1991 caught 597 metric tons in and in 199-19/93 eight trawlers caught 654 metric tons, of which only 15 metric tons were shrimp and the remaining quantity represented discarded fish. In 1990 eighteen companies were licensed to catch shrimp as the target species. Few of them have actually operated and the catch in 1993-1994 was only 79 metric tons of which only 800 kilograms were shrimp (PERSGA 1997a).

TABLE 9: PRODUCTION OF SUDANESE MARINE PRODUCTS, 1992-1998 (MT)

Year	Commercial fishes	Pearl oyster shell	Trochus shell	Sea cucumber	Shark fin
1992	1,100	13	485		
1993	1,235	23	305		
1994	1,120	14	534		
1995	1,047	13	432		
1996	1,762	3	190	2.7	0.32
1997	1,676	6	275	3.5	0.11
1998	1,421	5	54	8.8	0.50

Source: Farah, 2000. 1998 data are preliminary.

The present annual landings of the purse seine fleet amount to some 1,400 metric tons and the MSY is estimated at 2,300 metric tons. Catches are mainly composed of spotted sardinella (50.8 percent), Indian mackerel (18.5 percent), gold striped sardinella (12.9 percent), horse mackerel and scads (12.9 percent) (Brandford 1979; Feidi 1981; Sanders and Kedidi, 1981).

In Djibouti, national artisanal fisheries production increased from 200 metric tons in 1980 to 400 metric tons in 1984 and 446 metric tons in 1988. Between 1988 and 1991 the increase in production slowed down. Weak marketing of fisheries products is the main constraint for the fisheries sector. During 1991-1994, production decreased dramatically. In 1991, it was as low as 200 metric tons, due to unrest in the

TABLE 10: TOTAL FISH PRODUCTION (MT) IN YEMEN, RED SEA AND GULF OF ADEN COASTS, 1995-1997

1995	No. vessels	Pelagic fishes	Demersal fishes	Cuttlefish	Squid	Shrimp	Rock lobster	Total catch
Artisanal sector								
CFC	n.a.	100	-	-	-	-	123	223
Cooperative and private fishermen	n.a.	100,224	-	-	-	981	205	101,410
Industrial sector	16	-	4,871	1,049	408	3	6	6,337
Total 1995	16	100,324	4,871	1,049	408	984	334	107,970
1996								
Artisanal sector								
CFC	n.a.	-	-	-	-	-	60	60
Cooperative and private fishermen	n.a.	94,060	-	-	-	665	263	94,988
Industrial sector	32	-	8,023	1,817	67	-	-	9,907
Total 1996	32	94,060	8,023	1,817	67	665	323	104,955
1997								
Artisanal sector								
CFC	n.a.	-	-	-	-	-	85	85
Cooperative and private fishermen	n.a.	93,547	-	150	-	593	397	94,687
Industrial sector	n.a.	-	12,367	8,415	92	8	-	20,882
Total 1997	n.a.	93,547	12,367	8,565	92	601	482	115,654

Source: Ministry of Fish Wealth, Sana'a, 2000.

north of the country. Monthly production is highest in May, June and September. The annual MSY for Djibouti's waters has been calculated at 15,000 metric tons although 10,000 metric tons of this may constitute low value species such as ponyfish (family Leiognathidae) and triggerfish (family Balistidae). Catches of large pelagics are low, for example production of tuna was only 13.4 metric tons in 1994 and 10.8 metric tons in 1995. Barracuda landings were 21.9 metric tons and 18 metric tons in 1994 and 1995, respectively.

Available statistics for fisheries production in Yemen for the Red Sea and Gulf of Aden coasts between 1995 and 1997 are summarized in Table 10 above.

According to official statistics, Yemen's artisanal fleet has accounted for landings in excess of 90,000 metric tons since 1995, comprised mostly of pelagic species. This perceived increase over 1994 statistics is probably due to the effect of the civil war in 1994 on fishing activities.

According to FAO, Yemen's industrial and artisanal fleets landed 100,400 metric tons in 1998, which tallies well with the trend in catches indicated above. This accounts for some 46 percent of the Region's finfish landings, and is double the next largest producer of finfish in the Region, Egypt. Adding to a 1998 production of invertebrates of around 9,560 metric tons (mostly cuttlefish from the Gulf of Aden) and equal to 42 percent of the Region's total, Yemen is the dominant fishing country in the Region.

Since 1998, statistics have been collated by the Yemeni Ministry of Fish Wealth that separate Red Sea and Gulf of Aden production, as indicated in Table 11 below.

However it must be noted that Yemen's fisheries statistics are unreliable because of serious shortcomings in the system of data collection and processing. Landed fish are rarely weighed anywhere in Yemen; nearly all landed figures are therefore estimates made by eye only. This has been the case since at least 1990 when state control of landing centers diminished.

Although production records from cooperatives are available, these records represent only a portion of the total fish landed by artisanal fishermen. Landings take place elsewhere, outside the jurisdiction of the cooperatives, especially when fishermen are migrating along the coast over the course of the season. Even when landed at cooperative or market sites, the quantity sold is often underreported to avoid or reduce marketing charges. The portion accurately recorded varies from one area to another.

Production records for rock lobster are considered reliable. This is because of the high unit value and the fact that CFC has a monopoly on the purchase and export of the lobster. CFC weighs the lobster tails bought and maintains accurate records. Production in 1998 was 828 metric tons (assumed tail weight) with about equal quantities coming from the Sayhut/Qishn area and processed in Mukalla and from the al-Gaida area processed in Dabut.

TABLE 11: TOTAL FISH PRODUCTION (MT) IN YEMEN, RED SEA AND GULF OF ADEN COASTS (1998)

	No. vessels	Fish	Cuttle-fish	Squid	Shrimp	Rock lobster	Deep Sea lobster	Crabs	Total catch
Artisanal sector									
CFC	n.a.	-	82	-	-	194	-	-	276
Cooperative and private fishermen	8.030	103,681	-	-	600	634	-	-	104,915
Industrial sector (Gulf of Aden)	65	12,271	3,853	1,134	37	-	17	-	17,312
Industrial sector (Red Sea)	78	4,781	23	-	303	-	-	9	5,116
Total	**8,173**	**120,733**	**3,958**	**1,134**	**940**	**828**	**17**	**9**	**127,619**

Source: Ministry of Fish Wealth, Sana'a, 2000.

The level of production has been maintained in recent years by taking undersized and egg-bearing females and also by illegal fishing out of season. This is a major concern for the future of the fishery. The lobster fishery is closed June to September and the most productive period is October to December.

Since 1992 sharks have become the most important group in terms of volume landed. Prior to that, the highest landings were recorded for Indian mackerel, with 7,300 metric tons recorded in 1991. Landings of all other groups fluctuated during the 1990s. Spanish mackerel is the most important finfish species in terms of value. Landings of this species are apparently nearly twice as valuable as shrimp according to available records. The same is true for emperor production. The value of shark landings is also great due to the high price paid for fins and dried meat. The prime target for industrial trawlers in the Gulf of Aden is cuttlefish. Of secondary importance are the various species of demersal fish such as bream, emperor, grouper, snapper, barracuda and ribbonfish. Landings of cuttlefish in 1998 were about 3,800 metric tons, with a total ex-vessel value of 15.2 million).

In Somalia artisanal catches were between 4,070 and 7,720 metric tons from 1982 to 1985. Detailed statistics have not been available since 1988. FAO statistics do not split the catches between the northern coast and the eastern Indian Ocean coast. Catches off the northern coast are currently estimated at between 2,000 and 4,000 metric tons (Ministry of Fisheries and Coastal Development, 2000). Catches have declined since civil strife erupted in the early 1990s. Between 1990 and 1996, catches off the northern coast were probably around 1,500 metric tons (excluding sharks). Best estimates indicate that shark landings in north Somalia accounted for 35-40 percent of total marine fish production between 1990 and 1997. Nearshore demersal fish stocks off the northern coast are likely to be relatively under-exploited. Landings between 1988 and 1998 appear to be small and well within the sustainable yield potential of available stocks.

4

Post-Harvest Activities

Landing Sites, Onshore Facilities, Processing and Marketing

A summary of landing sites and shore facilities is given in Appendix E.

Jordan's small fleet of artisanal vessels land their fish un-iced at a single fish landing center, Sidra, near the town of Aqaba. Fish are sold immediately to merchants, hotels and restaurants in Aqaba. There are no facilities such as ice machines, cold storage etc. available. Four or five fish retail shops are located nearby where fish is sold fresh.

In Egypt, the industrial fleet's landings are made mainly at three major ports on the Egyptian Red Sea coast: Ataka Port in Suez (88 percent of recorded landings in 1997), Sakala Port (Ghardaqah (8 percent) and the fishing port at Quseir. Important landing sites for artisanal fishermen include Port Tawfik in Suez, al-Dahar (Ghardaqah), Halaib, At Tur (Gulf of Suez) and Dahab in the Gulf of Aqaba. Egypt's main port, Ataka, is the largest fishing port on the Red Sea and is home to most of Egypt's trawlers, purse seiners and long-liners. The 700 meter quay is protected by a breakwater and can accommodate up to 30 vessels at a time. Ice producing capacity is 80 metric tons/day. Sakala Port is protected in a bay, has a 100 meters quay and also serves the Navy as well as fishing vessels. The only shore facility is a fuel store. Quseir port has a quay for fishing vessels, but no other facilities apart from a slipway. Other landing sites are simply beaching sites with no onshore facilities. Ice facilities are centerd at Suez, Ghardaqah, Safaga, Quseir and Shalateen.

Port Sudan is the main center for fish consumption in Sudan. Other important landing sites include Dongonab Bay, Abu Hashish (close to Port Sudan), Mohammed Gol (160 kilometers north of Port Sudan), Arakikyai, Suakin (60 kilometers south of Port Sudan) Heidob and Sheik Ibrahim. Currently at Port Sudan, the Marine Fisheries Department owns one operating ice plant with a capacity of 6 metric tons/day, while the private sector operates four ice plants with a maximum capacity of 300 metric tons/day. The present production of the four plants is only 100 metric tons/day. A large privately owned cold storage plant with 2,000 tons holding capacity is also located at Port Sudan. However, ice is almost always in short supply because of frequent water shortages, electricity cut-offs, and increasing demand. Outside of Port Sudan infrastructure is poorly developed. There are virtually no fish handling and processing facilities, roads are unpaved and communications poor. There are no harbours or sheltered areas along large stretches of the coast except Suakin fishing harbour, although some coastal lagoons and sheltered bays or marsas form natural harbours and landing places. Maintenance and repair workshops are very scarce. Basic living conditions are generally poor and clean drinking water is a scarce commodity. The lack of ice facilities out-

side of Port Sudan places heavy pressure on resources that can be marketed without preservation, such as trochus, pearl shell and bêche-de-mer. Fish catches in remote areas (Halaib in the north and Aqiq in the south) are consequently dried or wet salted.

In Yemen the importance of the fisheries sector is reflected in the large number of landing facilities available for artisanal and industrial fleets. Artisanal fishing activities in the Gulf of Aden take place from some 50 locations along the 1,500 kilometer coastline. Many of them can only be accessed by four-wheel drive vehicles over rough dirt roads. In some areas, particularly al-Mahara, there are only tracks, which makes it almost impossible to reach the centers by vehicle. All artisanal boats are pulled up on the beaches or anchored offshore in shallow waters. There are only a few places, such as Aden, Mukalla, Qusayir and Nishtun, where natural rocks or breakwaters provide protection from wind and waves. It is from these places that the sanbuks operate, but only Nishtun provides suitable berthing and landing facilities.

Where there is no beach, or where the boats are not pulled up for other reasons, the fishermen swim to and from their anchored boats. During the monsoon, smaller boats can often not be operated from the beaches because of the heavy surf. In al-Mahara Governorate, fishing virtually stops during this period. Fishing in Hadhramaut Governorate is also much less intensive during this time and many of the fishermen migrate westward.

Nearly all fish is landed on the beach or, as is the case in Mukalla, on breakwaters. Landing jetties were provided at a few centers, such as Ras Imran, Shuqra and Bir Ali, under the Third Fisheries Development Project funded by the World Bank, but these are not being used for various reasons. It appears that fishermen prefer landing on the beach as they have done for centuries and indeed the craft are designed to run up the sandy shores. In the past two decades, artisanal fisheries cooperatives on the Gulf of Aden have benefited from three World Bank-funded fisheries development projects. Assistance to the main landing centers from Bir Ali to Ras al-Ara (west of Aden) has included the provision of flake ice plants, jetties, ice stores, insulated vehicles and receiving sheds.

The Fourth Fisheries Project funded by the International Development Agency (IDA), European Union (EU) and International Fund for Agricultural Development (IFAD) has provided facilities at six of the main landing centers in Hadhramaut Governorate—Mukalla, Shihr, al-Hami, al-Qarn, Musaini'a and Sayhut. Each comprises a receiving area/auction hall, petrol storage and pump dispenser, ice plant (5-10 metric tons/day), ice store, chill store, freshwater and sewerage, training and spare parts, site civil works and access road. These six centers are now operated by local cooperatives.

The Port of Aden is the base for the trawler fleet operating in the Gulf of Aden. It is a specially designed fishing port situated within the commercial port area. It was built with assistance from the former Soviet Union and construction was completed in 1988. It is managed by the National Corporation for Services and Fish Marketing (NCSFM). A number of flag vessels from Egypt, Somalia, Djibouti and Sudan frequent the port for provisions or unloading catches.

The port has a wharf length of 620 meters along which there are three gantry cranes with capacities varying from 5 to 20 metric tons. The port was designed to accommodate a fleet of 77 vessels (43 freezer trawlers, 2 tuna long-liners, 2 fish carriers of 1,000 metric tons capacity and 30 large sanbuks). The number of vessels that have used the port to date is far less than was intended. The total area of the port is 8.5 hectares and includes:

- A 2,000 metric tons cold storage complex which also contains a 100 metric tons/day ice maker, a general fish handling/processing area and a fishing gear manufacturing and repair area.
- Extensive engineering, repair and general service workshops.
- A GRP boatyard for small craft, operated by CFC.
- A large multi-story management and administration building.

Aden Dockyard is the main facility available for repair and maintenance of large fishing vessels. It is managed by the National Dockyard Corporation, a semi-autonomous organization under the

Ministry of Transport, and has a staff of about 450 people.

The infrastructure of the dockyard consists of:

- Large multi-purpose engineering workshops.
- Two floating dry-docks of 4,500 metric ton and 1,500 metric ton capacity.
- A 500 metric ton slipway with adjacent 40 metric ton gantry crane.

The dockyard provides repair and maintenance services for a variety of national and foreign vessels, including fishing vessels. However, fishing companies report they often experience difficulties when utilizing its services due to a lack of technical competence in the dockyard regarding modern vessel equipment and the long time required for completion of repair and maintenance services. The latter is due partly to the wait for spares and partly to inefficiency. Most industrial vessels therefore undergo routine maintenance and major repairs in Dubai.

Nishtun Port is located 60 kilometers west of al-Gaida, the capital of al-Mahara Governorate. It was completed in 1984 at a cost of USD 45 million, financed by a World Bank consortium. The intention was to provide a base for industrial fishing vessels, support for the artisanal fisheries and berthing facilities for general cargo vessels.

The port infrastructure and facilities comprise:

- A main wharf of 210 meters with a water depth of 4.5 meters plus a 150 meters wharf for smaller boats.
- A small craft slipway, engineering and carpentry workshops.
- A desalination plant and power station.
- A fisheries complex, including a 40 metric ton flake ice plant, a 160 metric ton ice store, three 10 metric ton blast freezers and four 200 metric ton cold stores.

The port has hardly been utilized at all, except to accommodate a small fleet of forty to fifty GRP OBM-driven artisanal fishing boats. The facilities have not been operated since 1995 due to problems with the power plant. Major repairs are needed but no action taken, partly due to shared but unclear responsibilities between authorities. The Ministry of Fish Wealth, through NCSFM, is responsible for the fisheries facilities but, as of May 1996, the basic infrastructure and the power generation are under the Yemen Ports Authority of the Ministry of Transport.

Khalf Port, located on the eastern side of Mukalla, was built as a combined fisheries and general cargo port in the early 1980s. The port is now administered by the Yemen Ports Authority and its use by fishing vessels is restricted. The port has facilities for refuelling and provision of water, but supplies are limited and are not used by the fishing fleet. Along the Red Sea coast, port facilities for industrial fishing vessels are limited to al-Hudaydah, Salif and Mokha.

Along the length of the Yemeni Red Sea coast there are some forty fishing communities. al-Hudaydah, located about halfway up the Red Sea coast, is the most important center for fish landings and marketing. Many of the boats and fishermen landing at al-Hudaydah come from other villages or towns along the coast. The second most important center is Khobah, to the north of al-Hudaydah. The third is Khokha to the south of al-Hudaydah. Nearly all the other centers are remote and provide few facilities. They are only accessible through desert tracks by four-wheel drive vehicles. Only al-Hudaydah and Mokha, further south, can at present be reached by asphalt roads but a new road is being laid to Khokha. The poor road connections not only cause human hardship but also make the marketing of fish difficult, with resultant lower prices offered to the fishermen. Fish are unloaded a short distance away from the beach, depending on the water depth, and then carried by men wading up on to the beach. The boats are usually anchored, and only beached for maintenance or for longer breaks. During the winter season, from October to December, the winds are from the south and the sea is rough, making operation from the beach hazardous. The smaller boats then stop fishing or migrate to more protected areas among numerous small inshore islands.

Hudaydah has a fishing harbour that was built in 1982-1983 under a project funded by the World Bank and the Danish International Development Assistance (DANIDA). It provides a 140 meter

unloading area, an auction hall, slipway, boat and gear repair area, and a berthing area for sanbuks and huris. Chill rooms for ice and fish originally installed have been removed. The harbour has been of vital importance for the expansion and development of Red Sea fisheries over the past fifteen years. It still is, but cannot accommodate any further expansion of the fishing fleet. The harbour area is very congested. There are also serious problems with silting, and the basin is becoming too shallow for the larger sanbuks. The littoral drift of sand has filled the entire area on the southern side of the harbour, up to the end of the breakwater. In Khobah, a pier with a total unloading area of 90 meters was constructed under the same World Bank/DANIDA project but cannot be used any longer due to silting. The Government of Yemen is at present seeking external support of about USD 14 million for a project to rehabilitate coastal areas around al-Hudaydah that have been affected by silting and erosion. The project proposal contains components for civil works at the 'al-Hudaydah Beach and Fishing Harbour' and the 'Khobah Fishing Harbour and Village.'

Shore facilities along Somalia's Gulf of Aden coastline are extremely limited; only two plants and cold stores are known, but these were destroyed during the civil unrest. Major landing sites include Caluula, Xabo, Qandala, Laas Qoray, Berbera, Lughaye and Saylac. The tuna canneries at Xabo, Laas Qoray and Qandala and the cold store at Bosaso have all been destroyed during the civil conflict. By 1996 only a few small containerized chill rooms in the north and mobile vehicle cold storage were available. The cold store at Berbera has been repaired by COOPI, an Italian non-governmental organization (NGO), and is now operational. The predominance of summer shark fishing in Somalia is mainly due to the absence of cold storage and processing facilities along the coast. Salting and sun drying of shark has developed, especially since 1990, except for a short period from 1989 to 1993, at the height of the civil strife. Dried shark fin production nevertheless continued throughout Somalia's civil disturbances. Since 1995 local entrepreneurs have utilized large former trawlers as floating processing stations and purchase the catches of local artisanal fishermen. It is reported that only grouper and snapper larger than 1 kilogram per specimen are accepted.

Fish Marketing and Distribution

In Egypt, Red Sea catches are marketed locally at the major landing site in Suez, and the rest are sent to markets in Cairo. At Ghardaqah the fish distribution systems are also similar to those of Suez, but marginal quantities are also marketed in Qena market in the Nile valley. The bulk of fish distribution is handled by private fish traders. Only 5 percent of purse seine landings and 20 percent of trawler landings are sold locally at Suez and Ghardaqah; the rest goes to the Cairo markets. Per capita consumption of fisheries products in Egypt was 9 kilograms/year in 1995 compared with 4.5 kilograms/year in 1980 and 7.3 kilograms/year in 1992. Around 80 percent of domestic marketing and distribution of fish is handled by private sector merchants, with public sector corporations handling the remaining 20 percent. The private sector is organized through fishing cooperatives. These sell through wholesalers by auction. Wholesalers then sell on to the local market or transport the fish to larger centers to fish markets or retailers.

In Saudi Arabia most of the fisheries products are marketed fresh in ice (chilled). Ice is commonly used on fishing boats, on the shore and also in retail shops. In the past decade fish marketing has been developed by the private sector using a large number of refrigerated trucks and modern fish retail shops. A small portion of fishing products is marketed frozen or canned, and smoked fisheries products are also exported.

In Sudan, fish are mostly marketed in Port Sudan. Catches from landing sites up and down the coast are marketed through the capital by private sector traders. In addition, the Marine Fisheries Department operates a fish distribution center in Port Sudan. Fish are marketed fresh, both un-iced and chilled on ice. Fish are sun-dried at Halaib and Abu Ramad landing sites, shark fins and sea cucumbers at Aqiq. The remoteness of fishing villages, poor roads and communications, and a general lack of shore facilities are major factors contributing to low levels of production and poor product quality. Trochus shells are exported unprocessed through merchants to markets in

Italy, Germany and Spain where they are use for making buttons and jewelry. The meat is not consumed prior to processing.

In Djibouti 90 percent of the catch is landed in Djibouti City and consumed close to point of landing, because of the lack of markets elsewhere. The distribution chain and marketing system for fish in Djibouti is very localized. In the 1980s over 70 percent of artisanal catches were marketed through the Association Coopérative des Pêches Maritimes (ACPM). No details are available on ACPM's current status.

In Yemen, prior to unification in 1990, all fish marketing in the former People's Democratic Republic of Yemen (PDRY) was controlled and carried out by the NCSFM, although from 1979 onwards cooperatives were allowed to sell fish directly to consumers at prices 50 percent above those set by NCSFM. These purchases were then marketed at low prices throughout the year in an attempt to supply even remote areas of southern Yemen. In complete contrast, fish marketing in the former Yemen Arab Republic (YAR) was left entirely to the private sector.

Fish marketing has changed a great deal since unification and the relaxation of government controls in southern Yemen. Fish is still bought by the government sector organizations NCSFM and CFC, but the vast majority of artisanal production is purchased by private sector traders and companies.

On the Red Sea coast all production is bought by the private sector. Literally thousands of small private traders and a smaller number of trading companies buy fish from beachside auction sites and sell to wholesalers or retailers. Insulated four-wheel drive vehicles are used to preserve the fish on ice.

It is reported that substantial quantities are purchased and exported to Saudi Arabia, destined for retail and wholesale markets or re-export. Estimates received suggested that 60 percent of fish and 90 percent of shrimp production in 1996 was exported to Saudi Arabia. Landed catches are purchased by small private trading operations or larger private companies. NCSFM figures suggest that in 1996 a total of 30,000 metric tons of fish were landed on the Red Sea coast valued at YER 3,132 million (though these figures may only reflect landings and/or prices at al-Hudaydah). Kingfish, bream and shrimp are the most commercially important species landed in al-Hudaydah in terms of total value.

Along the Gulf of Aden coastline artisanal catches are purchased predominantly by private traders and companies. NCSFM and CFC are also involved in fish marketing.

Artisanal fishing is mostly conducted with small huris operating on single-day trips. The fishermen operating these boats do not take ice to sea. Catches are stored directly on the open deck, in the bilges or sometimes in wooden boxes in areas that are likely to be contaminated by bacteria left over from previous catches. Often the catch is left uncovered, though sometimes tarpaulins are used.

Larger huris and sanbuks in the Red Sea work multi-day fishing trips because they carry and store the catch on ice. Such large huris have been adapted to incorporate insulated fish holds or in some cases chest freezers are simply used to hold iced fish.

In general fish are not headed or gutted at sea and the majority of the artisanal catch from small huris receives no icing until after first sale at auction.

Along the Gulf of Aden the majority of artisanal sales are carried out through well established auctions run by the fisheries cooperatives (established during the former PDRY) and newly formed (post-unification) societies. Facilities vary throughout the southern coast: some cooperatives and societies hold beach auctions while others use landing quays and specially built auction sites.

As a variety of services are provided by fisheries cooperatives and societies, a range of different levies are charged at auction on the value of fish sold. NCSFM collects a 3 percent marketing fee and the private auctioneer generally receives 5 percent. Most cooperatives and societies charge a 2 percent fee for payment into a Social Fund and some of the more established or active organizations make extra charges to fishermen and recently to traders as well.

Fishermen landing in the more remote villages where there are no auction facilities either have

direct supply contracts with private traders, private companies, NCSFM or CFC, or they arrange for their catches to be transported to nearby auctions by pooling transport facilities within the village.

On the Red Sea coast the majority of artisanal fish production is sold at beach auctions operated and regulated according to local tradition. Fishermen societies exist at Midi, al-Hudaydah, al-Khokha and Mokha. They collect 2 percent of the value of members' sales as contributions to the Social Fund, but it is not clear what other services they offer at auctions. NCSFM representatives are based in Midi, Khobah, al-Hudaydah, Khokha and Mokha and collect 3 percent of the value of fish sold as a marketing fee. They do not assist in the auctioning process. It is reported that they collect marketing information on prices and species sold although volume figures do not corroborate this.

Locally appointed private auctioneers command the auction process. The senior auctioneer conducts the day's affairs and assists in the collection of fees from fishermen including his own 5-10 percent of the value of sales. As the auctioneers both earn and deal with large volumes of cash, they can provide credit to buyers to facilitate transactions and to fishermen and their families for both fishing and social affairs.

The largest auction on the Red Sea is located at al-Hudaydah. The auctioneers are private individuals but NCSFM manages the facilities by maintaining the port, landing areas, and auction hall, and providing electricity and running water. It is also responsible for recording sales values and some weights.

In Saudi Arabia, fish are marketed chilled on ice. The national distribution of fish has improved dramatically in the past ten years due to significant private sector investment in fish landing, processing and marketing. In the vanguard of this development has been the SFC, which has pioneered the use of refrigerated trucks for fish distribution. Fishing vessels use ice far more than is common elsewhere in the Red Sea area. Value-added processes such as freezing, canning and smoking are in their infancy.

In Somalia there is little fish marketing activity along the northern Gulf of Aden coastline due to the danger posed by civil unrest, which affects every aspect of the national economy. Apart from the urban centers of Berbera and Hargeisa, where local markets are always available, other outlets for artisanal catches include the industrial processing plants at Berbera, Bosaso, Laas Qoray, Qandala and Xabo on the northern coast. Some private entrepreneurs occasionally export small quantities of rock lobsters, *Panulirus versicolour*, and demersal fish such as grouper and snapper to United Arab Emirates and Oman. About 150 tons of dried and salted sharks are exported to the East African port of Mombasa. Markets for dried shark products include Zanzibar as well as Mombasa, along with strong domestic demand. Shark fins also are exported to Dubai and southeast Asian markets.

Nature of Processes and Products

Fish in Egypt are landed either fresh/unchilled or fresh/chilled on ice from both commercial and artisanal vessels. Some species, such as mullet, are salted in the traditional way, especially in the south of the country, and fetch high prices for use in certain religious and customary occasions. Canned fish is produced by the Edfina public company from two plants at Damietta and Port Said, using imported horse mackerel and sardine as raw materials. Smoked fish is produced by four plants with a total capacity of 370 metric tons/year, which belong to the state-owned Egyptian Fish Marketing Company. The private sector also has seven plants producing 80 metric tons per year. Salted fish is produced by small private businesses with a total amount of 3000 metric tons/year. Fishmeal is produced by a public sector company in two plants which have a 70 metric tons/year capacity and by two small private units with a total capacity of 8 metric tons/year.

In Sudan fish is distributed to the domestic market mostly fresh and chilled on ice in the areas close to Port Sudan. Facilities for ice production have been detailed elsewhere. Shark fins and sea cucumber are dried for export. The salted sun-dried opercula of shells are used as a fixative in Sudanese perfumes. Processing of trochus or kokian shells (primarily *Tectus dentatus*), is simple: the meat is left to rot. Shells are then put in large rolling perforated cylinders and washed under a pressure jet. After drying they are bagged for export as round,

unprocessed shells. They are used ultimately for the manufacture of buttons and jewelry.

The availability of processing plants onshore and onboard fishing vessels has enabled Yemen to produce a wide range of fisheries products, particularly along the Gulf of Aden coast. These products include traditional salted, sun-dried and hot-smoked small and large pelagic species such as anchovy, sardine, mackerel and tuna. During the 1970s processing commenced on board the industrial trawler fleet and a range of new products was developed mainly for export markets. These included frozen cuttlefish, deep sea lobsters, deep sea prawns and demersal fishes. Value-added products produced onshore include Individually Quick Frozen (IQF) lobster tails, pelagic and demersal fishes, as well as shrimp, dried shark fins and dried bêche-de-mer.

Today most domestic production landed by artisanal fishermen is not processed. At first sale larger fish, such as tuna, are gutted but other species are not cleaned. With the exception of boats working multi-day fishing trips, artisanal catches are not put on ice until after first sale.

Large fish, such as tuna, kingfish, barracuda, etc., are sold to domestic consumers by the kilogram. Smaller fish, such as emperor, snapper, mullet, Indian mackerel, etc., are sold whole. Fish destined for domestic sale is generally not frozen or filleted, especially in coastal areas where consumers expect fresh, whole produce. Frozen fish is becoming more acceptable further inland in the Wadi Hadhramaut and larger towns and cities but the proportion of frozen to total fish sold to consumers is low, perhaps no more than 10 percent.

Some fish is preserved by traditional methods. At Harounia, on the Red Sea coast, Indian mackerel and mullet are salted and smoked and can be seen on sale at villages along the main road. Indian oil sardine (*Sardinella longiceps*) is spread on the ground to dry for up to four days in eastern Hadhramaut and al-Mahara Governorates. Dried sardine is used principally as animal feed (mainly for camels) but some human consumption is also reported. Recently, a sizeable export business has developed, with sacks of dried sardine transported by large sanbuks east to Oman. In Seyoun (Hadhramaut Governorate) dried tuna and bonito are purchased by low income consumers. Some tuna and kingfish pieces are cooked, smoked and dried in stone-lined pits over embers. Indian oil sardine is a good source of fish oil, which is extracted over 3 to 4 days by placing the fish under pressure and then separating the oil from the water. The dried residue is sold as fertilizer.

In Yemen, artisanal production destined for the export market is processed using a variety of simple methods. Private traders and the Shihr Fishermen's Society prepare fish in the following ways:

- Whole red snapper, grouper, kingfish, trevally, etc. are washed, but not gutted, frozen and wrapped in plastic.
- Fresh tuna are washed, gutted, graded by weight, put on ice and packaged.

Private companies with better facilities tend to process purchases for export in the following ways:

- Shrimp are washed, sorted and graded into size bands. 'Head-on' shrimp account for 75 percent of production, with the remaining 25 percent are peeled and have the heads removed. Packaging displays the country and company of origin.
- Frozen yellowfin tuna fillets are packed into locally manufactured cartons holding 15 and 20 kilograms total weight.
- Cuttlefish are cleaned, frozen and placed in 20 kilogram cartons.
- Sea cucumber are boiled, dried and bagged in 25 kilograms packs.

It should be noted that a large proportion of exports from both private traders and companies are re-processed in Dubai by purchasers or associated companies.

CFC processes rock lobster for export by washing, sorting and separately wrapping tails which are blast frozen in 10 kilogram cartons. In the past, whole frozen and whole cooked rock lobster have also been processed for export. In addition, a private company is supplied with live lobster by CFC. Of 100 metric tons bought in 1995-1996 only 65 metric tons survived export. As part of the contract, mortalities are returned to CFC.

All processing by companies holding industrial licences, with the exception of Egyptian shrimp trawlers, is carried out at sea. Fish are cleaned, sorted, frozen (to -25°C), nylon packed and placed in cold storage (-30°C). One company exports blocks of tailless emperor with a net weight of 10-20 kilograms and blocks of cuttlefish of 12.5 kilograms net weight.

Egyptian shrimp trawlers operating under licence in the Red Sea do not land catches in Yemen at all. Shrimp are iced while at sea and processed on return to Egypt.

Sharks are sometimes gutted and headed while at sea. Fins are removed from larger fish, salted and dried in the sun. In al-Hudaydah whole sharks are landed either fresh or salted at sea. The sun drying of shark fins in al-Hudaydah is usually contracted out by exporters and the meat is sold locally. Shark liver is boiled to extract the oil that is used locally for sanbuk wood.

Two fish canneries at Shuqra and Mukalla on the Gulf of Aden coastline currently can sardines, mackerel and tuna. The total capacity is around 13.8 million cans annually. The two plants operate independently but cooperate in terms of exchanging supplies. The plants suffer from fish supply problems as well as shortage of foreign exchange to import spare parts. The production of the Shuqra canning plant was 2.975 million cans in 1994, but it dropped to 1.7 million cans in 1995 due to long periods of low supplies. The canning plant in Mukalla, which has a small fishmeal unit for reduction of offal, has increased its production by 19 percent from 1.719 million cans in 1994 to 2.132 million cans in 1995. The fishmeal production in 1995 was 59.130 metric tons. Small quantities of canned tuna in oil are annually exported mainly to Saudi Arabia. Apart from these canneries and sardine and anchovy drying in the eastern part of the country, scope for fish processing in Yemen is limited. The best value-added will be achieved by concentrating on fresh products of high value (MEP, 1999).

Private sector activity in the fish market has increased markedly since unification. This is expected to continue especially if the Ministry of Fish Wealth's Public Enterprises are restructured or privatized since this will remove inefficient, subsidized organizations that have played a key role in the fisheries sector.

In Somalia canning plants situated along the Gulf of Aden coastline have been destroyed as a result of civil unrest.

Quality Control of Fish Products

In Egypt, more than one government department/ministry is responsible for inspection of fish processing establishments and quality control matters. The systems currently in place have developed in an ad hoc manner over the years and are in need of rationalization.

In Yemen, the Ministry of Fish Wealth's quality control activities are limited. All export consignments are supposed to undergo routine quality checks before they can be issued with a Health Certificate. There are no testing facilities located outside Aden and so it would appear that in those areas only visual checks are made. Samples from consignments in Aden can be sent to the quality control laboratories on Labour Island or a new facility that has been constructed in the fisheries port area under the Fourth Fisheries Development Project. There they undergo chemical, sensory and micro-biological analysis. However, an evaluation of procedures conducted in 1994 (MEP 1994c) indicated that tests that are undertaken are unlikely to provide conclusive indications of product quality.

The largest export problem Yemen currently faces concerns products destined for the EU, which requires that third country fisheries products be produced according to the standards outlined in Council Directive (91/493/EEC)[3] concerning health conditions for production and marketing of fisheries products in Europe. This Directive outlines minimum cleanliness, hygiene and organisational standards in handling, processing, packaging and transporting by individual companies. Since July 1, 1998, no fisheries products of Yemeni origin have been allowed into the EU.

3. Commission Decision of 22nd July 1991 laying down the health conditions for the production and the placing on the market of fisheries products 91/493/EEC. Official Journal of the European Communities. No. L 268/15 (24/9/91).

Yemen is working to put in place appropriate guidelines, facilities and quality assurance measures that meet EU quality standards in order to regain access to the European market.

Capacity and Value-added Production (since 1988)

Data for value-added production are not readily available from the PERSGA member states. Some information is available from Yemen, which in 1996 exported and re-exported 64 percent of all types of goods to other Arab countries. The UAE, Saudi Arabia and Qatar receive 93 percent of Yemen's total exports and re-exports to Arab countries (MEP, 1999). Prior to 1998 the European Economic Community (EEC) accounted for 25 percent of all exports and re-exports, while America, Asia and Africa each received between 3 and 4 percent. Fisheries exports follow a similar pattern, with the exception that more fisheries exports go to Jordan, rather than Qatar. It should be noted that a significant proportion of fisheries exports to Arab countries are destined for re-export to Europe but detailed figures are not available.

Environmental Issues and Precautions Regarding Processing

Virtually no information is available concerning the environmental issues with regard to processing operations throughout the Region. In Sudan, fish are simply iced after landing. No processing plants exist, other than a shell cleaning/grading and packing plant opened in Port Sudan in 1995. Planned activities under the Arab Investment Group for a Sudan Integrated Fisheries Project include the establishment of a tuna cannery, shrimp processing plant, fishmeal factory and shrimp feed mill. Tuna will be caught by Sudanese vessels operating in the Gulf of Aden and shipped in refrigerated trucks to Port Sudan. An optimistic volume of 40,000 metric tons per year is envisaged. The shrimp plant is to have a throughput of 30,000 metric tons per year, primarily from existing and planned shrimp farms. All recoverable wastes will be converted to meal at a rate of 4,000 metric tons per year, which will be utilized by the feed plant. Environmental impacts of these planned developments include: filling in of coastal areas for wharf/factory construction and possible siltation of neighboring reefs; effluent discharges to the marine environment; and increased demand for the already limited freshwater supply in Port Sudan.

5

Socio-Economic Aspects

The significance of fisheries to the economies of the Region is reflected in a number of indicators including the following:

- Number of fishermen directly employed.
- Employment generated in activities directly or indirectly related to fisheries.
- Fish supply to the national market.
- Revenues generated from exports, access fees, licences, penalties for infringements and other duties.

Human Resources in the Marine Fisheries Sector

Socio-economic aspects of each of the PERSGA states are presented in Appendix F. The institutional framework in which fisheries are managed, discussed in Chapter 6 also contains information of human resources.

In Egypt, figures for 1995 indicate a total of 9,024 artisanal and semi-industrial fishermen. Some 400 government staff and 10,000 other persons are involved in training, processing and marketing. A number of authorities are responsible for supervision of the Red Sea fisheries. The main agency responsible for training is the GAFRD of the Ministry of Agriculture. The number of staff engaged in the Egyptian Red Sea Fisheries Department is 30 persons and 23 persons are responsible or the 12 fishermen cooperatives (Barrania, 1992).

In Saudi Arabia the Ministry of Agriculture, Water and Fisheries Affairs supervises the fisheries sector. Training for staff members is continuous, through fellowships for overseas training, and on-the-job training programmes. Researchers have undertaken study tours to at least eight countries in the past to improve their technical skills. International expertise is available for in-country and on-the-job training of Saudi researchers.

In Sudan the government has about forty-eight technical personnel working in fisheries management and services, fourteen fisheries researchers and ten staff members at the Faculty of Marine Sciences and Fisheries and the Marine Research Institute of the Red Sea University. There are few records available for personnel in the private sector. Although eleven societies are registered, with a total of 600 members, only two are active and successful, each with around 100 member fishermen.

In Djibouti the Directorate of Stock-farming and Fisheries (DEP, Direction de l'élevage et des pêches) in the Ministry of Agriculture and Hydraulic is responsible for supervision of and policy formulation for the fisheries sector.

In Yemen, particularly on the southern coastline (Gulf of Aden and Eastern Arabian Sea), the government of the ex-PDRY was heavily involved in fisheries production processing, local marketing and export of fish and fisheries products. There were 565 staff members at the head-

quarters of the Ministry of Fish Wealth in Sana'a in 1997. The Ministry of Fish Wealth supervises the MSRRC with its Mariculture Resources Center and Marine Pollution Center (MPC), the Fisheries Training Institute (FTI) in Aden, the NCSFM and the CFC. In 1997 the MSRRC had 169 staff, the FTI had 84 staff, and NCSFM had 1,130 staff. The CFC had a total of 546 employees, including the crew on its fleet engaged in rock lobster and other fisheries (about 350 crew members). It is worth mentioning that the total number of government employees in the Ministry of Fish Wealth and the other fisheries institutions is 3,000, without counting personnel of the two canning plants and the industrial fleet crew. A review of the Ministry of Fish Wealth's institutional structure conducted in 1992 (MEP, 1994d) suggested reductions ranging from 22 percent to more than 50 percent in some departments to make the Ministry more efficient under the framework of reform policies and privatization.

Employment from processing in Yemen is significant. Some cooperatives and societies on the southern coast have full-time employees who receive a base salary while others pay a part-time wage to active fishermen who help run the organization. Opportunities also exist for entrepreneurs with their own transport to supply ice to fishermen in more remote areas. This is done, for example, at Salif on the Red Sea where ice is brought daily from al-Hudaydah some 100 kilometers away. In Khokha, fish from nearby fishing sites is brought in baskets on motorcycles.

At al-Hudaydah fishing port hundreds of people, excluding traders, crew and government staff, are involved in carrying fish; supplying petrol, diesel, and ice; and selling fish baskets, food, tea and clothes. Thousands of young men and boys find casual labour at landing sites and auctions around Yemen helping gut fish, move and load trader's purchases, unload fish holds or refill them with ice.

There are hundreds of private traders operating within Yemen and around ten to twenty private companies operating in the fisheries sector employ increasing numbers of workers—possibly as many as 2,000. No women are involved in fishing, and very few have any involvement in fish processing or marketing.

Affiliations

In Egypt, most fishermen come from the Nile Delta, Fayum and other upper Egypt provinces. Fisheries resources in the southern Red Sea are targeted by three groups:

- Sedentary Bedouin fishermen, belonging to the Besharin and Ababda tribes: small groups of 7-10 fishermen, particularly in Foul Bay, using small wooden boats with veranda nets, cast nets and hook and line. Production is consumed locally, with some salted or sun-dried. Most lack boats or vehicles and are therefore restrained in terms of fishing effort and market distribution.
- Migratory fishermen: fishermen from Ghardaqah, Safaga and El Quseir who follow fishing patterns down the coast, particularly the migratory grey and red mullet, during October to February. They usually establish seasonal fishing camps and possess motorized boats supported by vehicles. It is understood that increasing numbers of professional fishermen from the Mediterranean coast are also participating in Red Sea fisheries.
- The semi-industrial fleet of purse seiners and trawlers from the north who target sardine and demersal fish respectively and are predominately based in Suez.

Fisheries provide an important income earning opportunity for the first two groups noted above (that is, the sedentary Bedouin and the seasonal migratory fishermen) and shore access is essential to both groups. This is particularly the case for trammel net fishermen, who usually lack boats and need to walk across the shoreline and reef flat in order to set the net. Despite shoreline planning restrictions, there is already some conflict between tourism development and traditional fishing interests, and some level of compromise needs to be integrated into proposed shoreline management plans.

In Saudi Arabia, nearly all fishermen are foreigners, employed by Saudi vessel owners. In Djibouti

a large but unknown proportion of fishermen from Yemen operate vessels owned by Djiboutians.

In Sudan, the Beja (Kushitic/Hematic origin) have been considered as indigenous and the largest ethnic tribe in the eastern state. Within the Beja group the Amarar and Besharin sub-groups occupy the northern part of the Red Sea province and are both nomadic pastoralists and fishermen. The Hadandawa and Beni Amer sub-groups in the south Kassala state are agro-pastoralists and fishermen. The 'Rachides' are active fishermen in Suakin.

In Yemen tribal affiliations and influences are weak in the coastal areas. The growth of ports and sea trade with distant countries in southeast Asia and East Africa has fostered a mix of populations in Yemeni coastal communities, especially on the south coast, for example in the Gulf of Aden main ports of Aden and Mukalla and in rural fishing community centers such as Shuqra, Bir Ali and Shihr.

Social Structure and Employment Structure

Literacy levels of Egyptian fishermen are around 95 percent. By law fishermen have to belong to a pension scheme, but health and life insurance is not normally provided by the vessel owner or fisherman himself. Most fishermen in the artisanal fleet are related or belong to one family. Interestingly, fishermen in the south—Ras Banas, Shalateen and Halaib—all belong to a single tribe. There is a noticeable trend toward leaving fishing to work in catering, mining or drilling. Reasons cited include pollution, limited fishing ground and inadequate fishing related facilities.

From an employment perspective, upstream and downstream employment associated with fishing accounts for some 1 million jobs. Fisheries related employment accounted for 3.7 percent of total agricultural sector employment in 1997. Forty-six percent of fishermen are marine, 54 percent are employed in freshwater fisheries.

In Sudan, the main source of employment statistics is the 1993 population census. The Red Sea State has a population of 434,000. Out of this group, 49.7 percent were defined as economically active. Out of the total economically active population, 79 percent were employed. Of those employed, 70.3 percent were living in urban and the rest in rural areas, 33.2 percent worked in agriculture and fisheries, 21.6 percent in community and social services, 16.4 percent in transport and storage and 13.9 percent in wholesale and retail services.

Employment opportunities in the State are largely limited to the urban centers, above all Port Sudan and Tokar. Although agriculture and fisheries provide some employment opportunities for the rural population, these sectors are of minor importance as compared to urban employers. The fisheries sector, although potentially important, does not employ a large number of people. The reasons are: limited marketing opportunities, inadequate transport facilities, the lack of cold storage, and limited policies relating to fish resource utilization. At present, fisheries rank very low in the resource utilization priorities of the Red Sea State. Coastal people are semi-nomadic. Fishing is their main activity, along with herding and goats/camels. Fishermen are often illiterate, very poor and live at subsistence level in villages scattered along the coast. Basic services such as clean drinking water are largely absent.

In Yemen, artisanal fish processing does not provide direct employment for many people in fishing communities. It is difficult to calculate the employment generated by private companies and traders as this is a new and expanding sector. However, from information gathered during field visits, it is estimated that between 2,000 and 3,000 people are employed in private fish export and processing operations, with a range of between 5 and 200 employees per enterprise.

Average Income and Estimated Cost of Living

Fishermen in the Suez area in Egypt are described as having an 'average' living standard. For artisanal fishermen, 50 percent of catch earnings are distributed equally to the crew and the remainder put aside for operational and maintenance costs. For the industrial fleet, 70 percent goes to the vessel owner from which all operating costs are deducted. The remainder is divided between the skipper and mechanic, with a smaller amount to each crewman. Artisanal fishermen earn around EGP 300-400 per month during the season, compared to EGP 800-1,000 per month for semi-

industrial crewmen. Skipper and mechanic incomes are three times higher. These incomes are reasonable when compared with the average cost of living at around EGP 330 in urban areas and EGP 273 in rural areas. Most fishermen in Egypt support a family of 6-8 persons. A large portion of the fisherman's income is spent on food and children's education.

In Sudan, salaries and wages are generally low while inflation may be as high as 200 percent per month. Wage policies are set by the government. Currently, the minimum basic monthly wage for an unskilled labourer is SDP 10,000. It may reach SDP 50,000 for a government official. The private sector offers higher salaries than the government, with a minimum basic monthly salary of SDP 30,000 for an unskilled labourer and up to SDP 200,000 for a senior employee. The average cost of living for a household of five persons has been estimated to range between SDP 50,000 and 300,000 per month. Average income for huris targeting the fresh fish market is SDP 42,167 per year near Port Sudan, but in remote landing sites the income drops to SDP 18,525. Huris working on shell collection in remote areas do not have higher income levels than other fishermen in those areas, whereas those operating in shell and dried fish do make more, for example, SDP 21,300/year near Halaib. An average fisherman's family consists of 6-7 dependants, and most live in huts or shelters made of wood and tin-plate. Most depend on middlemen who provide loans for fishing operations against delivery of the catch.

In Yemen, the highest incomes are found in the rock lobster fishery in al-Mahara/Hadhramaut and in the yellowfin fishery in Hadhramaut where seasonal incomes average YER 40,000-100,000 (USD 317-793) per fisherman per month. In the extreme eastern and western parts of the coast, where the catch contains relatively large portions of low value fish, earnings may be only YER 5,000 (USD 40) per fisherman per month. There are no studies available in Yemen on the living standard of fishermen, only anecdotal information and visual observations with all their shortcomings. However, these differences in income are clearly reflected in the activities, living conditions and attitudes of the fishermen. Some of the better-off fishing families in the Mukalla-Shihr area own cars, have good houses with satellite television, modern kitchen equipment, wall to wall floor coverings and mobile telephones. These and others near larger population centers also benefit from relatively good social services. At the other end of the scale there are poor fishing families with very low incomes, living at subsistence level in isolated villages where social facilities and services such as water, electricity and health care are limited or absent. Without any systematically collected data, it is not possible to assess the situation in any quantitative terms.

The size of the Yemeni fishing population on the Red Sea stands at about 16,000. Most of the fishermen seem to fish full-time as an occupation. Owners of fishing vessels have earnings well above the average since in addition to their earned crew share they also have income from the boat share. It is understood from interviews that most of the boats are operated by their owners, however in some cases ownership is shared between two or more fishermen and in others boat owners do not take part in the fishing. The most common share system is 50 percent of the net proceeds, that is, gross revenue minus operating expenses, to the crew and 50 percent to the owner. Average income of fishermen is relatively high because of productivity and prices of fish and other fisheries products. The average income of one fisherman on a huri is about YER 10,000-12,000 per month which is the average monthly pay of a new university graduate. A crew member on a sanbuk will earn about YER 16,000-18,000/month, which is more than the average earnings of an experienced university graduate employed for 10 years in the civil service. Lobster or shrimp fishermen may earn an average as high as YER 30,000 per month (PERSGA, 1997h).

Additional/Alternative Sources of Income for Fishermen

Most fishermen in Egypt are true artisans in the sense that they have no other employment opportunities.

In Djibouti, fishermen have no alternative employment opportunities. This is a result on the one hand of the generally conservative attitude of this community, and the limited possibilities for agriculture

on the other hand. Djiboutian fishermen do not have access to formal credit. Informal credits from fish merchants or from the fisherman's family are a possible source of financing. The fishing strategy adapts to the requirements of the market, which means fish species, which sell on local markets, are caught. Unfortunately, consumers in Djibouti largely stick to three species: Spanish mackerel (seasonally), black-spot snapper and jack. Income depends on the number of departures to sea, social status, and whether the fisherman is a boat owner or crew member.

Fishermen's Societies and/or Cooperatives

Available data on the numbers of fisheries societies and cooperative and their membership are indicated in Table 12 below.

and cooperatives have a negligible role in supplying goods and services to fishermen, and in assisting in marketing of the catch, primarily because of lack of affordable finance and terms for credit. Although eleven cooperatives are registered, only five are operating with any degree of success, the most notable being Abu Hashish Cooperative Society. The Government of Sudan recognizes the importance of cooperatives but the constraints to their effective operation include: cost and availability of imported fishing gear; illiteracy in fishermen, resulting in poor understanding of the need to support the cooperative; poor road conditions; inadequacy of public services resulting in private sector intervention and manipulation of the fisheries post-harvest systems.

TABLE 12: FISHERIES COOPERATIVES AND SOCIETIES IN THE REGION

Country	Active coops	Members	Active societies	Members	No. private fishermen	Reference year (Source)
Jordan	1	85	0	0	n.a.	1995 (PERSGA archive)
Egypt	12	4,462	-	-	4,758	1997 (Barrania 1997)
Saudi Arabia	n.a.	n.a.	n.a.	n.a.	n.a.	no data available
Sudan	11	600	-	-	n.a.	PERSGA (1997)
Djibouti	1	270	-	-	n.a.	PERSGA (1997)
Yemen	23	13,160	15	n.a.	n.a.	MEP (1997)
Somalia	18	8,000	0	0	n.a.	Internal report (SOM/94/004)

Source: National fisheries administrations. N.a. means data not available.

In Egypt, fishing cooperatives are governed by a fisheries cooperative law that stipulates the role of the cooperatives in improving the economic, social and professional status of members. As is the case elsewhere generally in the Region, cooperatives provide a number of benefits and services, including: supply of fishing gear and equipment often at subsidized rates, credit finance, fish transportation, marketing, and basic social services. Many fishing cooperatives are limited to providing fishing gear, which is perceived as a minimal assistance by the fishermen. The Suez cooperative provides considerable economic and social services thanks to efficient management personnel and adequate finance.

Sudan has no social security programme in place for fishermen. Most are dependent on their skills at fishing and the extended family system. Societies

During 1971-1973 the fishermen on the Gulf of Aden coast in Yemen were organized into thirteen cooperatives under the socialist PDRY government (one being the Socotra Cooperative). During 1999, three new cooperatives were formed on Socotra (Yusef and Kaseem, 1999). The cooperatives have received much assistance directly from, and through, the Ministry of Fish Wealth. The Third Fisheries Project funded by the World Bank provided facilities for landing, auctioning, and storage of fish and for ice-making and boat repair. The cost of the productive elements has not been recovered from the cooperatives as planned.

Under the Fourth Fisheries Development Project large loans were provided for the purchase of boats, engines and nets. Recovery performance with respect to these loans has been very good.

Fishing gear and engines provided under the Fourth Fisheries Project have undoubtedly stimulated the expansion of the artisanal fleet. Fish Receiving Centers at six landing centers in Hadhramaut and al-Mahara Governorates were provided.

With today's liberalized economy and less government support and control the cooperative structure started to loosen up, particularly in the vicinity of urban areas. In addition to the original cooperatives, by mid-1997 there were at least nine new societies, all having been created through breakaway groups from the cooperatives.

The establishment and function of cooperatives and societies are today governed by Law No. 18 of 1994. The Law states: 'cooperative societies are independent, voluntary and democratic, social and economic organizations.' The Ministry of Social Affairs is the responsible authority, while the Ministry of Fish Wealth is the competent ministry in technical matters. Despite the present autonomous status of the cooperatives, many of their directors and other employees are still on the payroll of Ministry of Fish Wealth branches.

A common income generating activity of all cooperatives/societies is the auctioning of fish from which they derive their main income through a levy varying from 2 to 10 percent of the value of fish sold. Income is also earned in many cases from the sale of OBMs, spare parts, fishing gear and fuel and in a few cases from the sale of ice and storage of fish. Two of the cooperatives still own sanbuks and earn money from members' use of them.

Most of these organizations' expenditures relate to sickness benefits and health coverage. Some of them also support other social infrastructure and services such as schools, water supply and health clinics. There appears to be a genuine solidarity among members and responsibility on the part of the cooperative/society for providing social services for members and their families.

A number of 'societies' exist along the Red Sea coast. These are not involved in fishing, marketing of fish or providing supplies to fishermen. They do however provide social security functions and sometimes give limited loans to their members from funds accumulated by charging 2-5 percent of the value of the landed fish in the auction halls. Often the communities are made up of a few families who have expanded but are interrelated. Some families have relatives in other fishing communities along the coastline. With development and expansion of schools many young people, especially in the Gulf of Aden area, leave to take other jobs, yet they keep their boats for fishing or work on other boats whenever they have the time to go fishing.

Artisanal fishermen are not organized into cooperatives. It is reported that attempts have been made to establish such organizations, the latest in 1994 by the Ministry of Social Affairs, but without success. Despite the absence of functioning organizations, a commission of 2 percent of the value of the fish auctioned at the landing sites goes to the 'association'. It is unclear whether this commission is actually charged and, if so, how it is accounted for and by whom. Social facilities and services in fishing villages on the Red Sea coast are rudimentary. Electricity supply is rare. Water is very limited, if available at all, and expensive to buy if supplied by truck. Schools are available in most communities but there is an acute shortage of teachers and many of the schools remain closed. All the fishing centers, except al-Hudaydah and Khobah, completely lack landing facilities such as harbours, jetties, protected anchorages or unloading facilities.

Until 1996 Djibouti had a single fishermen's cooperative (the ACPM based at Boulaos), which served to market fish and sell ice and petrol to the fishermen. It was a state-owned organization. which was managed by civil servants. The ACPM no longer exists and the site is now operated by the private sector.

Development of fisheries cooperatives in Somalia was assisted by FAO during the 1980s, through integrated community fishing centers within the cooperatives system. As of 1996, most fishermen were grouped either within eighteen state-run cooperatives, or were part of the Coastal Development Project, an offshoot of the Ministry of Fisheries created in the aftermath of the 1973-1975 drought in an unsuccessful attempt to teach fishing to nomads.

Many of the Region's cooperatives have largely failed to deliver the services needed by their members. The reasons are many, but the principal problems include: lack of management capacity in administration, supervision and guidance of cooperative affairs; inability to provide fisheries extension services; weak financial management, irregular auditing and poor account keeping; lack of planning; interventions by various authorities and outside vested interests; and limited ability to provide handling, processing and marketing services for members' catches.

Availability of Credits (Sources, Conditions and Amounts)

In Egypt a 'formal credit' system operates through the commercial banks: these provide short- to medium-term loans, often in support of grant aid, and set at prevailing interest rates. The Supporting Fund for Fishermen Cooperatives, financed by and under the supervision of GAFRD, is an independent body that offers soft loans to fishermen cooperatives. The following loans were provided by the Fund between 1990 and 1995 (Table 13).

TABLE 13: Supporting Fund for Fishermen Cooperatives: Loans Provided 1990-1995

Year	Loan (EGP)
1990	547,000
1991	609,000
1992	405,000
1993	505,000
1994	284,000
1995	557,000

However, most vessel owners depend on fishmongers for loans to finance operations, gear, maintenance, etc. These loans are provided on the basis that the fisherman sells his catch to the particular merchant. This 'informal credit system' often leaves the fisherman at a disadvantage in regard to pricing structure.

A similar situation to that in Egypt is faced by fishermen in Sudan, who borrow heavily from private sector traders to pay for their recurrent and capital costs, often at high rates of interest. In the absence of other more amenable forms of credit, the rural fisherman is left at the mercy of private sector loan sharks who use the relationship to the loaner's maximum benefit. Besides this informal credit system, the Agricultural Bank of Sudan (ABS) operates a seasonal or medium term loans system to fishermen. In 1991, forty-four seasonal fisheries loans worth SDP 274,702 (11 percent of total loans) and 45 medium term loans amounting to SDP 1.3 million (42 percent of total) were issued. ABS is the main avenue for fisheries credit, although the interest charged (27 percent is common) puts these funds beyond the means of many fishermen.

In Yemen, three main sources of credit appear to be auctioneers, families/friends and the Cooperative Agricultural Credit Bank (CACB). Nothing but anecdotal information is available regarding the first two sources. CACB activities and performance are, however, well documented. CACB has branches in Aden, Abyan, Mukalla and al-Gaida on the Gulf of Aden coast. The CACB branches cater also for agricultural credit but their main business (80-90 percent) is in the fisheries sector. Funding for fisheries loans has been provided by the Ministry of Fish Wealth since 1992, utilizing funds obtained from sale of equipment supplied through the Fourth Fisheries Project, purchased using funds from IDA and IFAD. CACB receives a management fee of 2.5 percent and charges the borrower an interest rate of 7 percent. This rate is very low compared with commercial bank rates of 20-30 percent, but is fixed by the government.

The total amount disbursed to the fisheries sector on the southern coastline during 1992-1996 was YER 190 million (USD 1.5 million), covering 1,150 loans. Most loans have been used for boats (51 percent) and OBMs (40 percent), with the balance used for purchase of nets and other fishing gear, insulated boxes and boat repair.

Of the YER 190 million (USD 1.5 million), as much as YER 83 million (USD 658,730) was disbursed in 1996. The average size of loans was then about YER 190,000 (USD 1,510), most of them for OBM purchase.

CACB has four branches along the Red Sea coast in al-Hudaydah, al-Zohra, Hayees and Mokha, through which credit is extended to artisanal fish-

ermen. At present, an Agriculture Credit Project financed by IFAD and the Arab Fund for Social and Economic Development (AFSED) provides the funds through a fisheries component. Since 1992 the number of loans issued stands at 1,912 with a total value of YER 254.2 million. The yearly distribution is given below in Table 14.

TABLE 14: LOANS ISSUED BY YEMEN'S CACB BRANCHES IN THE RED SEA AREA, 1992-1997

Year	Number of loans	Value:	
		million YER	USD
1992	349	5.3	185,965
1993	702	28.5	721,520
1994	242	12.1	219,200
1995	152	11.7	117,000
1996	466	165.2	1,310,000
Jan-May 1997	101	31.4	241,538
Total	1,912	254.2	2,795,223

Source: CACB, Sana'a. USD equivalents calculated at average exchange rate for year in question.

Assuming that actual lending since 1996 is a reflection of the present policy and capacity of CACB in that area, an average amount of YER 100,000 is lent to 280 fishermen every year. The average loan amount is sufficient to finance a small fishing boat with OBM. The number of fishermen benefiting from the credit is at least 840 or about 5 percent of the total fisherman population.

In a recent review of the Agriculture Credit Project it was noted that loans had helped to increase production, cash earnings and household income and had improved the living conditions of the borrowers and their families and indirect beneficiaries. The job opportunities for young people had also increased; 25 percent of the borrowers were less than 30 years of age.

The recovery rates on Red Sea lending have been satisfactory. However, as in the Gulf of Aden region, there is a downward trend. The average repayment rate was 85 percent during 1992-1994 but had diminished to 68 percent in 1996.

In Somalia, private sector entrepreneurs extend limited loans, in the form of materials and provisions (food), to ordinary fishermen. As in the case of Egypt and Sudan, high interest rates coupled with inflated material prices are often involved. However, prior to 1990, a revolving fund was in operation, managed by the Ministry of Fisheries and Marine Transport, which provided funds to rural fishermen. It is believed that this fund collapsed at the outbreak of civil unrest.

Revenue Generated from Local Sales

Local sales revenue data for most of the PERSGA member states is not available.

In Egypt, the value of fish production is calculated at around 6 percent of total production of the agriculture sector. Revenue figures are available for 1995, indicating first sale value of EGP 2,356 million (including imported fish products).

Revenue Generated from Export of Fisheries Products

Reliable export data for the PERSGA members states is not available. Partial information for some states is given below.

Egypt exports small quantities of eel and shrimp, mainly to the Netherlands, and some fresh fish to Italy. Total exports were 1,633 metric tons in 1994 and 932 tons in 1995. Figures for 1998 indicate that 2,137 metric tons of fisheries products worth EGP 41 million were exported (Barrania, 2000). Egypt is mainly a net importer of frozen fish from Europe such as sardines, Indian mackerel, longspine, sea bream, lizardfish and grouper which totalled 165,413 metric tons in 1994 and 141,743 metric tons in 1995.

Saudi Arabia exported 2,072 metric tons of fish worth SAR 19 million in 1996. Like Egypt, Saudi Arabia is a net importer of fish products, mainly chilled and frozen fish. The average annual imports of fisheries products in the last ten years were about 45,322 metric tons valued at USD 64.1 million, while the average exports during the same period were 1,793 metric tons, representing USD 4.8 million. Available official statistics on

fish imports and exports in Saudi Arabia are summarized in Table 15 below.

TABLE 15: VOLUME AND VALUE OF FISH TRADE, SAUDI ARABIA, 1988-1995

Year	Imports	Value	Exports	Value
	Volume (mt)	(SAR million)	Volume (mt)	(SAR million)
1988	53,177	267.0	1,774	20.7
1989	54,815	266.7	2,444	33.8
1990	38,711	214.0	2,559	20.2
1991	54,073	310.6	1,765	14.9
1992	37,162	217.4	1,972	15.3
1993	46,517	208.4	1,496	10.5
1994	43,750	196.7	1,830	18.7
1995	66,831	345.2	1,569	13.1

Source: MAW.

Sudan's Red Sea State is well endowed with natural resources, but its inhabitants are comparatively poor, especially those living in rural and marginal urban areas. At present, the natural wealth of Sudan's Red Sea coast is considered to be largely under-exploited. There is no offshore oil exploitation and the contribution of fisheries and tourism to the gross national product (GNP) is negligible. In 1993-1994 all fisheries, forestry and agricultural services contributed less than 3 percent to the GNP. The backbone of the local economy is maritime transport, with the national shipping company, Sudan Line, being of major economic importance. It is expected that the resources of the Red Sea will rapidly gain importance in development planning. Exported finfish include lizardfish, which are exported to Egypt frozen. Mother of pearl, trochus, sea cucumber, shark fins and small amounts of shrimp are also exported. Although trochus ('kokian') exports are a minor part of the total exports, they are extremely important for income generation in the coastal areas; lack of ice and other shore and road infrastructure constrains the marketing potential of fresh fish to the domestic market. Between 1970 and 1998 average export of *Tectus dentatus* and *Trochus virgatus* was 521 metric tons, or somewhat less than 0.1 percent of the total annual value of all exports.

Export data are recorded by Marine Fisheries Administration through an export permit issued for each consignment. Export data are also collected by the customs department, Ministry of Trade and the veterinary department. An export market to Saudi Arabia commenced in 1994-1995 with a total of 52 metric tons of fresh fish exported.

Yemen is among the poorer countries of the world with GNP of about USD 300 per capita (1998). Fish production constitutes an important component of the gross domestic product (GDP). The annual fisheries statistical report for 1995 published by the Ministry of Fish Wealth indicates that fisheries products exported in 1995 totalled 6,228 metric tons, worth USD 18.3 million, without giving details on the composition of the exports or their destinations. Exports in 1994 totalled 1,906 metric tons of various fisheries products worth USD 13.7 million. A general decline in high value exports is believed to be due to overfishing of cuttlefish, deep sea lobsters and rock lobsters. Exports of canned fish have gradually increased, however problems in obtaining funds from the government for purchasing supplies of raw material have adversely affected canning production. Production of whole cooked rock lobster directed to France commenced in 1990. All these exports were through the NCSFM. Fisheries exports from Yemen's Red Sea coastline consist mainly of small quantities of dried shark fin and dried sea cucumber, exported by local fish traders. Shrimps are also exported, mainly through Saudi Arabia but accurate data are not available. The Red Sea Company for Shrimps and Fisheries was active in the Red Sea shrimp fishery up until 1994 when its operations ceased.

In Somalia, 90 percent of artisanal fishermen are involved in shark fishing, primarily for fins. Exports of shark fin from Somalia are currently

valued at least USD 1.5 million per year (Ministry of Fisheries and Coastal Development, 2000).

Contribution of Fisheries Products to Local/ National Protein Supply

The fish resources of the Egyptian Red Sea are regarded as valuable resources that provide foreign exchange revenue and an important source of domestic protein and employment. Figures available from 1991 indicate that average national daily protein intake is around 107 grams per capita. Animal protein accounts for 15 percent of this amount, of which fish is calculated to provide 6 percent. Fish consumption in coastal urban areas is much higher but data are not available. GAFRD's Five Year Plan 1992/93-1996/97 aimed to raise per capita consumption from 7.5 kilograms in 1989 to 10 kilograms in 1997, through an investment programme to the fisheries sector worth USD 95 million. When compared to the global average of 13 kilograms per capita, fish consumption in Egypt is currently low, and fish is not regarded as a staple protein source.

In Sudan, total fish production is estimated at around 1,047 metric tons per year, most of which is consumed domestically. As indicated earlier, Port Sudan is the main market.

In 1993, Djibouti had 557,000 inhabitants, most of whom live in the coastal zone. The capital is the largest coastal city, with a population of 290,000. The only other coastal towns are Tadjoura with 3,500 and Obock with 2,500 inhabitants. The GNP in 1993 was USD 448 million, and in 1991 the GDP was USD 379 million). Owing to prevailing ecological conditions in the Sahelo-Saharian zone, the importance of renewable marine resources in the local economy is very minor. Agriculture, cattle breeding and fisheries contribute only some 2.2-2.4 percent to the national income. The major economic sectors in the coastal zone are maritime transport and port related activities. At present, fisheries and tourism play a limited role, although subsistence fisheries are locally important. Both tourism and fisheries have a remarkable growth potential.

Fish consumption along both Yemeni coastlines is high. It was estimated at 22 kilograms per capita annually in ex-PDRY coastal areas during the 1970s (PDRY had a population of around 2 million people). Consumption now is about 16 kilograms per capita annually. Total average consumption of fish in the whole country is 6-7 kilograms per capita, and is expanding.

6

Institutional Structure of the Fisheries Sector

National Capacity for Fisheries Management

The main authorities responsible for fisheries in each country are summarized in Appendix G. A brief status update for each member state, indicating the main problems faced in the fisheries sector, current institutional arrangements and the legal framework for fisheries, is given in Appendix H.

Egypt's fisheries are administered by a number of authorities. Fish production activities in Egypt are regulated by the GAFRD. GAFRD publishes fisheries statistics (monthly and annual yield, fishing vessels and gears and number of involved fishermen) based on a database of information collected from official landing centers.

In Saudi Arabia, management activities are focused on implementation and enforcement of regulations regarding to fishing gear restrictions, closed seasons (for example, for shrimp a ban is in place from April to July each year), closed areas (such as recognized spawning areas), and control of reclamation/dredging activities along the coast. To balance the need for environmental protection and conservation of living marine resources with socio-economic needs requires strengthening institutional management. In Saudi Arabia, the Meteorological and Environmental Protection Administration (MEPA) is the central environmental agency. It sets environmental performance standards, monitors the activities of operational agencies and serves as a central coordinator for environmental management Operational agencies such as the Ministry of Petroleum, Ministry of Agriculture and Ministry of Industry and Electricity retain actual regulatory control over activities carried out under their respective mandates.

In Sudan, various institutions are concerned with fisheries management, including the Marine Fisheries Administration, Marine Fisheries Research Center (MFRC), Ministry of Environment and Tourism, and the Sudan Marine Conservation Committee (SMCC).

In Eritrea, the Ministry of Marine Resources was formed in 1993 and is aiming to completely rehabilitate the fisheries sector. Main policy goals are to increase fish supply to the domestic market and improve food security, increase fisheries related employment, increase foreign exchange through fish exports, enhance skills in the sector for fishermen, public sector scientists etc., manage and control fisheries with due regard for the conservation and protection of the environment and introduce new technology to foster development.

Fisheries administration in Yemen is vested in the Ministry of Fish Wealth and its five branches along the coast of the Gulf of Aden and one branch on the Red Sea coast (see Table 16). Under the jurisdiction of the Ministry of Fish Wealth, there are also two specialized institutions for research and training located in Aden: MSRRC and FMDC. There are two semi-autonomous commercial organizations: NCSFM and

TABLE 16: MINISTRY OF FISH WEALTH (YEMEN) EMPLOYMENT PROFILE 1997

Sector of Employment	Employees	
	No. of employees	Percent of MFW staff
Ministry of Fish Wealth:% of Ministry staff (Sana'a MFW Headquarters - 19; Aden MFW - 54; other Governorates - 27)	455	16%
Research and Training Institutions, Research Vessel Crew	162	6%
NCSFM N.B.: 5.9% of total Government Service Sector employees	1,189	41%
Public Enterprises (CFC, Canneries) N.B.: 1.5% of total Government Production Sector employees	842	29%
Government Share Fishing Companies: (FICO, YFC) - active and excess employees	250	9%
Total	**2,898**	**100%**

CFC, plus two fish canneries, located in Mukalla and Shuqra.

The structure and function of the institutional framework for fisheries in Yemen has been reviewed and options given for improvements (MEP 1994d; MEP 1999).

In Somalia, prior to the outbreak of civil disturbances, the Ministry of Fisheries was in overall charge of implementing national policy for fisheries. Currently no management or development work is being conducted, but the need is greater than ever. Local authorities are seeking the assistance of agencies such as UNDP/FAO to revive the artisanal fisheries in their areas.

National Fisheries Legislation

The main laws concerning fisheries and environmental in each PERSGA member state are summarized in Appendix I. A detailed analysis of the strengths and weaknesses of the legal framework for fisheries in each of the PERSGA member states is beyond the scope of this report. There is room for improvement in the national legislation of all PERSGA states to provide for better fisheries management and conservation.

In all states, fisheries are governed by national laws that dictate the terms and conditions under which fishing activities may take place and which provide for protection and conservation of living marine resources. Regulations (or by-laws) set out the details concerning fishing activities and restrictions that apply.

Existing national legal frameworks provide for effective management and protection of living marine resources and the environment, but to varying degrees, in the Region. A common feature in the Region is that most laws do not have the strength and clarity needed for effective management and monitoring, control and surveillance (MCS) (Lintner and others, 1995; Nichols, 1997). Common concerns include inadequate definition of terms such as 'fishing,' 'artisanal fishing vessel' etc. for sound administration and enforcement and the legal process. Penalties for infringements are frequently far too low, undermining respect for management and control, since there is minimal deterrence. Licensing systems are often unclear with inadequate or outdated schedules by which to set out forms for licence applications, licenses, logbooks, etc. Fisheries observers and enforcement officers' powers, duties and responsibilities are in some cases not described, procedures after seizure and arrest are not specified and often there is no option for imposing an 'administrative' penalty by the minister responsible for fisheries rather than a lengthy court process. Technological considerations, such as requiring fishing vessels to carry a vessel monitoring system (VMS), are lacking. National legislation should also be in line with current international initiatives, to promote cooperation in management of shared stocks as required under the UN Convention on the Law of the Sea (UNCLOS) and facilitate implementation of the FAO Code of Conduct for Responsible Fisheries and the Conservation and Management of Straddling Stocks Agreement.[4]

Illegal fishing by foreign vessels and violations of the laws and regulations by licensed vessels will not stop unless the law provides for enforcement, prosecution procedures and deterring penalty fees. For instance, off Yemen's southern coast industrial trawlers continue the damaging exploitation of the spawning stock of cuttlefish in shallow waters because the level of fines for this offence are too low to act as a deterrent (MEP, 1994a).

Level of Law Enforcement and Policing

In Egypt, GAFRD is responsible for enforcement and policing of fisheries and environmental law. Officers work closely with the Frontier Corps (Ministry of Defence). There is no data regarding efficiency of enforcement or degree of compliance.

In Yemen, existing regulations governing the demersal trawl fisheries are as follows:

- Trawling is not allowed within three nautical miles of the coast.
- The water depth for trawling must not be less than 40 meters.
- Minimum mesh size in the cod-end is 55 millimeters.
- The trawling area must be changed if the bycatch of cuttlefish exceeds 20 percent of the total catch.

Unfortunately, these and other fisheries laws are poorly enforced, resulting in habitat destruction and gear conflicts between industrial and artisanal fisheries.

In Sudan, enforcement of marine and fisheries laws is the responsibility of the Ministry of Defence through the naval forces. Surveillance and enforcement of laws is considered effective, despite a need for better training and more material support. Branches of the Fisheries Administration enforce fisheries regulations and local ordinances. They are efficient in this task but again require more training and financial and material support. Poaching has reportedly decreased since 1988.

In Yemen, under the terms of industrial fishing licences fishing vessels must carry two observers onboard, whose salaries are paid by the vessel owner. They are in daily radio contact with the Department of Marine Inspection and Control located at the Ministry of Fish Wealth Branch in Aden and provide summarized information on vessel location, activity and catch. All vessels are required to undergo an unloading inspection during which the details of the landings are recorded. However, penalties for violations of agreements and laws are very low and do not act as an effective deterrent. In addition to the low penalties, enforcement and prosecution procedures are not properly specified. A review of the fisheries legislation was undertaken under the Fourth Fisheries Project but did not have any follow-up. There is currently a new proposal for a substantive revision of fees and penalties awaiting consideration by Parliament.

Regional Fisheries Agreements

The Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment (Jeddah Convention) aims to protect the Red Sea, Gulf of Aden and Gulf of Aqaba environments. Regional agreements concerning fisheries and environment are reviewed below.

Egypt has no foreign fisheries access agreements in place.

Saudi Arabia is signatory to regional and international agreements which place obligations upon it for prevention of pollution and protection of resources. Notable among these is the Protocol Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency (1978); Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment and its Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1982); and the Declaration of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (1995).

4. United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982, Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.

Sudan has ratified the following fisheries and environment related agreements: Convention Concerning the Protection of the World Cultural and Natural Heritage (1974); Convention on Biological Diversity (1995); Convention on International Trade in Endangered Species of Wild Fauna and Flora (1982); Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment and its Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1984); Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (1984); United Nations Convention on the Law of the Sea (1985). The International Convention on the Prevention of Pollution from Ships (MARPOL) has not yet been ratified, because of a lack of port reception facilities. In 1994, Sudan attended the Meeting of African Environment Ministers in Nairobi and a year later the Arab Environment Ministers' Meeting in Cairo which discussed environmental conservation issues of the Red Sea area. In these conferences participating countries agreed to environmental conservation programmes for the Red Sea.

Djibouti and Somalia have had a fisheries agreement in place since 1986, although the details of this are unknown. Djibouti, Yemen and Somalia are signatories to an agreement to establish a subregional center, the Marine Emergency Mutual Aid Center (MEMAC), in Djibouti, to combat oil pollution in the Gulf of Aden. Oil pollution control equipment for the Gulf of Aden area (Yemen, Somalia and Djibouti) has been stored at MEMAC. Yemen and Djibouti are currently negotiating a bilateral agreement regarding the use of these facilities.

Yemen is a party to several international conventions, agreements and treaties which have implications on the marine environment. Treaties or conventions that were signed by former YAR and former PDRY Yemen are still in force according to the unification decree. In 1995 alone, four conventions relevant to environment, including the Biodiversity Convention, were ratified. Yemen has signed but not yet ratified the MARPOL Convention, due to lack of funds to purchase the necessary port waste reception facilities. Yemen is party to the following conventions: Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1996); Convention on Biological Diversity (signed 1992, ratified 1996); Montreal Protocol on Substances that Deplete the Ozone Layer (1996); and Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1992, updated 1994). Yemen cooperates with Djibouti and Somalia in combating oil spills, as noted above.

Egypt and Yemen signed a fisheries agreement in 1996 which permits Egyptian industrial trawlers access to Yemeni waters. Information about the ventures operating trawlers in the Red Sea is not readily available. It appears that in one case, fifteen Egyptian trawlers are operated through a Yemeni agent under a bilateral access agreement between Yemen and Egypt. In the other case, a Yemeni company has permission to operate fourteen chartered Egyptian trawlers.

In Somalia, no access agreements are in force for foreign vessels to operate off the northern coast. Spanish and French tuna vessels fish under licence off the Indian Ocean coast.

Data Collection, Fisheries Research, Training and Extension Services

In Jordan, the Ministry of Agriculture collected fisheries data up to 1985, when access to neighboring waters ceased. Since then, the government has undertaken little research or management activities in the sector. Training and extension for artisanal fishermen will only expand if access to neighboring waters can be secured (Khalaf, 2000).

In Egypt, the NIOF has field stations at Suez (96 staff, of which 31 are involved in research) and Ghardaqah (55 staff, 4 involved in research). The Suez station is well equipped with laboratories and research facilities, but the Ghardaqah station has limited facilities. Egypt has no research vessel for applied stock assessment. Main research areas include physical and chemical oceanography, pollution research, fisheries biology and shrimp culture research. In addition a number of the national universities and institutes at Suez and Alexandria are involved in fisheries research. GAFRD has overall responsibility for the development and conservation of fisheries resources. GAFRD is

responsible for collecting statistics and enforcing regulations, and for training and extension activities in fisheries and aquaculture. Twenty three enumerators collect data on Red Sea fisheries (10 for the Red Sea, 2 for the Gulf of Aqaba and 11 for the Gulf of Suez). Landings and species composition data are collected at landing sites. Data coverage for the artisanal fleet is reported to be good (Barrania, 2000). Effort data are available through licence allocations; the Fisheries Department and cooperatives maintain vessel registers on vessel specifications, gear and licence conditions. The Coast Guard authorities maintain data from fishing vessel logbooks completed by the skipper with regard to fishing grounds and trip dates. No stock assessment research has been conducted in Egypt since the early FAO/UNDP assessment studies in the 1980s.

With regard to fisheries training and extension services, annual training plans are developed for fishermen and fisheries cooperative staff. Workshops are frequently held covering topics such as fisheries technology, fisheries management, preparing fishing projects, fish culture, cooperative management and legislation. GAFRD has active public awareness campaigns.

National institutes and universities also offer extension and training services to the fishing community. The government operates an active programme of study tours and training sessions for senior staff from government and academic institutions through bilateral arrangements with numerous countries in Europe, South America and South East Asia.

In Saudi Arabia, Ministry of Agriculture enumerators collect catch and species composition data at sampling sites by interviewing fishermen. The Coast Guard Authorities collect effort data in the form of boat trips and gear used per trip. About fifteen enumerators are employed at nine sample stations: Dhuba, Umm Lajh, Yanbu, Tuwwal, al-Gad, al-Badhea, al-Lith, al-Qunfudha and Jizan. Data collection forms are well developed. Daily recorded data are compiled at fisheries out-stations into monthly summaries, along with the Coast Guard vessel trip information. The data are then passed to Department of Fisheries headquarters for final analysis and production of annual summary statistics. No weights are recorded during sales to merchants, thus the sampling data raised to national level is the only estimate of fisheries production in Saudi Arabia. Despite the importance of sharks, no special forms are used for recording dried fin production or gross landings of shark. A vessel licence and specifications register is maintained by the Ministry of Communications. In addition, industrial vessels are required to keep daily catch and effort logbooks which are sent to the Ministry of Agriculture. Fisheries research in the Red Sea area is conducted by several institutions, among them the Fisheries Research Center in Jeddah, which operates under the Ministry of Agriculture and Water, and the Faculty of Marine Sciences at King Abdulaziz University, Jeddah.

In Sudan, fisheries research is conducted by the Faculty of Marine Science and Fisheries of the Red Sea University and the MFRC, which operate under the Federal Ministry of Agriculture. Both institutions are located in Port Sudan. Over the last 15 years, the MFRC has been concentrating on pearl oyster research. For the marine fisheries, data are collected from various sources. One enumerator visits Port Sudan market seven days each month and records catch composition, weight and sizes of fish that day. At Suakin, one enumerator from the Marine Fisheries Administration collects data from vessels as they land. One Marine Fisheries Administration fisheries observer is assigned to accompany foreign industrial trawlers. When unloading, the catch from trawlers is estimated by multiplying boxes full of fish by 20 (each holds about 20 kilograms). The data maintained on foreign vessels is better than that for national vessels, especially the artisanal fleet. Fisheries cooperative managers also supply monthly statistics to the Marine Fisheries Administration on the landings and catch composition of member fishermen. Finally, export figures from exporting companies and cooperatives are available from the data recorded on export certificates. The Marine Fisheries Administration statistical division is responsible for data collation and analysis. Data are passed to the fisheries headquarters at Khartoum and used to estimate total production by species class each year. Fishing vessels are expected to complete catch logs which provide catch and effort, species caught, gear used and area fished. The national

licensing system provides information on vessel characteristics, and the name of the owner and skipper, but not the gear used, number of crew or where fishing occurs. Applied stock assessment research in Sudan has been limited to the work conducted during the 1980s by ODA (Brandford, 1979; O'Riordan, 1982) and FAO (Anon, 1988). The latter indicated a total sustainable yield of 10,000 metric tons per year for all Sudanese waters and this is the figure used by government as a guide for long-term planning.

In Yemen, the MSRRC is the successor of the research branch of the Public Corporation for Fish Wealth (1970-1978). The MSRRC was established with assistance from the IsDB. In 1983 the headquarters building was completed on Labour Island in Aden. Through a UNDP funded project, UNESCO provided technical assistance to Yemeni scientists during 1983-1986 in the fields of marine biology, physical oceanography and fish stock assessments. The Japanese International Cooperation Agency (JICA) donated a 38 meters stern trawler, the R/V Ibn Majid, originally for training but later converted to basic oceanographic and fisheries research. For inshore work the MSRRC has a small 10 meters GRP launch 'Donafa'. However, both vessels are currently in need of major repairs. They are laid up at the MSRRC site on Labour Island in Aden and have not been used for research for several years.

The MSRRC has a large modern Mariculture Research Center (MRC) in little Aden, fully equipped under a grant from Japan. The MRC focuses on penaeid shrimp culture. In addition, the MPC was completed in 1991 with the objective of developing methods to monitor pollution in Yemeni coastal waters. The MPC runs under the supervision of the MSRRC. Unfortunately, the work of the MSRRC, its branches and research stations is severely hampered by shortages of equipment, recurrent funding and institutional management capacity. The MSRRC has a branch in Mukalla and has plans to open a new one in al-Hudaydah on the Red Sea coast. Other Yemeni institutions undertaking fisheries research include the Department of Oceanography in Sana'a university and the Biology Department in Aden University.

Fisheries training and research in Yemen started in 1970 with the construction of the FMDC and in 1990 new premises, financed under a World Bank/IDA grant (Third Fisheries Development Project), were established next to the headquarters of the MSRRC on Labour Island in Aden. The FTI, as it is known at present, offers a five year training programme for young students who have obtained the General Education Certificate (nine year schooling-primary and intermediate) and who passed physics, mathematics, chemistry, biology and the FTI entrance examination with high grades. Graduates from the FTI receive a Technical Diploma on fishing and fisheries industrial skills. The FTI also organizes short-term training courses of three to six months to upgrade skills in the fisheries sector. Such courses include marine mechanical and electrical engineering, refrigeration and air-conditioning engineering, marine navigation, fish processing and handling and workshop machinery. Enrolment of trainees to sixty students annually.

The Marine Fisheries Administration in Sudan is the main public sector department devoted to extension services and is well represented along the country's entire Red Sea coast. Over the past years, FAO provided considerable assistance for extension services in reestablishment of cooperatives, mechanization of vessels, repair and maintenance, and exploratory fishing. Today however, many of these functions have declined since FAO assistance was terminated. The Faculty of Marine Science and Fisheries of the Red Sea University in Port Sudan provides formal education in fisheries sciences. The NGO community is active, especially the Sudanese Environment Conservation Society (Port Sudan and Suakin), the Sea Friends Association (Port Sudan) and OXFAM of the United Kingdom (Port Sudan and Tokar). All NGOs work towards establishing environment conservation programmes, revolving funds, and capacity for training and marketing. The SMCC is a semi-NGO with representatives from concerned public sector bodies, the private sector and environmental NGOs. It plays an important role in raising environmental awareness issues and policy advice.

In Somalia, data are not collected in an organized fashion. Some information on landed weight, species composition and sometimes length frequency

of the catch is collected by a Ministry of Fisheries enumerator at landing centers in Zeila, Lughaye, Bulahar, Berbera, Karin, Laas Qoray and Elayo. Data are complied at the regional fisheries office and then passed to Ministry headquarters at Hargeisa. Despite the problems facing Somalia's fisheries authorities, record forms are well developed for vessel registers for both artisanal and industrial vessels, licences, daily catch and effort logbooks. Special forms have been developed to monitor the artisanal shark fishery, in terms of fisherman details, gear, number of sharks caught, species, sex and fin weight produced.

The current status of Somalia's Fisheries Training and Commercial Center (FTCC) at Berbera is unclear. Catch landing data are reportedly recorded on beaches and sometimes on vessels. These are compiled on a monthly basis by category (demersals, pelagics and sharks). Data collection is however very poor at present. No licensing system is functional.

7

Collecting Activities for Aquarium Trade

Present and Planned Activities

The marine aquarium fish trade offers considerable interest to the Region and several countries have developed industries or are considering such developments. The world market is supplied by relatively few exporting countries. Bahrain is an irregular supplier to Europe, especially the United Kingdom. Kenya is the biggest exporter in East Africa, where the fishery is well controlled and highly organized. Mauritius exports small but consistent amounts of aquarium fish to Europe. Sri Lanka and the Maldives are two of the largest producers in the world, with Philippines the world leader in terms of value and volume of exports. Singapore is a significant producer country, but much of its market is re-exports for Indonesia and Thailand. Indonesia is a major direct supplier to the United States, Germany and Singapore. The supply of Red Sea fish on world markets is limited and nothing is available from the Gulf of Aden.

Collection of aquarium species in Egypt was a thriving industry some years ago, but all activity has ceased due to the high prices charged and relatively low quality of the product because of poor handling through Cairo. No plans to reactivate the industry are indicated.

In Saudi Arabia at least seven companies are involved in the collection and export of aquarium fish.

At present two companies in Yemen are licensed to collect coral reef fishes for the aquarium trade. More licenses are expected to be issued in the future.

In Djibouti, Barratt and Medley (1988) studied the potential of exploiting tropical marine fish for the aquarium trade. They concluded that there is a substantial market for good quality Red Sea and Western Indian Ocean fish. Djibouti waters hold the commonest and popular species including damselfish (family Pomacentridae), butterflyfish (family Chaetodontidae), angelfish (family Pomacanthidae) boxfish (family Ostaciidae), pufferfish (family Tetraodontidae), triggerfish (family Balistidae), surgeonfish (family Acanthuridae) and wrasses (family Labridae). They noted that there is a need to undertake a thorough systematic survey of the reefs in Djibouti and their stocks and that management plans for the aquarium fish industry should be developed before the industry expands.

There are also plans by the private sector to collect ornamental fish in Somalia.

8

Ongoing and Planned Mariculture Projects

Aquaculture Production Since 1988

To date, the aquaculture industry in Egypt has been restricted to fresh and brackish water pond and lake culture along the Mediterranean coast and in the Nile Delta, where tilapia, grey mullet and carp are farmed. Mariculture on the Red Sea coast is virtually non-existent, largely due to the considerable investments required for intensive production of marine juvenile and adult fish. Reluctance to promote aquaculture in an area designated for tourist development is also a factor. Nevertheless there is clearly potential for various aquaculture systems on the Red Sea, including extensive culture in lagoons, artificial lakes and penned enclosures as well as semi-intensive and intensive aquaculture development on shore based sites or in floating marine cages. Such development, if planned effectively, should not be at the expense of tourism development. Indeed, the rapidly increasing demand from the tourist industry for high value fish is a key stimulant to the future of coastal aquaculture in the Red Sea and a number of tourist resorts have included fish farms in their own planning proposals.

A number of potential sites have been identified by various authorities. With the advent of commercial hatchery technology for marine fishes, many local and Mediterranean species have potential for culture. These include breams (*Sparus auratus* and *Pagrus major*), seabass (*Dicentrochus labrax*), grouper (*Epinephelus* spp.) for tourist and export markets and grey mullet (*Liza* spp.), rabbit fish (*Siganus* spp.) and euryhaline tilapia for domestic and regional markets. Water temperatures are probably too cold to permit the two crops needed a year for commercial shrimp culture. One private concern currently farms shrimp in the Gulf of Aqaba, 30 kilometers from Sharm El Sheikh along the Gulf of Aqaba coastline. EEAA monitors the farm, which has twenty earth ponds covering around 50 hectares. The shrimp farm in Egypt has a target production of 100 metric tons/year of *Penaeus japonicus* and *P. semisulcatus* shrimps and 3-5 million post-larvae. Another shrimp culture farm is expected to be established on a 40 hectare area either in Za'afrana south of Suez or in Quseir (Sadek and Gamal, 1997).

In Saudi Arabia fish culture is a relatively new activity. There are eighty-eight fish farms, but most are used for freshwater aquaculture. Saudi Arabia's total aquaculture production in 1997 was 3,775 metric tons of which 2,945 metric tons was from freshwater culture and 830 metric tons from marine culture (see Table 17).

In Sudan, mariculture started as early as 1904 with the pearl shell oyster, *Pinctada margaritifera*, in Dongonab Bay, 110 miles north of Port Sudan and Mohammed Gol. Pearl oyster shell production peaked in 1971 at 118 metric tons, but the average annual landing of wild oysters declined to 25 metric tons in subsequent years. Oyster farming flourished in Dongonab,

TABLE 17: MARINE AQUACULTURE PRODUCTION (MT) IN SAUDI ARABIA, 1988-1997

Year	Production
1998	11
1989	19
1990	52
1991	136
1992	179
1993	188
1994	35
1995	261
1996	158
1997	830

Source: MAW

where up to 65 family farms, with 130 local beneficiaries, were established. Large-scale farming stopped in 1969, following mass mortalities. However export continued, mainly based on wild populations. Between 1966 and 1989, the average annual export rate was 37 metric tons. In 1992-1993 production amounted to about 40 metric tons. During the last two years, the Dongonab oyster culture scheme has been revived and Mohammed Gol added as an additional site. Local villagers were entrusted with operating 36 farms in Dongonab and 15 in Mohammed Gol. The farms, which grow some 6000 oysters each, are supervised by scientists. Growth rates were improved, enabling partial cropping after 2 years rather than 3-4 years. Present production based on 30 percent mortalities is about 14.3 metric tons from 51 farms 214,200 oysters (at 15 oysters/kilogram). Projected production is 30 metric tons from 65 farms at Dongonab and 40 farms at Mohammed Gol.

Fishermen from the Dongonab area rely on further development of the oyster culture scheme as their main source of income. Market prices, which are currently at SDP 1,600/kilogram, are encouraging. However mortalities are still high (up to 50 percent) and it is recommended to shift from the present bottom culture to floating rafts, despite the high costs in establishing this technique. The traditional oyster culture site at Dongonab has limited carrying capacity. Exceeding maximum densities leads to mass mortalities, as happened in 1969. This has to be considered when planning future expansion of oyster cultures. OXFAM United Kingdom/Ireland currently funds oyster farms under the supervision of the MFRC as part of a community development project (FRC/IDRC 1985, Mishrigi 1993).

An integrated fisheries project in Sudan includes the establishment of several shrimp hatchery and grow-out facilities in the Port Sudan area. The target is 30,000 metric tons of shrimp per year.

There are no mariculture activities in Djibouti.

In Yemen, some prawn research studies have been conducted at the MRC but shrimp farming has yet to develop as a commercial activity.

Somalia has not developed a mariculture potential and is unlikely to do so for the foreseeable future.

Environmental Threats Arising from Mariculture

Threats to coastal and marine environmental resources, including those posed by mariculture, are listed in the PERSGA National Fisheries Reports and Country Reports (PERSGA, 1997a-1997i, published in consolidated form in 2001). The major concern comes from planned shrimp and fish pond construction activities. With regard to shrimp farming, environmental impacts include: clearing of coastal areas/mangroves for pond construction; pond dykes diverting the normal flow of freshwater to the sea with consequent effects on the area where it flows; removal of adult shrimps from the Red Sea as brood stock for the hatcheries may affect recruitment to wild populations; effluent discharges from shrimp ponds is the largest concern (El Naiem, 1990; 1988).

Irreversible damage to coastal habitats, destruction of mangroves and declining water quality on coastal areas may result if mariculture activities are not well planned and if Environmental Impact Assessments (EIAs) are not undertaken as a prerequisite to approval of new developments. The use of chemicals and hormones and their effect on the marine ecosystem, plus increased nutrient loads caused by the farming operations pose additional potential threats to the environment. In all cases where mariculture expansion is a development goal, government intends to impose adequate control measures, including a requirement for EIA studies to be undertaken by an independent author-

ity, before licensing of mariculture ventures will be allowed.

In Egypt, France Aquaculture had planned to develop 65 sites on the Red Sea coast for mariculture in the 1990s. However given the priority attached to tourism, these plans were not authorized. The size and scope of current shrimp farming activities indicates minimal impact on the environment, although there is no available information.

In Sudan, mariculture of pearl oyster has had no noticeable effects on the environment (Rahama, 1990). Mass mortalities have occurred such as in 1969, as a result of high stocking densities and adverse environmental factors. Current plans to use bays with good circulation, floating rafts rather than bottom culture trays and appropriate stocking densities should lessen problems in future (Gabor, 1995).

9

Fisheries Threats to Coastal/Marine Habitats and Resources

Fisheries operations in the PERSGA Region pose a number of direct threats to the marine resources upon which they depend, as well as indirect threats to the coastal and marine environment. Other reports produced by PERSGA summarize the threats to the coastal and marine environment and marine resources (PERSGA 1997a-i). These will not be repeated here but can be categorized as follows:

- Habitat degradation and destruction (due to coastal development, shrimp and fish farm pond construction, mangrove destruction, physical damage to coral reefs and damage to reefs by tourists).
- Living marine resources (overfishing, illegal fishing, collection of turtle eggs, infringement of fisheries laws).
- Navigation and maritime risks (vessel discharges, vessels running aground)
- Petroleum industry transport and developments (oil spills, oil exploration, oil terminal construction).
- Industrial activities (surface groundwater usage, industrial pollution, waste disposal).
- Urban development (surface and groundwater usage, saltwater intrusion to aquifers, solid and liquid waste disposal); plus agricultural threats (sedimentation, pesticides, and fertilizers).

A number of common threats specific to fisheries are expanded upon below.

Unsustainable Exploitation of Living Marine Resources

Increasing fish prices have led to a steady rise in the number of people involved in fisheries and fishing effort has increased in an uncontrolled manner. A general lack of adequate management controls for fisheries has led to the present situation.

As mentioned previously, Egypt's trawl, purse seine and reef associated fisheries are all considered over-exploited. The fishing grounds in and around Foul Bay are fully exploited. Severe fishing pressure, coupled with water pollution in the Gulf of Suez and the Red Sea, have been indicated as negative impacts on fisheries.

In Sudan, stocks are fully exploited in waters adjacent to Suakin in the south and Mohammed Gol in the north. A steady decline has occurred in catches of finfish species of snapper such as *Lutjanus bohar*, *Aprion virescens* and *Pristipomoides filamentosus*. In the Suakin area landings of the trochus shell *Tectus dentatus* have declined and the main area of production has now shifted to Mohammed Gol. Production from Suakin dropped from 163 metric tons in 1990-1991 to 26.3 metric tons in 1992-1993 and exports as a whole declined from 485 metric tons in 1991-1992 to 432.7 metric tons in 1994-1995. CPUE has dropped from 3 to 1.5 metric tons per

trip. Shark resources have also shown rapid decline to only 163 metric tons in 1990-1991 to 26.3 metric tons in 1993/94. Catches of 'najil' (*Plectropomus maculatus*) show a high percentage of small sizes due to the use of finer mesh nets. Collection of turtle eggs on offshore islands is common as an alternative food source, although the degree of turtle exploitation is largely unknown in Sudan.

In Djibouti, no comprehensive scientific studies of the effect of fishing on coastal and marine environments have been completed. Although parts of the coasts and territorial waters are still in a largely pristine state, some studies show that in several areas there are alarming signs of degradation and threats are increasing rapidly. Anthropogenic pressure is particularly high in the vicinity of the capital.

In Yemen, the lucrative industrial fishery for cuttlefish (*Sepia pharaonis*) in the Gulf of Aden provides a clear example of overfishing and resultant decline of the fishery. Damage to the spawning biomass during the 1970s and 1980s was caused by the trawling operations of large stern trawlers from Japan, the former Soviet Union and also Yemeni companies operating under license or through joint venture arrangements. The stock today has still not recovered and remains far below its biological potential. Similarly the deep sea lobster (*Pereulus sewelli*) was also overfished during the same period, often by the same trawlers operating deep-water gear at times when cuttlefish were not available. Reasonable data for landings by the Gulf of Aden rock lobster fishery targeting *Panulirus homarus* and *P. versicolor* off the coast of Yemen indicate that landings have declined since 1990 and the average size of rock lobster has decreased; despite government attempts to initiate management controls, these have not been successful due to inadequate enforcement and lack of compliance by fishermen.

Declines in the landings of sharks by fishermen operating in Yemen's Red Sea waters and in Sudan are an indication of overfishing, probably due to intensive fishing efforts for the purpose of exporting dried shark fins.

Practices Harmful to Living Marine Resources

In Egypt, use of explosives is recorded and has resulted in damage to coral reefs in some areas of Egyptian Red Sea waters. Although the existing law bans certain types of gear for certain fisheries, poor enforcement has resulted in the unlawful use of some gear.

The Sudanese Red Sea environment is still in a largely pristine state. However, with the present growth rates of the coastal population, marine transport and industrial development, threats are increasing rapidly. Human-induced pressure is particularly high in the vicinity of the two coastal cities, Port Sudan and Suakin, and in the mangrove areas.

The implementation of the Sudan Integrated Fisheries Project is expected to cause major destruction of coastal habitats (CIDA, 1995). At the entrance of Port Sudan harbour, 5-8 hectares of land will be reclaimed from the sea by landfill for the construction of industrial processing plants. This will cause loss of coastal and marine habitats and coral reef areas such as Wingate and Towartit. Effluents from the tuna and shrimp processing plants will pose additional threats to the marine environment. The risk of immediate and cumulative impacts is very high, unless appropriate environmental precautions are taken.

Physical damage to coral reefs, resulting in a loss of coral habitat and decline of reef associated fauna, is caused by anchorage. Wingate and Towartit reefs are still the main anchorage areas for large vessels waiting to enter the port for unloading and loading. Fishing vessels and tourist boats are also damaging reefs with anchors and fishing nets. There is an urgent need of moorings. Wading in shallow reef areas by artisanal fishermen and tourists to collect corals and invertebrates, results in coral breakage.

There are signs of coral die-off at several sites on the fringing reef, for example, parts of Wingate reef. The causes are unknown and this phenomenon needs urgent investigation. Mangrove habitats are deteriorating rapidly along much of the Sudanese coast, resulting in reduced water quality and a decline in fish and shrimp catches, and in bird populations.

In the absence of alternative affordable energy sources, mangrove wood is used as fuel. As a result of several years of drought, more than 50,000 nomads together with their camels moved into the coastal zone. Above all in the southern part of the country, camels are browsing heavily on mangroves. The damming of wadis diverts the already scarce freshwater away from the mangrove habitat. Some mangrove areas have been completely destroyed. Mangrove destruction must be considered a major hotspot issue. The construction of an asphalt road linking Suakin with Tokar will increase human activities in the area.

In Djibouti, habitat destruction as a result of coastal development is still rather localized and concentrated in the capital area. The construction and expansion of the port resulted in severe pressure on coral reefs. Mangrove habitats are deteriorating rapidly along much of the coast of Djibouti, resulting in reduced water quality and a decline in fish and shrimp catches. In the absence of alternative affordable energy sources, mangrove wood is used as fuel.

As a result of several years of drought, an increasing number of nomads together with their camels moved into the coastal zone. In some areas, camels are browsing heavily on mangroves. West of the capital, where there used to be a very extensive mangrove, some stands have been completely destroyed and the remaining ones are severely threatened. In this area mangrove destruction must be considered a major issue. Of eight mangrove areas investigated in a recent study, two were classified as in good state; two as in good state, but locally exploited; one as partially degraded; two as degraded; and the one at Gaan Maan as severely degraded.

Physical damage to coral reefs, resulting in a loss of coral habitat and decline of reef associated fauna, is very severe near the capital and in the Marine Protected Areas (MPAs) of Musha and Maskali. Reefs in other areas are affected to a lesser extent. Reefs near the port of Djibouti, which were once flourishing, are rapidly degrading because of silting. In popular recreational areas, such as the reserves of Musha and Maskali and near Khor Ambado, corals are severely damaged by visitors. Anchor damage is obvious. The collection of corals and reef associated invertebrates and the use of spear guns, although illegal, continues at a large scale.

Signs of degradation of reefs in the Strait of Bab-al-Mandab have also been reported, which may possibly be attributed to the heavy ship traffic in the Strait (see also comments in Sheppard and Wells 1988). Surveys conducted in the 1980s on the ecological status of twenty-three reef areas throughout the country indicated nine to be satisfactory, all of which are in the western part of the country; three are classified as medium; four as bad; and eight as disastrous. In some reef areas, there were signs of coral die-off without obvious reason.

In Yemen, there are frequent conflicts between the cuttlefish trawlers and the local artisanal fishermen in the Gulf of Aden. The heaviest concentrations of cuttlefish are found in shallow waters, especially during the spawning period, and complaints abound regarding illegal trawling within the three mile limit and shallower than the law allows. One company openly admits that this is a common practice. As a result, trawlers have been shot at by armed fishermen and by the Navy and detained for periods up to a week.

Other conflict situations occur when the trawlers cut or destroy fishing gear used by the artisanal fishermen for which the latter demand compensation. There has been a dramatic increase in such conflicts since 1995. In the Red Sea there are widespread complaints in regard to large foreign trawlers operating illegally or licensed under access arrangements in Yemen waters and others concerns of artisanal fishermen, which require action by the Ministry of Fish Wealth. Problems reported include:

- Direct competition for shrimp and demersal fish, causing a reduction in catch rates for the artisanal fleet.
- High rate of discards of juvenile demersal fish, causing a decline in the stocks.
- Damage to or loss of local fishermen's nets.
- Destruction of habitat by indiscriminate use of heavy trawl gear.

- Fishing for shrimp during the closed season under the pretext of fishing for demersal fish.

In Somalia, some artisanal lobster diving fishermen have been reported to use sharp iron bars to drive rock lobsters from their crevices causing damage to the reef. Taking egg-bearing females and undersize specimens is also common. There have also been reports from Somalia and Yemen of occasional poaching by unnamed foreign trawlers, using pair trawl nets with heavy ground gear that badly damage the habitat, and small cod-end mesh sizes that catch undersize and juvenile species (Elder, 1987).

Poaching by Foreign Vessels

Data are lacking throughout the Region regarding infringements by foreign vessels. Although anecdotal information is available from fishermen and officials, there is virtually no documented information available by which to quantify illegal fishing practices.

The problem is exacerbated by the fact that few common marine boundaries have been negotiated and agreed between neighboring states; indeed, within the Red Sea, the issue of maritime jurisdiction is a complex and persistent problem. Fishing by flag vessels other than those of the states surrounding the Red Sea is uncommon. Poaching by foreign vessels in the Gulf of Aden is commonly reported.

Somalia's domestic problems have meant that no functional government has been in place since 1990. Consequently no MCS and enforcement of fisheries has taken place in the waters over which it claims jurisdiction. No licences are issued to foreign vessels, however Somalia's waters (both off the north and eastern coastlines) have become literally an open access area for many industrial vessels of various flags using a range of gear, from small Pakistani gill netting Dhows to large Taiwanese pair-trawlers and Italian and South Korean stern trawlers. The area around the Cape Guardafui reportedly attracts more illegal activity than the Gulf of Aden and the Southern sections of the coast (FAO, 1995).

In view of the common problems facing the countries in the Region in regard to implementing effective systems for MCS of fishing activities, there is a strong case for increased regional cooperation in this area. This is discussed further in Chapter 11.

Present and Anticipated Future Problems Facing the Fisheries Sector

There are a number of common problems facing the fisheries sectors of the countries in the Red Sea and Gulf of Aden. These can be summarized as follows.

INADEQUATE INFORMATION BASE

A major problem is the current lack of accurate, reliable and timely basic data from the fisheries. Current data collection systems lack planning and transparency. Data formats vary widely and are often not amenable to effective stock assessment or monitoring of fisheries management regimes currently in place. At the national level a lack of comprehensive biological and economic statistics is a major constraint to effective fisheries management. This is compounded by a lack of awareness or application of the precautionary approach principle currently being adopted by other countries to good effect.

The current state of overfishing in the Red Sea and Gulf of Aden is not unique: the history of marine fisheries is full of incidences of overfishing and stock collapses resulting in failure of fishing industries and bankruptcies. It can be argued that the primary objective of fisheries management and planning of fisheries development is to avoid overinvestment. When limited background data is available, the precautionary approach should replace the 'optimistic' approach taken by investors in the fishing sector. Knowledge and understanding about the real underlying ecosystem and dynamics of fish stocks are crucial to informed decisions.

For stocks targeted by small-scale/artisanal fisheries that provide livelihoods for hundreds of thousands of people and food for many more, the information systems in place throughout the Region are particularly poorly developed. This is largely due to the general difficulty of obtaining information from diffuse and widespread sources, including from the communities themselves, par-

ticularly where fish products do not enter the formal economy. The standard methods used for small-scale fisheries statistical systems (census/frame surveys, stratified sampling programmes, etc.) are lacking. Thus even the key parameters such as catch, fishing effort, price and participants in the fisheries are largely unknown. Chakraborty (1984) developed comprehensive manuals for the collection of fisheries statistical data that could be applied throughout the Region. The basic premises of his work are still relevant today.

In addition to the fact that tropical fisheries are inherently difficult to manage because of the diversity of species harvested, issues for effective management center on the insufficiency of data upon which to initiate a substantive programme of fisheries management. Management for targets of maximum or optimum sustainable yield, however, must await an improved database of catch and effort. The problem of collecting reliable data are discussed in more detail in Chapter 11.

Need for Effective Management

Fisheries management policies are not currently well defined, and are not based on reliable scientific information. There are inadequate human and financial resources for administration of the sector. Modern guidelines such as the Code of Conduct for Responsible Fisheries is not yet part of national legal frameworks. The adoption of the precautionary approach has considerable implications for fisheries management agencies and the fishing industry. Scientific advice to fisheries managers should allow for uncertainty in both the understanding of the state of the stocks and the effects of future management actions. When less is known, fisheries management agencies should be more cautious. This requires a management approach less focused on and influenced by short-term considerations, and more concerned with long-term sustainability of fisheries resources and the environment.

Overfishing, due to over-capacity and ineffective application of controls, is the major problem facing many of the Red Sea fisheries. High prices for fish attract new entrants to the fisheries, leading to uncontrolled effort expended on the resources.

Additional attention will need to be paid to management of migratory species that traverse international borders; this will require regional management. Destruction of important coastal habitat (landfill of mangroves, filling in of back reef lagoons, etc.) will need to be reduced since this translates directly into reduced recruitment to exploited populations.

Socio-economic factors also need to be considered in establishing objectives for the management of fisheries. Unfortunately, all desirable objectives cannot usually be met simultaneously, and one of the main roles of fisheries management agencies in a precautionary approach would be to derive trade-offs between competing objectives in consultation with interested parties. Whichever approach is taken, it will be necessary to quantify objectives and trade-offs if they are to be translated into measurable factors such as the level of fishing mortality. The more limited the available information about a fishery, the more cautious managers should be in opening the fishery to exploitation.

Inadequate Basic Applied Research

Institutions involved in fisheries research need to focus on applied research of the type that facilitates development of appropriate and effective management regimes for living marine resources. Greater involvement of the fisheries sector in formulating annual work plans for national research institutions would result in more needs-directed research. The fishing sector likely would be more amenable to increasing funding for research if it had more say in setting research priorities and saw greater practical use made of the results.

For stocks targeted by the industrial sectors, data on landed weights for major species, and size/weight distributions of the catch are either not gathered, not comprehensive or simply unreliable. Information on biological parameters such as reproductive state, stomach contents, length-weight correlation, age structure of the populations etc. are not collected, either by seagoing observers or port inspectors. Stock assessment surveys of commercial species have in some cases resulted in

nothing more than a species list and distribution map of the fish caught, without providing any real stock information upon which management strategies could be developed.

Shore Infrastructure

For some countries, such as Sudan, Somalia and Yemen (on its Red Sea coast), a lack of adequate shore facilities is a major constraint. Inadequate or absent landing jetties, service facilities including workshops, ice and cold storage facilities, spare parts and fuel facilities handicap fishing communities and constrain the quality and therefore ultimate value of the fish landed. In the case of Sudan, there are virtually no shore facilities, with the exception of Suakin and Abu Hashish, for boat and engine repair facilities, freshwater, ice and cold storage. The road infrastructure is very poor causing difficulties in delivering quality products to consumers. In Somalia the closure of the former processing and storage facilities, which were the primary markets for the bulk of the fishermen, has meant that many fishermen are now redundant. The physical deterioration of existing onshore infrastructure, through natural and human damages, presents enormous difficulties for future rehabilitation and intervention.

Integrated Coastal Planning

In general, legislation on fisheries and environmental is in need of revision and updating in order to make better provision for both fisheries and environmental conservation. Integrated coastal management is also lacking: tourism and oil industries are afforded high priority, but the negative impacts of such activities on coral reefs, nursery areas and fishing grounds are not considered in policymaking for these lucrative sectors. Environmental Impact Assessments are generally not undertaken for new projects.

A common feature is the lack of effective communication between those formulating fisheries policy, and the fishing industries and communities who are ultimately affected by the management measures imposed. This results in poor understanding of the need for, and agreement with, management measures. Considerable opportunity therefore exists for increasing the involvement of rural communities in the development and implementation of appropriate management measures for coastal living marine resources. This trend of a 'bottom-up' approach to fisheries management is being used increasingly throughout the world.

For example, many of the environmental problems facing Saudi Arabia require an integrated approach for their solution. Such an approach has been difficult due to the sectoral Organization of its government. Recent efforts in creating Advisory Councils and a national coastal zone management plan may begin to address this issue. Development along Saudi Arabia's coastline has historically proceeded out without environmental impact assessment as a pre-condition.

Extension Services, Training and Public Awareness

These services vary throughout the Region. Public awareness of the need for a balance between fisheries and environmental protection and conservation requires urgent attention. Many of the undesirable activities currently practiced (such as use of explosives, dumping of used gear at sea, poor fish handling practices leading to lower value products, etc.) could be reduced considerably if more physical and financial means were provided to national authorities in order to facilitate improved extension and training services and public awareness campaigns.

Access to Affordable Credit

This is a major problem underpinning fishing activities. In Egypt and Sudan, fishermen must obtain credit through the so-called 'unofficial credit' system operated by fish merchants and retailers. This often results in inefficiencies and blatant extortion. The high interest rates and difficult repayment terms required by banks often put such credit lines beyond the reach of smaller and more impoverished fishermen. In Somalia, a scarcity of foreign exchange due to the trade situation has resulted in an inability to purchase fishing materials such as nets, hooks and boats.

Poorly Developed Market Systems

Monopoly activities by a few large traders or 'middlemen' tend to stifle the rational development of the market, due to vested interests. Sudan's artisanal fishermen in areas far from Port

Sudan are constrained by the lack of proper roads, communications and shore facilities. No ice production or cold storage facilities exist outside the urban areas. The problems facing Somalia's artisanal fisheries are exacerbated by the remoteness of the fishing villages and the inadequacy of government institutional capacity. Fishing effort is limited due to lack of trained technicians (boatbuilders, engineers, refrigeration specialists), chronic shortage of spare parts, fuel supply and working capital. A similar situation is faced by the artisanal sector elsewhere in the Region.

Tourism

In spite of the undisputed benefits that tourism has brought to the Region, especially in Egypt, measures are required to ensure that the tourism industry works within a framework of integrated coastal zone management that ensures conservation and protection of living marine resources. Natural resources such as coral reef systems in the Red Sea, the nesting and breeding grounds of marine turtles, mangroves, areas inhabited by birds etc. are a considerable draw to tourists and their future conservation needs to be ensured.

Development along Saudi Arabia's coastline historically proceeded without environmental impact assessment as a pre-condition. For example, 'corniche roads' have been built by land-filling to the reef edge; private villas and coastal cities have been developed with extensive dredging and landfill; and municipal sewage outfalls have been built in proximity to recreational beaches. Now EIAs are required for development projects and there is an immediate need for a structured programme of environmental assessment and integrated planning for projects that have an impact on coastal resources.

Marine Aquarium Trade

Reef ecosystems are highly sensitive to any form of fishing. In areas such as the Philippines and Indonesia, uncontrolled collection of aquarium fish species, often with harsh techniques, has resulted in damage to the reefs similar to that witnessed in areas where dynamite fishing occurs. Aquarium fish collection is currently only undertaken in Saudi Arabia and Yemen to any extent and thus poses only a moderate threat to the living marine resources of the Red Sea and Gulf of Aden. However this is an emerging issue that urgently requires attention.

Before expansion of the aquarium fish industry proceeds, the following should be considered and appropriate plans developed:

- Systematic and thorough survey of reefs and the aquarium stocks present.
- Control to ensure no over-exploitation of accessible reefs, in order to avoid direct consequences to diving tourism.
- Consideration of a possible predator/prey interaction whereby aquarium fish removal takes food from important artisanal reef fish species.
- Establishment of 'no take' zones which would serve as functional sanctuaries for aquarium species. Buffer zones should be established between exploited and 'no-take' zones. Such zones could form part of a larger system of MPAs.
- Training of collectors in methods that are non-destructive and result in minimal damage to corals and fish.
- Good monitoring of the fishery (collection of detailed catch data by species and by area) and careful control (allowable harvesting areas, restricted number of vessels/operators/companies). Licensing offers an effective management tool for a thriving, sustainable industry that can produce a quality product.
- Development of guidelines for handling and marketing.

Pollution

In Djibouti, there is a constant threat of oil spills of varying magnitude along the coastline. Oil may leak from oil terminals and tankers, causing chronic pollution in the intertidal zone. Considering prevailing currents and winds, oil pollution may occur in almost any part of the coast, at least at certain times of the year. Tar balls originating from passing ships are often found on the beaches of Djibouti. The port area is particularly threatened by oil spills. A spill of 20 to 25 metric tons was reported from the port in 1980 and

two minor spills of 2 to 3 cubic meters occurred in 1981 and 1985. The Sawabi Islands (Iles des Sept Frères) are at risk because of their proximity to major shipping lanes. The construction of a refinery is planned at Doralé/Saline-Ouest. If implemented, this project will pose a major threat to the rich coastal and marine habitats and biota of the area. A conflict of interest with fisheries development in the area is also expected.

In Somalia, the coastline is generally clean except around the main urban areas of Bosaso, Berbera and Zeila. However, signs of oil pollution have been observed on the extreme west of the northern coast close to the Strait of Bab-al-Mandab. This is believed to be due to the high level of maritime traffic that passes through the narrow area at the entrance to the Red Sea (Awad 1995; Rushdie and others, 1991; 1994). Reported incidents of dumping toxic wastes by developed countries into Somalia's unguarded waters has prompted Greenpeace and other environmental NGOs to investigate, but these findings have not yet been made public.

10

Recent, Current and Planned Fisheries Projects

A summary of recent, current and planned environmental interventions and priority actions for the fisheries sector are summarized in the PERSGA National Fisheries Reports (PERSGA 1997a – 1997i). Briefly, these focus on the following areas:

- Legislation: Improving the legislative framework for environmental and fisheries management and conservation; accession to international treaties (such as UNCLOS, Convention on Biological Diversity, MARPOL, Code of Conduct for Responsible Fishing, etc.).
- Habitat conservation: Development of integrated coastal zone management plans, mangrove/coral rehabilitation and conservation, establishment and management of MPAs; oil spill contingency planning.
- Tourism management: Guidelines for visitors to coral reefs; guidelines for mooring boats on reefs.
- Living marine resources management: Fisheries management plans and strategies; improved fish handling and marketing; conservation of sea birds, turtles and marine mammals; establishment of MPAs.
- Community development: Development of community management initiatives.
- Navigational risks: Improved navigational markers, updating of marine charts.
- Industrial and urban development: Requirement for EIA for all applications, control of dredging and filling for urban and industrial development, port construction and maintenance of navigation channels.
- Applied research: Fish stock assessment activities; databases for biological resource and environmental information; improved data collection for formulating management plans.
- Education and awareness: Development of public awareness materials, provision of training for private and public sector staff.

The following information focuses on fisheries projects in some states in the Region.

In Saudi Arabia, short and long term projects have been prepared by the Ministry of Agriculture and Water in collaboration with international organizations. The focus is on building national capacity in fish handling, processing and marketing; improving the fisheries shore infrastructure and services; technical ability to undertake fish stock assessment and applied research; and further development of aquaculture. Priority actions are under development to improve enforcement of legislation related to management of coastal and marine areas. Plans are also being developed to improve stock assessment and management for finfish and shrimp through better collection and evaluation of catch and effort data (Olsen and others, 1996).

In Sudan, the Sudan Integrated Fisheries Project is the main planned activity (discussed previously).

One of Eritrea's top national priorities is the rehabilitation and development of its artisanal fisheries. Improving the socio-economic situation of artisanal groups and reconstruction of the shore infrastructure are the main priorities. All investors who wish to participate in Eritrea's fisheries are required to actively invest in infrastructural development.

In recognition of the importance of strengthening the enforcement of existing regulations relating to the management of coastal and marine areas and resources, Djibouti is considering a revision of its National Maritime Law, related laws and regulations. A Programme for the Development of Artisanal Fisheries, which was initiated in 1980, resulted in a substantial growth of this sector. Before 1980 there were only 50 fishermen, mainly of Yemeni origin. Their means consisted of wooden boats of 4 to 6 meters length and very limited loading capacity. These boats, which had no engines, allowed only for subsistence fisheries. In the framework of the programme, fishermen were supplied with fishing gear, outboard engines and fiberglass boats. Ten years after the completion of the programme, in 1990, the number of active fishermen had increased significantly. The average age of fishermen used to range between 40 and 55 years, and a rejuvenation of the operations and productions became an imperative for the development of the sector. To this end a training center for professional fishermen was created in 1991 with support from IFAD. Unfortunately political events of the early 1990s interfered with the successful execution of the training.

In Yemen, past, present and future assistance has been summarized by a recent fisheries sector review (MEP, 1999). Infrastructure projects have helped to build fisheries harbours in Aden, Mukalla, Nishtun, al-Hudaydah and Khobah (jetty) and to provide some access roads to fishing centers. The harbour facilities in al-Hudaydah and Khobah have been of crucial importance in the development of the Red Sea fisheries but are now facing serious siltation problems. The Aden harbour has also been, and still is, very useful and important for the industrial fisheries. The Khalf commercial port at Mukalla is a good harbour but not used by fishing vessels. The only failure is Nishtun, which has hardly been used; problems relate to silting of the harbour basin and its entrance and to the supply of power and water. The lack of road communications to that part of the country, al-Mahara, is probably another reason for the limited use of the facilities.

The artisanal sector in Yemen has been supported with landing and shore facilities, boats, engines and credit schemes in both the Red Sea and Gulf of Aden areas. The introduction of boats and engines and the availability of loans have worked well and helped significantly in the development and expansion of the fisheries. Some of the shore facilities, such as cold storage and ice plants along the southern coast, have functioned well but a general problem is maintenance and particularly non-availability of spare parts. Others, on the Red Sea coast, have failed, mainly due to poor management and maintenance by NCSFM. Landing facilities (jetties), slipways and workshops, such as those provided under the Third Fisheries Project at Ras Imran, Foqum, Shuqra and Bir Ali, have been used to a very little extent or not at all.

Past assistance to Yemen's industrial sector essentially consisted of supply of twenty-one old freezer trawlers from the former Soviet Union and Japan, all of which have been scrapped or are still occupying the Aden harbour as wrecks. The fish processing industry was financed by large international development loans in an attempt to establish a fishmeal industry (20 years ago), which totally failed. Fish canneries in Shuqra and Mukalla were also established and refurbished with foreign assistance and are still working. In the area of fish processing and marketing, a large number of cold storage facilities, chill rooms, freezers and ice plants have been installed with external assistance. The largest ones by far are located in Aden and in Mukalla and Nishtun. Smaller facilities of 5-30 metric ton capacity have been set up at some twenty other locations. The larger ones, except in Nishtun, and the CFC facilities in Dabut and Mukalla have been extensively used and fulfil an important function. Most of the smaller ones were provided in the 1970s and are now out of commission; it is not clear to what extent they were used.

Yemen's MSRRC was established with support from external funding and technical assistance and the research vessel was received as a grant in aid. FMDC was established under the IDA-funded Third Fisheries Development Project. Many other projects have also included components of in service training and specialized training abroad. In this context, the assistance from the former Soviet Union is noteworthy. A very large number of senior staff in the Ministry of Fish Wealth and its institutions were trained in the former Soviet Union and the former East Germany. Technical assistance was also a large input from the former Soviet Union in the 1970s and 1980s. Other projects include those sponsored by IDA and associated agencies, among them the Fourth Fisheries Development Project.

Yemen has identified a number of key areas where future assistance is required, such as coastal roads to better integrate fishing villages with the national mainstream of economic and social activities. Fisheries harbours and landing facilities are insufficient to meet the needs of the artisanal fishing fleet and need to be improved and expanded. Earlier inputs of this kind, such as Ras Imran and Nishtun, have not always been successful and it is very important to clarify why some of the provided facilities are not being used before starting on new ones. The creation of a network of harbours and landing facilities is a complex task involving geographic, technical, economic, social and political factors and, in all this complexity, the end user must not be forgotten.

Yemen is in need of financial assistance to rehabilitate and improve harbours like al-Hudaydah but would also benefit from technical assistance in preparing a long-term rolling master plan for future development as a guide for the Ministry of Fish Wealth, the government and international development cooperation agencies. Smaller landing areas, such as at Khaisa fishing village which requires a breakwater to allow year round landing even during the monsoon, should also be included in such a master plan.

Regarding fisheries research, the tight restrictions on government expenditures have made it impossible for the Ministry of Fish Wealth to mobiles national resources for funding of overseas training and education. Actual needs are yet to be established and should be done in connection with a prioritizing of MSRRC's work programme. But it is already clear that a large, long-term programme of assistance is needed. For assistance in research, a long-term twinning arrangement with a suitable research institution in a developed country should be considered. The main advantage would be consistency in the transfer of technology and training.

Regarding MCS of fishing activities, technical assistance, training and equipment is needed. The main components of MCS assistance would be preparation of new legislation, design of monitoring schedules, assessment of surveillance needs and Organization of suitable systems, training of inspectors, communication equipment, etc. Assistance could be broken down into different projects, but should preferably be delivered as a package for consistency and effectiveness. However, the assistance to draft a new law, by-laws and suitable agreements for fishing rights, which is a prerequisite for meaningful implementation of the other components, could be undertaken on its own.

Regarding future assistance Yemen is currently focusing on two key areas: improved management of fisheries, especially through provision of physical means and training for more effective MCS, and also improving fish handling and processing at the national level so as to meet the stringent criteria of markets such as the EU. The specific needs for improved fish quality control in Yemen have been identified and the actions required are slowly being implemented (MEP 1994c, e, f). The EU is providing funding assistance in these areas. In addition, a Socotra Archipelago Master Plan is being formulated, which aims at producing a comprehensive framework for the economic and social development of this unique group of islands in the Gulf of Aden. This is funded by the European Commission (EC) and is being implemented by Yemen's Environmental Protection Council (EPC).

In Somalia, several international organizations (notably UN agencies) and NGOs are involved in support of the fishing communities scattered along its northern coast on the Gulf of Aden. The assistance provided has mostly been in the form of fishing gear and vocational training. Attempts to

provide new shore infrastructure such market buildings on beaches and storage/processing facilities and to refurbish existing facilities have not been successful, due primarily to the absence of a functional national and local government administration. The United Nations is endeavouring to start a fisheries revolving fund to allow import of fishing gear for the northern towns of Bosaso and Qandala.

11

Discussion and Conclusions

The preceding chapters indicate that there are a number of key areas in which future developments should be focused in order to improve living marine resources management and conservation throughout the Region.

Fisheries Policy Objectives

The fisheries sectors of some PERSGA members states—Egypt, Saudi Arabia and Yemen—are in a dynamic phase of development. Since 1988 new boats have entered the fisheries at a rapid rate and new companies and individuals are investing in marketing facilities. Various development projects have helped to stimulate this development. The private sector has also been instrumental in expanding catches, processing and exports, especially in Yemen since unification in 1990. However, careful planning is needed within an appropriate legal framework to provide for effective management of fisheries resources and habitat/biodiversity conservation.

In the four southern states—Sudan, Djibouti, Yemen and Somalia—fisheries are at very different stages of development. Only Djibouti has developed and implemented a coordinated approach to fisheries, despite the low contribution the sector makes to GNP. Yemen has limited institutional capacity to provide adequate monitoring and surveillance. Stock assessment research is lacking and therefore cannot form the basis of management planning. Control of the fisheries is weak, due to inadequate laws and insufficient enforcement capability. Virtually no government management is possible in Somalia because of the effects of the civil war. Sudan has concentrated on mariculture, particularly pearl oyster shell. The industrial sector is inefficient and the artisanal sector suffers from poorly developed shore infrastructure. The rehabilitation of the programmes and activities initiated with ODA and FAO assistance in the 1970s and 1980s may be the best policy choice for Sudan.

The policy objectives of the relevant national fisheries administrations have been developed largely in proportion to the relative importance of fisheries to the national economy. In some cases, policy objectives appear to be incongruent: for example, the goals of increasing artisanal and industrial production whilst conserving resources and the marine environment may not be simultaneously possible. Similarly, the goal of creating foreign exchange through increasing exports needs to be clarified further if the goal of increasing domestic consumption is also to be achieved.

It is suggested that all governments in the Region aim to develop a clear policy for national fisheries within a framework for integrated coastal management. Fisheries policy should aim to facilitate greater control and management of fisheries so that future expansion is well planned and adequately regulated in order to generate sustained economic and social benefits from the fisheries. The emphasis of government's role

should be on *control* rather than *stimulation* and should be reflected in the policy statements of the relevant national authorities (see Box 1).

BOX 1. PRINCIPLES OF FISHERIES MANAGEMENT

1. Management objectives

Historically the main objective of fisheries management is conservation of fish stocks. More recently, this limited aim has been extended to address additional economic, social and environmental objectives. The broad objectives of management today include: (a) Conservation of fisheries resources and their environment; (b) Ensuring that fisheries are exploited on an ecologically responsible basis; (c) Maximization of economic returns from the fisheries and economic efficiency of operations; (d) The social wellbeing of fishermen and rural coastal communities and employment considerations; (e) Payment of fees to the community from profits made by the exploitation of a public resource; and (f) Developing institutional competence, which focuses on the role of institutions involved in fisheries management and in particular their capability to adapt to changes in resources, technologies and markets.

The objectives of management can be realized by adopting one of several strategies, each with its own set of consequences. As fisheries management must often address social, political, legal, economic and biological factors, the overall objectives of fisheries management will almost always involve compromise.

2. Management strategies

Once the objectives or policy aims of managing a particular fishery have been defined, the range of management strategies capable of achieving these objectives can be considered.

Fisheries research and stock assessment should provide advice to fisheries managers in the form of probable biological, economic and environmental outcomes for a range of possible management strategies. This advice should include an assessment of risk associated with alternative strategies and a summary of the particular controls or regulations required to achieve the objectives. Cost-benefit analyses should take into account the enforcement costs of controls and regulations associated with each strategy. A fisheries management plan should in general contain a description of: (a) The current state of development and level of exploitation of the fisheries; (b) The policy aims, or objectives, of managing the fisheries; (c) The management strategies which would achieve the objectives; (d) The regulations which may be applied to the fisheries under various strategies.

3. **Key goals in fisheries management**

Objectives of fisheries management may include the aims of maximizing yield either in weight or revenue terms, and of maintaining a particular level of stock in order to provide a buffer against poor recruitment years or to maintain a minimum spawning stock. These biologically based objectives or goals may be modified to include a range of interdisciplinary objectives related to economic and social benefits and environmental protection.

In some states, a body which functions as a 'fisheries management advisory committee' (FMAC) has been established under the fisheries laws in order to coordinate management and research activities with the needs of the fisheries sector. These committees are of fundamental importance if policy is to be developed that meets the needs of the sector. It is suggested that the responsibilities of such committees be strengthened wherever possible to include the development of specific management plans for commercial fisheries and to oversee all aspects of marine fisheries research and management. This could be best achieved by expanding the committee role to advise the Minister responsible for fisheries on sector policy and oversee the establishment of specific fisheries management plans, research, MCS and enforcement activities. The formulation of appropriate fisheries management plans would be a significant improvement on the current situation. The FMAC could then function as the main coordination body for the activities of national research and MCS agencies. The composition of any FMAC is crucial to its function as a forum for communication and consultation between different fisheries sector stakeholders. It is suggested that persons from pertinent govern-

ment ministries, authorities and also private sector organizations be members of such committees.

In those countries where an equivalent body does not exist, it is suggested that the creation of such a body be initiated as a matter of priority. Formation of a FMAC could proceed through a formal understanding between the government departments concerned, and does not necessarily require legal endorsement in order to become operational.

Institutional Structures

Proposals for structural reform of the national authorities involved in fisheries management are beyond the scope of this report. Although there are variations, most of the national fisheries authorities have responsibility for the following tasks:

- Fisheries data collection and collation.
- Sector policy, management and administration.
- Stock assessment and applied fisheries research.
- Preparation of management, development and investment plans.
- MCS and enforcement of legislation.
- Formulation of fisheries legislation, control measures and licence conditions.
- Preparation of reports, research papers and technical studies.
- Financial support to fishermen.
- Training and extension services.
- Provision of shore facilities and marketing infrastructure.
- Quality control measures.
- Financial accounting and auditing for the sector.

The principal responsibility is the effective management of the fisheries sector (see Box 2).

In some states weak staff motivation, often as a result of low salaries, inadequate management oversight and a general lack of direction have led to an almost total cessation of routine activities. Lack of transparency in relationships between headquarters and branches may compound the problem. These issues require consideration by national authorities and appropriate restructuring and improved procedural arrangement need to be put in place

Information and Financial Transparency

Free flowing information is crucial to organizations for their daily functioning, development and employee motivation. Fisheries management in the Region suffers from information flow problems for a variety of reasons, including a lack of facilities and communication infrastructure. The tendency not to share or distribute information is widespread, to the extent that central statistics are unreliable (see data collection and analysis discussion below), if available at all, and new and useful information is not disseminated to the appropriate departments or branches.

Salaries and Public Sector Jobs

The average civil servant wage is low in most states. When this is combined with slow dissemination of small operational budgets and a lack of investment/improvement funds, it is not surprising that many employees in fisheries management positions lack motivation or spend time away from their posts attending to other wage earning activities. Some states are attempting to implement privatization programmes in the hope that this encourages government ministries to become more proactive through a reduced staff and higher real wages. Likewise, it is hoped that stimulating the private sector will provide opportunities for excess government employees to find fulfilling and well paid work outside government institutions.

National governments should consider rationalization of their staffing, structure and functioning of the national fisheries administrations, including branches and institutions. It is envisaged that such an exercise might be best undertaken as part of a national structural adjustment plan for the public sector. As part of the rationalization process, the job descriptions of all staff should include allocation of responsibilities for increased efficiency. A review of the total staff requirement would identify those who qualify for assistance in redeployment and retraining.

BOX 2. FISHERIES MANAGEMENT GOALS

Management goals or objectives are achieved by either placing limits on catches (output controls) or placing restrictions on fishing effort (input controls) and can be categorized as follows:

maximizing Catches: MSY as a management objective is often criticized, but attempts to replace MSY with concepts such as Optimum Sustainable Yield (OSY) have had limited impact, since OSY includes social, economic as well as biological factors and therefore means different things to different people.

maximizing Economic Yield: maximizing profit is very appropriate in strictly commercial fisheries where most of the catch is exported. Maximum participation is usually sacrificed in favour of maximizing profits in the form of foreign exchange. There is another benefit of maintaining catches at MSY, since this is below the amount of effort required for MEY, and thus recruitment overfishing is less likely.

Fishing to Biological Reference Points: In many fisheries, management objectives are based on a recommended Total Allowable Catch (TAC) which can be framed as biological reference points such as MSY or MEY. If research has included the monitoring of recruitment and biomass, the TAC can be adjusted to reflect the strength of recruitment in that year.

Maintaining Minimum Stock Sizes: Maintaining a minimum or buffer stock size has the aim of improving the stability of catches from year to year.

Maintaining Spawning Stocks: Objectives may include ensuring, at least within some level of probability, that the spawning stock does not decrease below some minimum value. Many fisheries have crashed because recruitment fails due to the spawning stock being reduced too much, such as the clupeid herring and sardine fisheries, and the anchoveta fishery off Peru and Chile in the 1970s. The problem is that the minimum level of spawning stock required to maintain recruitment is not known in most species.

Ecologically Sustainable Development (ESD): In the face of decreased catches even in strictly managed fisheries, many scientists now advocate that the narrowly based management of a single resource should be replaced by broader based management of the ecosystem that supports all marine species. This acknowledges that protection of the ecosystem that supports fisheries is required and that marine ecosystems are valuable for reasons other than commercial fishing. ESD attempts to address the demands of various resource users, such as commercial and subsistence fishermen, recreational fishermen, aquaculture, tourism, water sports, shipping, coastal development, industry etc. The goals of an ecosystem approach to fisheries management include: sustainable use of both species and ecosystem; maintenance of essential ecological processes; preservation of biological diversity at all levels.

Adaptive Management Strategies: One of the criticisms of applying a single management strategy to a fishery as a whole is that there are no results from alternative strategies with which to make comparisons. This approach applies different strategies to different parts of the stock in the expectation of learning something of their effects.

Risk Assessment: A management strategy proposed for a fishery may be framed in terms of an acceptable level of risk of deleterious effects. For example it may be estimated that recruitment overfishing will not occur as long as the stock is not reduced to less than 40 per cent of the virgin biomass. In this case, a TAC can be set at such a level that there is less than a 10 per cent risk that the stock will be reduced to less than 40 percent of the virgin biomass in any year. Simulation models are often used in risk assessment.

Technology Creep: Management strategies based on fishing effort, rather than on fishing mortality or catches, suffer from the fact that increases in efficiency of gear or methods (technology creep) results in an increase in the effective effort, even though apparent effort (say number of vessels) may stay the same. Technology creep also poses considerable problems in fisheries assessment, particularly if the assessors are not aware that effective effort is increasing over time.

Although a lack of adequate financial resources for fisheries administrations is common throughout the Region, the problem is particularly great in Sudan, Djibouti, Yemen and Somalia. Without sufficient funding, national public authorities and their institutions cannot effectively discharge their

duties. Governments should therefore strive to ensure that adequate finance is provided from core sources, and also investigate alternative sources of funds such as fishing vessel licences, penalties paid for infringements etc.

Member states should ensure that benefits available through membership in international organizations and as signatories to international conventions, in the form of direct aid, information transfer and in academic and research links, are used to the fullest extent. At present some states such as Somalia, Djibouti and Yemen receive limited benefit from membership in international organizations.

Human Resource Development

The fisheries training establishments in the Region face common constraints, including:

- Funding levels are erratic and too low, affecting the efficiency of training.
- Classes are often too large for quality tuition.
- The roles of some departments are duplicated.
- Training curricula are in places outdated, with too high an emphasis on theoretical training.
- More practical and short-term courses are required to meet the needs of the fisheries sector.
- Much of the equipment is run down, due to lack of repair and maintenance, or at the end of its useful life.
- Working practices and safety procedures can be lax.
- There is a shortage of books in the library and of consumables in workshops and classrooms.

A complete review of present fisheries training structure and function, especially the appropriateness and adequacy of course syllabi currently offered, would be useful for focusing on the problems at hand and future needs. Material and financial resources required in order to enable the institutions to function effectively and serve the changing needs of the fisheries sector should be identified and provided for. The potential regional role of fisheries training centers in each of the PERSGA member states and their neighbors warrants careful consideration.

Fisheries Research

Research Priorities

Past assistance from international donors and institutions has been provided mainly through technical assistance, equipment and infrastructure. Historically there was an emphasis on oceanographic work primarily, followed by fisheries, mariculture and the environment in decreasing order of priority. Environmental issues came into prominence in the 1990s.

Oceanographic research is extremely important in both the Red Sea and Gulf of Aden. The Gulf of Aden is regarded as unique in that an annual upwelling occurs, providing Yemen, Djibouti and Somalia with very rich pelagic fisheries. If oceanographic research of a long-term nature is undertaken and carried out effectively, this will provide invaluable information on the dynamics of the Indian Ocean.

Research in fisheries stock assessment, mariculture and environmental protection have been in general applied and short-term in nature. Applied research on the mariculture of pearl shell in Sudan has been ongoing for over ten years and is forming the basis for future development. Only Djibouti has undertaken any significant fish stock assessment (with the assistance of GTZ) since 1988 and has also investigated the potential for developing an aquarium fish industry (with assistance from FAO). There is a need for research into the environmental impacts of mariculture in some states, especially Saudi Arabia and Egypt.

In view of the economic and social importance of the fisheries, with so many people depending on them directly for employment and indirectly as consumers of fisheries products, there is an obvious need for fisheries resource assessment. Information is required for planning and regulation to prevent over-exploitation and to ensure the long-term sustainability of the fisheries. The importance of marine environmental protection is indisputable. In the context of the Region's marine environment, the environmental hazards are fortunately not many at present. However, if

awareness of the environment and the need to develop fisheries within a framework of integrated coastal zone management is not developed now, future coastal development and fisheries management and their associated practices may not serve to protect fish stocks, their breeding grounds or human health.

As resources are often limited within national research institutions it seems prudent to focus on activities generating high priority benefits, for example the preservation of fishing communities and livelihoods through fish stock preservation and research. While scientific research and environmental sustainability are undoubtedly important, the fundamental objective should be to assess potential yields of fish stocks and explore suitable means and methods to ensure exploitation of the resources within maximum sustainable economic levels (see Box 3). That is the level at which the maximum possible sustainable economic benefit is derived from fishing, which is different from simply the maximum sustainable physical exploitation levels.

production, have not been researched and basic catch and effort statistics, when available, are questionable. Only Saudi Arabia has a good fisheries data collection system in place. Valuable species should receive priority attention because of their economic importance and vulnerability. Besides careful and continuous monitoring of the catch and effort data and associated analyses, studies of suitable measures to enhance sustainable economic yield are vital. Priority issues in fisheries research include:

- Fleet structure, costs and earnings, effectiveness of existing management regimes should be addressed. Focus should be placed on fisheries that target rock lobster, cuttlefish, shrimp, trochus and pearl shell.
- Demersal fish caught by the industrial trawler fleet require attention for reasons similar to cuttlefish. The quantitative information available on species composition and rate of exploitation, and costs and earnings of the trawling fleet are insufficient for stock assessment or formulation of effective management plans. Basic catch and effort data are produced regularly by the trawlers and although data are collected by some national authorities, few analyses are being carried out. The data are simply collated and published in annual catch summary statistical reports.

BOX 3. PRINCIPLES OF POPULATION DYNAMICS AND YIELD

Population dynamics involves:

- Studying basic biology and distribution of resource species.
- Studying the population dynamics of species.

Some of the major parameters that must be estimated are species distribution, abundance, size/length parameters, selectivity of fishing gear, growth rate, reproduction/recruitment, mortality rate.

Yield:

For fisheries management, estimating life history parameters is less important than how these estimates may be used to calculate the maximum weight or yield from a stock without adversely affecting future reproduction and recruitment. This quantity, called the Maximum Sustainable Yield (MSY), and the level of fishing effort required to take it, formed the basis for biological fisheries management in the past. Since the 1970s, however, fisheries regulations have increasingly addressed other aspects of fisheries management, including (a) access rights/allocation of resources, (b) economic efficiency of fishing (c) environmental protection and (d) stock conservation.

Fisheries research has until now largely been limited to some species with high commercial value—such as snappers, cuttlefish and rock lobster—their vulnerability to over-exploitation and their location in limited geographical areas. Species such as yellowfin tuna, sharks, kingfish, emperors, and other species that are as valuable, or more, in total

- The species caught by the artisanal fisheries require more study. The current status of these resources is generally unknown. To study them all is an enormous task and very strict priorities should be established when selecting species and type of research to be conducted. The main criterion for selecting species should be their socio-economic value. The type of research should in the first place aim at determining the rate of exploitation by collecting length frequency data at landing sites and on vessels, and secondly at determining whether a particular stock is resident or migratory, which will be fundamental to future management strategies. Any study of the artisanal fisheries will require the establishment of a sampling programme (discussed below).

Setting priorities for fisheries research work must be done with the participation of all interested stakeholders. Once priorities have been set, it is essential that they are followed up with the necessary reallocation of resources, including staff. In many cases the fisheries research priorities mentioned above have been proposed earlier but the work has not materialized for lack of follow-up actions.

Highest priority should be given to applied fisheries research that is of direct practical use in formulating specific fisheries management strategies and plans, while oceanographic, marine and coastal environmental studies should be encouraged to continue using available resources.

Annual work plans should be developed that address the priority research issues facing the fisheries sector. Regular meetings with interested public and private sector bodies and fisheries stakeholders would allow continuous review of work activities, achievements and direction, and engender a sense of ownership of fisheries research activities.

Data Collection and Analysis

The basis for effective fisheries research is the routine and systematic collection of appropriate data. The degree to which fisheries data are collected in the Region varies considerably: Djibouti, Egypt, and Saudi Arabia have well established systems. In Sudan and Yemen data collection is not well organized. Data collection in Somalia and Jordan has virtually ceased, but for different reasons. In all member states fisheries data collection and analysis systems could be improved.

In general, data for the artisanal fisheries is scarce and affected by a very high degree of inaccuracy. Production data for industrial fleets and on exports are more readily available. It is not clear whether all inspections of industrial landings are carried out thoroughly, or whether foreign vessels operating under licence adhere to their terms and conditions. There are discrepancies in the data obtained from different sources and there is certainly scope for improving and streamlining the system for data sharing and distribution of responsibilities for data processing and production of value-added statistics required for specific functions. Such an exercise should be fairly simple and low cost, being mainly a question of organizing and managing the information flow.

Further to the general production data from industrial fleets, more details on the catch and fishing effort are required for stock assessment purposes. These requirements could be easily met by cooperation between national research agencies and the fishing companies and, if necessary, included as obligations in the fishing licensing agreements. Information on costs and earnings data is required to calculate MEYs, though this may require further training of staff.

The artisanal fisheries in the Region, often with several thousand producers scattered along the entire coastline, present a major problem for adequate monitoring and generation of reliable statistics. On Yemen's Gulf of Aden coast, cooperatives and societies provide information on the landings in their respective areas of jurisdiction. In some cases the data are broken down into species or groups of species. Since unification of the PDRY and YAR in 1990, only part of the catch is sold through cooperatives/societies and very little is known about fish landed elsewhere. Artisanal data on fishing effort, that is, boats and fishermen for Somalia's northern coast and for Sudan and Yemen's Red Sea coast, are very sparse.

A common problem for both the Red Sea and Gulf of Aden coasts is that fish are never weighed at first sale on the beach or at the landing center. In

most coastal markets, fish is auctioned in numbers, lots, baskets or heaps. Weights recorded in 'official' statistics are therefore merely estimates, which are necessarily subjective and therefore unreliable.

A fundamental requirement for statistical information on artisanal fisheries, for purposes of resource assessment, planning and future management, is the establishment and implementation of an appropriate sampling programme. This must be based on a new census of the size, location and characteristics of the fishing fleet. The implementation of the programme will require enumerators stationed at, or near, the sites selected for sampling.

The situation is not likely to change unless support is provided in the form of information technology and staff training in data collection and analysis. Techniques are being developed in other regions using multidisciplinary approaches in Fisheries Stock Assessment Models (Preikshot and Pauly, 1999), which include biological, fishery, economic, social and ethical values. Many of these values can be obtained through simple scoring systems (and relevant attributes agreed) and implemented (data/views obtained and appraisals undertaken) at the community level, and in ways that the fishing communities can understand and whose outcomes they can appreciate and accept. These forms of rapid and participatory fisheries assessment methods (Pitcher and Preikshot, 1999) might form the basis for some of the new approaches that could be taken by countries in the Region.[5]

To ensure country-wide uniformity, a national institution should ideally be made responsible. Technical and scientific competence is required for implementation of the data collection system, for training and supervision of samplers and in the collation and interpretation of the data (see Box 4).

A significant step in clarifying the flow of statistical information and in providing a basis for improved production statistics would be to make one institution responsible for statistics on marketing, including export and fish prices, and for the overall dissemination of all official statistical information.

It is suggested therefore that the present arrangements for fisheries data collection and analysis be revised in each country. Data should be collected that will allow routine catch, effort and CPUE analysis at species level. The data collection system with a view to manpower and financial constraints and the importance of the fisheries.

Training of scientific staff in modern techniques and procedures both in-house and in appropriate bodies within the Region should be facilitated. Organizations such as FAO or the EU and other bilateral and multilateral donors could be approached to provide assistance in stock assessment training.

Formal channels for information exchange should be established that clearly define the responsibilities of the various users of the data. The standard formats to be used for data collection, already developed, should be used as far as possible. Formal channels of information flow should be developed between all government parties and other users of basic statistics.

Data suitable for stock assessment purposes should also be gathered as part of a coordinated national fisheries statistics plan. A single government body should be the overall coordinating authority for the national fisheries statistics collection system.

It is anticipated that much historical data is currently unused at national research institutions. As a first step, this data should be collated and analyzed to produce working estimates for standing stocks and sustainable exploitation rates as a basis for setting catch levels and licence numbers. These estimates could be used for fisheries management purposes until further data can be established from new fisheries research programmes.

Financial Resources Available for Research

National research institutions have the important role of providing data and information to decisionmakers on fisheries resources and the marine environment for the formulation of policy and management plans. In many cases, this role is not

5. The use of the RAPFISH technique in addressing ways to evaluate a fishery's convergence with the Code of Conduct for Responsible Fisheries is under development by FAO.

BOX 4. PRINCIPLES OF FISHERIES ASSESSMENT AND MONITORING

Fisheries assessment aims to establish the status of a fish resource and determine the levels at which it may be sustainably exploited. Stock estimates, in addition to environmental, economic, social and political considerations, are then used to suggest management strategies for the fisheries. Following the assessment of the fisheries, a monitoring programme is necessary to collect data including catch and fishing effort, and to assess the effectiveness of fisheries management strategies.

Data requirements

Several types of information are required from the fisheries, including species composition, distribution, abundance, biological data, environmental data and financial/economic information.

Data collection

Types of data required for effective resource appraisal depend on the target species and fishing method and may call for different collection strategies. Most surveys involve regular sampling of the target stock and recording information including CPUE, and length frequency data. Properly designed data sheets are essential for field workers.

Data analyses and stock assessment

Data analysis and stock assessment methods vary according to the aims of the survey and the species caught. For the multi-gear/multi-species fisheries of the PERSGA Region, traditional methodologies used to assess temperate fisheries are generally inappropriate.

Fisheries monitoring

Following the assessment and development of a fishery, a permanent and lower level system of data collection may be used to monitor the 'health' of a fishery to determine the effectiveness or otherwise of management strategies. The basic data required is for catch and fishing effort, supplemented by regular collection of length frequency data. In monitoring fishing effort, inventories of boats, fishing gear, and fishing methods must be maintained and continually updated. Gradual increase in fishing efficiency through gear and method improvements result in an increase in effective fishing effort. Such 'technological creep' can only be detected by having good and regular contact with fishermen.

supported with adequate financial, equipment and human resources.

Extensive training and education of research staff can help them to attain the standard required to perform the role they have been assigned. Scientists can benefit from undertaking continuing education courses in various subjects, with emphasis on computer-aided resource assessment methods. They should also be able to participate in international workshops, seminars etc. to gather new information and techniques, exchange lessons learned and share experiences.

With regard to scientific equipment, many institutions suffer from a shortage of computers for processing, storing and analyzing data, of vehicles for field work, and of research vessels of an appropriate size. A lack of vehicles has been a serious hindrance to effective research. Provision of vehicles through existing aid projects and government sources should be pursued. Any increase in equipment assistance should be accompanied by staff training in the use of computers for fisheries related research.

National research bodies should be provided with an adequate operational budget from government, with improved financial transparency and accounting. In order to reduce government expenditure on research and to increase cooperation between the industry and national research bodies, it is suggested that commercial vessels be required to undertake applied fisheries research for short periods as a provision in the licence agreement.

Stock assessment programmes could usefully be supported at the national or regional level by forming long-term agreements with foreign institutions specializing in the collection, analysis and inter-

pretation of resource data using modern techniques applicable to tropical fisheries. Such 'institutional twinning' arrangements work well in other parts of the world and could provide valuable ongoing institutional support and training for countries in the Region.

National research bodies should increase the degree of exposure and contact with the wider scientific community, both through contacts with other Organizations and through access to scientific literature. Contacts with other Organizations, in the Region or internationally, could be assisted (as appropriate) by joining the IOTC, which would provide numerous benefits in terms of increased scientific contact, involvement in regional fisheries research and management initiatives, joint research, reciprocal visits, attendance at scientific symposia, etc.

Monitoring, Control and Surveillance (MCS) of Fisheries

The requirements for MCS vary between countries in the Region and between fisheries within a country. Different arrangements are often necessary for different fisheries (such as artisanal fisheries as compared with industrial trawl fisheries). Monitoring aspects (data collection) have been discussed earlier. Control (regulatory framework), and surveillance (observations and inspections required to ensure compliance with the regulatory controls) are discussed below.

Legal Framework

While regulations for control of fisheries activities may differ considerably between fisheries, there must be one basic legislation common to all aspects of fisheries exploitation, management and development. It should be comprehensive, covering existing fisheries and, as far as possible, new technical and commercial development. It should also be in line with international initiatives such as FAO's Code of Conduct for Responsible Fisheries and the UN's Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks.

Some states have recognized the shortcomings and weaknesses of existing legislation and are taking steps to update and improve current laws. This is necessary to provide for effective management and protection of the living marine resources. Illegal fishing by foreign vessels and other violations of laws and regulations by licensed vessels will not stop unless the law provides for enforcement, prosecution procedures and effective penalties.

For those states whose legal framework for fisheries and environment is outdated, laws and regulations should be reviewed, weaknesses identified and new legislation formulated. A comprehensive legal framework is a prerequisite for fisheries management and its establishment should receive highest priority. This could be accomplished in a relatively short time with assistance from readily available regional and international expertise in fisheries legislation, working together with national legal draftsmen (see Box 5).

Delimitation of maritime boundaries in the Region is a complex issue, especially in the Red Sea. Many boundaries between contiguous maritime zones have yet to be agreed. Where possible, states should take measures to agree on maritime boundaries. As a first step, charts showing areas of disputed jurisdiction within the Region should be prepared. This will assist in MCS planning.

MCS Organization

A competent and appropriately sized MCS department is required to plan, direct and supervise national MCS programmes. Monitoring needs to be coordinated with national research and planning departments and inputs are required for the control measures, including fishing agreements, that are handled by legal departments. Coordination is also needed with military forces for assistance in aerial surveillance and inspection at sea. Regular communication and coordination with neighboring countries for cooperation in surveillance activities is another important aspect.

Surveillance of artisanal fisheries can be assisted by implementing boat registration and licensing systems. These are already established in Egypt, Saudi Arabia and Yemen and form a basis on which to build improved monitoring and control of the artisanal fleets. Sharing of such vessel registers between states can greatly assist in management of transboundary fisheries. At present, however, such collaboration is not in place.

BOX 5: FISHERIES REGULATIONS

These are imposed on a fishery to support a strategy designed to achieve predefined objectives. Regulations are of two main types: Input controls which are used to either reduce or contain effective fishing effort, or Output controls which are used to restrict total catch in line with predetermined limits.

Although regulations are imposed by government to control fisheries activities, in some inshore fisheries, such as coral reef fisheries in the Pacific, social regulations according to custom, taboo or traditional reef ownership rights can reduce the need for government intervention. In Europe, there is an increasing trend towards involving those communities living most closely to them in the regulation of inshore fisheries through co-management (industry, government and coastal communities all working together).

Examples of Input Controls:

- Limiting the number of fishing units.
- Limiting the number and types of gear.
- Area/temporal closures.
- Minimum mesh sizes and escape gaps.

Examples of Output Controls:

- Size limits (minimum legal lengths).
- Rejection of females or spawning females.
- Catch quotas.

In general, MCS and enforcement activities are either non-existent or ineffective. Extensive training programmes are required for national MCS staff in all aspects of MCS including vessel boarding methods, observer duties, and the correct operation of field equipment.

National MCS staff should improve communication with their counterparts in other member states, and in the case of Yemen with Oman. Closer regional links are an essential first step for improving MCS at the national and regional levels. There is a strong case for developing a framework of regional cooperation in MCS; this has been exceptionally successful in the central western Pacific, where small island states have joined forces in harmonizing their approach to fisheries management and have developed reciprocal arrangements to improve MCS, such as regional observer programmes, regional minimum terms and conditions for access of foreign fishing vessels, a regional database on fish licensing and vessel details, sharing of aerial/surface MCS assets, etc.

MCS OPERATIONS

Artisanal Fisheries

As noted earlier, the artisanal sector has expanded very rapidly in the Region. In Yemen, there has been at least a doubling of the number of boats and fishermen in the Gulf of Aden during the period 1990-1999 (that is, since unification of Yemen in 1990). Returnees from the Gulf War have also added to the numbers entering artisanal fishing. Uncontrolled expansion eventually leads to over-exploitation. The most appropriate way of regulating fishing is to limit the fleet to a certain size. It is also appropriate for the government to charge fishermen for the right to exploit the common resources of the country and recover some of the costs of administering the fisheries. This, of course, also applies to the artisanal fisheries of the Red Sea, although expansion there has not been of the same magnitude.

One possible management measure to limit the number of boats is to implement a registration and licensing system for boats and fishermen. Vessel registers are a very valuable tool for fisheries managers in many parts of the world. In many cases, such registers are already provided for in the existing legislation The authorities responsible for registration and licensing would be the national fisheries authorities and their branches, for which they need to be properly staffed and equipped. The actual requirements could be worked out on the basis of existing information or on a census basis. Besides the number of persons, vehicles, etc. that might be required, the staff needs to be trained to communicate with the fishermen on the rationale of the system to facilitate its implementation. The

introduction of the system should be launched with an information campaign.

Once the system is introduced fisheries administration branch officers could function as 'inspectors' to enforce it. Requirements for this will depend on the intensity of supervision that is needed. Enforcement officers should receive specialized training for their duties and be provided with transport and sufficient funding to perform them (see Box 6).

high degree of surveillance. Ministry of Fish Wealth branches are not equipped to undertake this task at present due to lack of trained staff and transport facilities, as well as loopholes in the legislation. Until adequate legislation is put in place and Ministry of Fish Wealth branches have developed their capacity, the present arrangement with CFC, as the only Organization permitted to buy and market lobsters, is probably the most effective way of ensuring compliance with the regulations.

BOX 6: ENFORCEMENT OF FISHERIES REGULATIONS

For any fisheries management strategy to be effective, the regulations designed must be effectively enforced. Most fisheries officials agree that the most important aspect of enforcement is education of the fisherman, and prosecution should be regarded as a last resort. Making fishermen familiar with all regulations that apply and the reasons for their imposition can be achieved by close personal contact, public meetings, radio talks, press articles etc. If the majority of users support the aims of regulations, peer pressure becomes a strong deterrent to those disregarding the law.

Although prosecution is a last resort, regulations must be rigorously enforced. If not, due to insufficient enforcement staff, equipment or funding, or overly complex and impractical rules, regulations will fall into disrepute. If regulations are unenforced, benefits will accrue to those who ignore them at the expense of those who abide by them. Penalties for infringements must be significant so as to act as a deterrent, such as large fines and/or gear confiscation in the case of industrial fisheries. If not, fishermen will disregard regulations.

Enforcement staff should be adequately trained in fisheries law, public relations, fisheries management, evidence collecting, inspection/boarding procedures, court procedures and the legal process. If an infringement cannot be dealt with by education, cases taken to court should have a high probability that the prosecution will be successful.

Enforcement costs often account for a large part of total costs for managing a fishery or MPA. Costs of enforcement vehicles, boats and equipment are high, especially for open sea fisheries. Enforcement costs need to be carefully considered when formulating management strategies for the fishery; in some cases, applying less direct regulation, which is cheaper, may be better than direct ones that are expensive to enforce. For example, enforcing legal minimum lengths is likely to be expensive in a large artisanal fishery that has many fishermen spread over an extensive area. However, if catch is marketed at a limited number of points, it would be simpler to inspect fish at point of sale rather than point of capture, thus a regulation making it illegal to sell rather than catch undersize fish would be easier to enforce. Fishermen would soon avoid keeping smaller individuals that are legally unmarketable.

The main problem in enforcement is not so much in enforcing the regulations, but convincing the community of their necessity. The renewability of fisheries resources depends on fisheries stakeholders accepting controls that not only protect fish stocks but also ensure that the environment in which they live does not deteriorate.

The rock lobster resources in the eastern part of Yemen's Gulf of Aden coast are already heavily exploited. The fishery is regulated as to season (October to April), catching method (traps), and minimum size of lobster. Landing of egg-bearing females is not allowed. Because of the high unit value of the lobster, the risk for infringements is high and the fishery therefore requires a relatively

There is anecdotal information concerning illegal fishing and marketing of lobsters but there are conflicting estimates of its magnitude. CFC managers in Mukalla and Dabut believe that only small quantities are handled illegally. Intensive surveillance could assist in quantifying the problem, but very little can be done about it without empowered enforcement officers.

Egypt, Saudi Arabia and Yemen attempt to regulate the Red Sea shrimp trawl fishery using a number of management strategies, including closed seasons and gear restrictions. Collaboration between these states could improve the effectiveness of such measures. Regional cooperation is required in order to regulate the number of boats and allowable mesh size of the trawls. However, this cannot be determined without better monitoring of the fishery, as discussed previously. Boats land directly at relatively few sites on both sides of the Red Sea. Because of the limited geographical extent of the fishery, future surveillance activities could probably be conducted by shore based inspectors at a few of the landing centers. There have been reports of the transfer and sale of catch at sea for export to Saudi Arabia. Such practices would also need to be monitored and controlled.

National authorities are currently unable to undertake effective MCS of artisanal fisheries due to a lack of equipment, recurrent finance and suitably trained personnel. The allocation of resources for enforcement as well as training of enforcement officers, particularly in areas of high fishing pressure, should be given priority.

National authorities might consider establishment of a revolving fund into which licence fees and revenues as well as fines for infringements are paid, in whole or in part, in order to provide adequate operating funds to support MCS. With careful management, a user-pays approach could mean that no direct costs would be borne by national governments once the system is established. To be successful, however, the payment of licence fees and other dues must be actively enforced.

Field and office equipment should be procured for national MCS departments. A properly equipped MCS operations center, with communications and field equipment for controlling national MCS operations is required in Egypt, Saudi Arabia, Sudan, Djibouti, Yemen and Somalia. Equipment needs include transport, office equipment, handheld global positioning systems (GPS) and communications equipment. Onboard fisheries inspectors/observers require proper instruction manuals and other documentation, rough weather gear, protective clothing, identity cards, and handheld GPS.

Industrial Fisheries - Gulf of Aden

The industrial fleet in the Gulf of Aden consists of freezer trawlers fishing for cuttlefish and demersal finfish. In Yemen, trawling operations are regulated with regard to area, which must be beyond three nautical miles from the coast and in waters deeper than 40 meters. The season for cuttlefish is also regulated. There are regulations concerning quantities of cuttlefish caught as bycatch during the off-season and the handling of the fish bycatch. In Somalia, the current civil situation means that no enforcement is possible and industrial vessels from many countries are able to fish at will.

Those regulations that do exist to control industrial fleets are unfortunately very often violated. Trawlers operating off Yemen's coast fish at times in very shallow waters close to the coast where there are large concentrations of spawning cuttlefish. This practice is destructive to the cuttlefish resources and results in serious conflicts with artisanal fishermen as the trawlers damage their gear. There are reports from artisanal fishermen that large quantities of dead fish have been observed floating or washed ashore on the beaches and are said to have come from the trawlers. Violations of the bycatch regulation might therefore be another problem.

Two measures may assist in reducing the frequency of infringements.

- Imposition of deterrent penalties in new legislation, as already discussed above.
- Onboard fisheries inspectors/observers must be empowered to initiate enforcement actions and their duties, powers and responsibilities must be clearly specified in the law. The inspectors must also be carefully selected, properly trained and well paid.

Further, to reduce ambiguities and obtain evidence needed in case of legal actions, the communication between vessels and the national surveillance operations center should be efficient. The use of satellite transponders and similar electronic information transfer techniques for independent reporting of vessel positions is a novel approach that offers considerable scope in the Region, but has as yet not been considered.

The above mentioned measures would meet most of the surveillance requirements for fleets targeting major stocks, such as cuttlefish and demersal finfish. They would also be sufficient to cover a fleet of vessels fishing for tuna, another resource susceptible to industrial exploitation. Nevertheless, onboard inspection at sea assisted by patrol vessels may also be necessary. Maintenance and operation of patrol boats is expensive and requires good management and flexibility to be effective. Since this is difficult to achieve and incidences are expected to be infrequent, it is suggested that arrangements be made with the Navy and/or Coast Guard to use their vessels for inspection trips as and when the need arises.

Industrial Fisheries - Red Sea

The industrial fleet in the Red Sea consists of trawlers fishing for shrimp and demersal fish. Some Egyptian vessels operate under an access agreement with Yemen. These trawlers reportedly take fisheries inspectors on board before they commence fishing. Thereafter, the inspectors report daily on the fishing operations via radio to the operations center in Aden. At the end of the fishing trip, the vessels again come close to the coast and the catch is supposed to be inspected by an unloading committee before they leave for Egyptian ports for unloading. In 1997 there were 30 vessels each undertaking approximately 12 trips per year which would require a total of 360 unloading inspections at Salif port and 720 inspector trips a year, all coming from the MCS Operations Office in Aden. Therefore it must be concluded that the catch in the fish hold is not inspected other than in a very superficial way, and also that the Ministry of Fish Wealth/Aden cannot control such a complicated inspection program concurrently on both coasts. The entire system appears to have many weaknesses and is in contravention of one of the fundamental MCS principles that transhipment at sea must never be allowed, since this deprives the authorities of a large element of control.

Improved surveillance of the industrial fleet in the Red Sea would require the same fundamental measures of penalties and onboard inspectors as discussed for the Gulf of Aden fleet. The introduction of VMS using satellite transponders might be feasible on this size and type of vessel, however establishment of such satellite based VMS may well be beyond the technical capabilities of national MCS authorities. Although VMS is a useful tool for improving fisheries management, it should be recognized that VMS transponders placed aboard a licensed vessel give managers information about the position and activities of that vessel, but do not indicate the presence of illegal vessels operating without a licence (and therefore a transponder) thus a satisfactory surveillance programme has to include other elements such as patrol boats with empowered inspectors capable of operating in the entire EEZ. Costs of this should be weighed against other benefits derived from improvements in MCS. It might also be useful to evaluate the need for or desirability of resource exploitation by foreign vessels.

There is no documented information on illegal fishing by unlicensed foreign fishing vessels in the waters of any PERSGA members states. The extent of illegal fishing by unlicensed foreign vessels is therefore unknown, although anecdotal information indicates that it is a significant problem. An appropriately scaled MCS programme would need combine aerial surveillance, at sea inspection by patrol boats, onboard observers and port-side inspection. Before expanding on existing operations, the extent of the problem and indicative costs in relation to the total value of the fisheries must be carefully assessed in each country. In the Red Sea trawlers are restricted to trawlable areas, and therefore it should be relatively easy to determine the magnitude of the problem by use of occasional aerial surveillance supplemented by a Navy vessel with inspectors onboard.

National fisheries authorities should review existing licence agreements with joint venture companies and the agreements entered into by the joint ventures with foreign partners, to rationalize existing fishing effort within existing MSY estimates, or estimates developed in accordance with precautionary principles. A clear policy with regard to number and size of vessels needed to exploit the resources of any particular state and identification of those companies considered most desirable and whose activities should be allowed to continue needs to be established as part of a specific man-

agement plan for the fisheries, and existing agreements amended accordingly.

No further industrial fishing licences, whether for domestic or foreign access vessels, for any resource should be issued until basic scientific research has been undertaken to determine the ability of the resource in question to sustain at least the existing level of fishing effort and until fisheries management plans are formulated for the individual fisheries, based on scientific information. In the absence of reliable data for the fisheries, a precautionary approach to setting allowable catch and other licensing conditions should be adopted. Specific mention should be made of the Yemeni-Egypt agreement: Yemen should consider whether allowing industrial trawling of Red Sea shrimps in its sovereign waters is an appropriate policy option, given the importance of the resource to the artisanal sector.

Fisheries Cooperatives

Fishing gear and engines provided to the artisanal fisheries sector should be supplied without subsidy so as to foster expansion of the private sector as a future source of supply. Where assistance to the fisheries is provided by national government-sponsored activity, inputs should be carefully price coordinated so as not to compete with private sector vendors.

National fisheries authorities should liaise with public and private sector lending institutions to ensure that continued financial support to the fisheries sector is in line with current development aspirations. Importantly, credit policy adjustments could be encouraged, allowing fishermen to invest in new, intermediate technology vessels and gear for offshore fishing. Obtaining 'affordable' finance is a major constraint to interested fishermen, especially in Egypt and Sudan.

Support should be given to the establishment of Organizations representing fish exporters and/or traders/companies. Such Organizations could bolster the growing private sector by making information on prices, government decisions and export requirements and markets available. It would also provide a united voice in discussions with national government on relevant decisions or legislation.

Environmental Issues

General

The Gulf of Aden and Red Sea areas are rich in marine resources and have high biodiversity. In the Gulf of Aden nutrient-rich water is a result of annual upwelling, driven by monsoon winds, and centerd on the south coast to the east of Mukalla and also of nutrients and plankton transported by the wind through the Strait of Bab-al-Mandab into the Red Sea. Unfortunately, not enough is known about the fish and marine resources or habitats in the Region. The GEF/UNDP funded projects 'Yemen - Protection of Marine Ecosystems of the Red Sea' and 'Conservation and Sustainable Use of Biodiversity of Socotra Archipelago' both incorporate base line survey work and aim to develop protection and management plans for marine resources. If these GEF/UNDP projects are executed effectively with full support from involved national Organizations, they could greatly stimulate national research centers. A proactive stance is required from all staff to make use of opportunities presented.

There are a number of current threats to the Region's marine environment, as indicated in Chapter 9. Fishermen in both the Gulf of Aden and Red Sea complain about licensed industrial fishing vessels trawling for demersal species within the 3 mile limit, the area where artisanal boats operate. In the Gulf of Aden cuttlefish spawning grounds are protected by the 3 mile fishing limit in Yemen's waters, but due to a lack of government control on activities, vessels appear not to be complying with regulations. Similar reports are made by fishermen on the Red Sea coast about licensed and unlicensed shrimp trawlers operating during the closed season. Inshore nursery and feeding grounds are important for many species of marine fish and it is therefore imperative that such areas be protected by active and effective controls for the sake of target and non-target fish stocks.

Oil pollution does not appear to pose a significant threat to coastlines at present. The foreign companies operating terminals carry out their own sampling of surrounding sea and beaches and rigorously analyze samples for any hydrocarbon content of their product's specification. Most have

contingency plans in place in the event of a spill or accident. A more serious threat comes from passing tankers discharging ballast or oil.

The Region has a growing population is due to high birth rates, increased life expectancy, and returnees from Arab states where employment opportunities have diminished. Consequently, new property developments are springing up on the coastline of Egypt, Sudan and Yemen, often only metres away from high water lines. Prime coastal sites are being bought for future housing or tourism development. In many cases, such development is ugly, done with no environmental assessment, little planning and in areas where water, sewage, electricity, etc., infrastructure is not in place.

Land based pollution from agriculture, industry and domestic waste is causing problems. Agricultural run-off, containing sediment, pesticides, heavy metals and fertilizers, is increasing. In Yemen, raw sewage is pumped directly into the Gulf of Aden.

For some countries, especially Egypt, tourism is part of national development objectives and tourist numbers are rising. Yemen offers great diving and snorkeling opportunities for tourists on both coastlines. But if coastal development, particularly of hotels and tourist complexes, is not controlled, then the beaches and marine life that helped attract tourists in the first place will lose their ability to do so. Tourists swimming in Adeni waters already are subject to stomach upsets and further uncontrolled development will make the situation worse.

Trade in ornamental fish is carried out by several companies on the Red Sea coast. The scale of this trade is relatively small at present, but should be observed carefully in the future especially if tourism activities focus on viewing coral reefs and their fish.

The Gulf of Aden is a breeding ground of worldwide importance for green, hawksbill, and loggerhead turtles which are classed as endangered species by the World Conservation Union. The leatherback turtle is also an occasional visitor. In Yemen and Somalia turtles are killed by coastal communities for their meat and oil which is used as a cure for asthma. Eggs are also eaten. As turtles have a long life cycle, nesting site exploitation may take many years to impact upon the population. Little is known about Yemen's turtles and nesting sites as there is no current monitoring or research, however killing sea turtles is illegal throughout Yemen under Law 49 of 1991. Unfortunately, Yemen currently lacks a well defined institutional framework for enforcing these laws, which exist only on paper.

Countries in the Region have ongoing plans to establish MPAs as part of the overall drive for Integrated Coastal Zone Management. Special attributes of such areas range from mangroves, seagrass-rich khors, rocky shores, mud flats, coral areas and reefs and turtle nesting sites. Such plans are highly laudable and should be afforded continued support.

SOCOTRA ARCHIPELAGO

The Socotra Archipelago warrants a special mention. Socotra's fisheries have been documented under the Ministry of Fish Wealth's Fourth Fisheries Project (Watt 1995, 1996).

The Socotra Archipelago Master Plan aims at producing a comprehensive framework for the economic and social development of this unique group of islands, 400 kilometers off the southern coast of Yemen in the Gulf of Aden. Funding is being provided by the EC. Implemented by Yemen's EPC, the Master Plan is being undertaken in two phases: Phase 1 is an assessment of the current status, the major development constraints and the policies and aspirations both of the people and their government. A major outcome of this current Phase is the outline of a series of investment projects for discussion and agreement at a Phase 1 Workshop in Spring 2000. Phase 2 will take these agreed projects and develop detailed, costed project proposals for presentation in the Phase 2 report.

Socotra Archipelago is regarded as an area of globally significant biodiversity. Preliminary studies have found endemism of plant species on the islands to be high and there is an as yet unexplored potential for marine endemism at the specific and sub-species level.

Information that is available notes that fishing effort is focused on a limited number of species:

pelagic shark, kingfish and tuna. Demersal fish and lobster stocks are reported to be large, but only lightly exploited. Shark stocks are either heavily or over-exploited. There is a lack of storage facilities on the islands and few traders or reefer vessels visit because of the islands' isolation and uncertain weather. As a result much of the fishery relies on export to the mainland of dried product, particularly shark meat and fins.

Current estimates put the shark catch in the Socotra Archipelago at between 4,000 and 6,000 metric tons per year (Saeed, 2000). In recent years the demand for dried shark fin for export to Singapore through the mainland has increased to the extent that some shark carcasses are being completely discarded and not even used for meat. Kingfish, yellowfin tuna and mackerel tuna are usually boiled, salted, dried and shipped to Mukalla on Yemen's southern coast. Grouper, emperor, snapper and grunt are lightly exploited for local consumption. Rock lobster is caught using large mesh (18-25 centimeters) multifilament nets. At the moment stock levels are estimated to be good, but increasing and uncontrolled commercial interests could soon begin to overexploit high value stocks. Dried sea cucumber is collected by mainland traders each year. Pearl fishing has declined markedly on the islands with the advent of pearl culture and synthetic mother-of-pearl but a recent upturn in demand has been reported.

There is a strong village based fisheries management system in place which limits fishing effort. Control and enforcement of rules is good as a result of both peer pressure and tough penalties for infringements. Socotra's fisheries will come under threat if the islands' societal structure changes markedly or outside interests begin to exploit resources on an unsustainable basis. A GEF/UNDP project focuses on protecting Socotra's marine resources through strengthening the local management system and protecting the Archipelago from outside commercial interests through regulation (Hariri and Krupp 2000). Such regulations must be enforceable to be effective.

Physical Infrastructure

In parts of the Region infrastructure for landing, preservation, handling and marketing of catches are a greater constraint to the development of fisheries than resource abundance and sustainability. This is particularly true for Sudan, Yemen and Somalia where improving the basic shore facilities, providing basic services such as clean water and electricity, and road infrastructure would aid private sector development to increase the utilization of available fish resources. With regard to exporting fish products by air, service is often not reliable and priority is not given to perishable freight. There is considerable scope for improving the efficiency and functioning of the services that directly affect fisheries exports.

A lack of suitable harbours and associated landing facilities including areas and facilities for berthing, maintenance and repair of fishing boats forms a major constraint to the operation of intermediate sized craft, which would be capable of exploiting offshore resources especially in Sudan, Somalia and the Red Sea coast of Yemen. This would perhaps reduce pressure on coastal and nearshore resources. Some of Yemen's existing harbours are in need of rehabilitation and expansion for example, Hodeida and Nishtun have major siltation problems, reducing the availability of the harbour to deeper-draft vessels.

Multi-day fishing in the Red Sea and Gulf of Aden undertaken by sanbuks and large huris has expanded considerably in recent years. The landings of such vessels is concentrated at a few sites where the best market prices can be obtained and where there are suitable facilities available. The multi-day fishing trend is likely to continue since it is financially more rewarding than single-day inshore fishing. Landing facilities all along the Red Sea and Gulf of Aden coasts for multi-day fishing vessels are limited.

Changes in the small boat, single-day fleet in the Region are also foreseen. Fishermen generally respond to higher fish prices by attempting to increase their fish catch and for this they need to venture further out to sea for longer periods, making it necessary to carry ice. Some of the single-day boats may also start carrying ice to improve the quality of the catch and thereby obtain better

prices on the market. The boats will have to be larger than the present ones and some huris in the Red Sea will find it uneconomical to use petrol-driven OBMs. Inboard engines will make the boats heavier and more difficult to operate from the beach. During the calm weather season they may be able to operate from the beach by ferrying the catch ashore and supplies to the boat. However during the monsoon period there will be a demand for protected landing and service facilities. To build such facilities along open beaches is technically difficult and expensive. They have to be concentrated in a few places where the coast configuration provides natural protection through rock formations and bays.

Harbour development is a long-term affair because of its complexity and the high capital costs involved. Usually, a series of investigations has to be undertaken to determine the feasibility, impact, costs and benefits. It is also of utmost importance to plan the work in close consultation with the end users, that is, the fishermen. There is at present little evidence of effort devoted to this important aspect by national authorities in improving the infrastructure for artisanal fisheries. Development of a 'national master plan' would be valuable, which could be regularly updated in accordance with changes in requirements. There is currently no recognition of the need for this type of work in the Organization and staffing of the appropriate national fisheries authorities.

Fish Handling, Processing and Marketing

The domestic markets of some PERSGA member states are not overly concerned with fish quality at present. Domestic consumers do not buy fish strictly because of price and quality, although these factors are important. Rather, they tend to accept what is on offer at local markets and are only just beginning to embrace the free market consumer mentality of buying the best possible quality at the lowest possible price. Domestic marketing systems have developed fast and are profitable, even with the generally low prices paid.

Post-harvest fish handling is generally poor. In Sudan, Yemen and Somalia, ice is not taken to sea on single-day fishing vessels; catches are often not handled with care; auctions are conducted in unhygienic conditions; fish are often transported in open vehicles with no form of protection from the sun and without ice; public retail markets are generally of a poor standard of hygiene. The reason for this lack of post-harvest care is that consumers do not yet demand high quality product. In general they will not pay a premium for better quality/cared for fish and so buyers/sellers further along the distribution chain will likewise not pay a premium or demand better quality fish or handling.

In most countries per capita consumption of fish is high in the coastal regions but low inland except for a few major urban areas with good road connections. There is thus considerable scope for increased consumption. The bottleneck is the poor state, or absence of, road connections. Facilities for storing and handling fish are also lacking but would no doubt be forthcoming if the roads were provided. Consumption of fish could be further stimulated by government interventions to improve market facilities and hygienic conditions.

Potential for Improved utilization and Marketing

At present the countries in the Region are not major exporters of fish, with the exception of Yemen. Egypt and Saudi Arabia are net importers of fish and fish products. Fish exports from Jordan, Sudan, Djibouti and Somalia are small.

One of the main opportunities for improving fish utilization is in the export of prime species such as tuna, grouper, snapper, emperor, bream, etc. on ice to Middle East and European markets. This could augment incomes of the fishermen and all other participants in the distribution network. However, this requires much improved handling of fish from first capture right through processing and packaging, reliable checks on quality and health certification processes, and an efficient transport system to get product to the airport with minimum delay. There is an opportunity for future development by private business, especially in the southern states, if government and/or foreign development assistance is made available to improve supporting services and infrastructure. Unless efforts to improve

domestic quality control systems and export certification procedures are made, these opportunities will not materialize. The importance of good quality product and processing is recognized by international markets through prices paid for high quality fish and imposition of import regulations, such as those of the EU or the United States developed Hazard Analysis Critical Control Point (HACCP) food technology and quality system (see Box 7).

quality for all international markets. These should then be enforced, since the importance of adequate national quality control criteria is increasing in world trade today.

In Yemen, traders and companies active in exporting to international markets are beginning to demand high quality fish and are paying premium prices. Fishermen are starting to link financial benefit with good handling and preservation as only their best fish are bought at high price by traders

BOX 7. THE HACCP PRINCIPLE

HACCP (Hazard Analysis and Critical Control Point) systems identifies specific hazards and measures for their control to ensure the safety of food. The objectives of HACCP are to: (a) provide a system of preventive controls for every specific product and process, (b) clearly define practices under which plant staff prevent hazards occurring, (c) define procedures to monitor and audit these practices; and (d) provide cost-effective assurance of food safety, placing more responsibility on operating staff. HACCP is aimed at dealing with processing hazards (product safety) not quality, which is regarded as an issue between buyer and seller.

The day-to-day monitoring should be performed in the processing plant itself, while specific tests should be supplied by specific laboratories having the necessary technical and professional support. The Seafood HACCP Regulation requires that a HACCP plan be prepared for fish and fisheries products that each company processes (where significant safety hazards exist). Once a HACCP system is established, the main effort in quality assurance will be directed towards the Critical Control Points and not at numerous tests of the final product. The goal is to assure a much higher degree of safety at less cost.

As part of the HACCP system, criteria (tolerances, target level) that must be met to ensure that a CCP is under control will be established. Based on the criteria a monitoring system is developed, under which procedures for corrective action are established. Furthermore, procedures for verification, documentation and record keeping should be maintained.

In a HACCP based system for assuring seafood quality, a detailed description of all CCPs is necessary. This includes determination of criteria and specified limits or characteristics of a physical (such as time, temperature, condition), chemical (salt concentration, NaCl) or biological (sensory) nature which ensure that the product is safe and of acceptable quality. These criteria must be monitored regularly in a well equipped laboratory in order to cover all analyses. In the processing plants some simpler tests can be run, while more specialized analysis (microbiology, sensory) and those that need an objective assessment should be performed by a certified independent laboratory.

Buyers in many countries are also requesting that the producer/exporter be certified according to certain international standards, such as the ISO-9000 series. In order to verify that handling, processing, storage and distribution have been done under controlled conditions, these must be documented by laboratory tests of process/product quality and plant sanitation.

Raising the standard of health inspection of fisheries products benefits both domestic consumers and businesses and traders wishing to export. If standards are improved to satisfy EU and/or United States import regulations and the HACCP system, then fisheries products from PERSGA states will be regarded as acceptable in terms of health and

purchasing for export. The introduction of private retail shop chains in the main cities is also starting to attract discerning consumers, especially as prices are being set the same as or lower than those in well established, but unhygienic, public retail markets. However, as discussed earlier, since July 1998 Europe has banned the entry of fish products

into its member states when national quality control systems do not meet European Union requirements.

For countries where quality control procedures are lacking, the following steps should be taken as a priority in order to bring countries in line with international standards for fish quality control and hygiene:

- Existing guidelines and regulations for fish handling and quality control for fresh and frozen fish and other marine products, and the processing of fish on board fishing vessels should be updated to conform to the requirements of major importing countries, particularly those set out in EC Directive 91/493/EEC or the requirements laid down by the United States Federal Drug Administration.
- Once national legislation has been amended and an adequate legal framework for a practical fish inspection quality control system is in place, inspectors should be trained in the principles underlying the new regulations and inspection practices and procedures should be developed to allow them to effectively enforce regulations.
- Quality control and technical departments should be structured to allow them to operate effectively.
- In cooperation with municipal authorities, guidelines should be developed for the hygienic handling of fish in wholesale and retail markets. These guidelines should be incorporated as regulations in any review of the national fisheries legal framework or other appropriate legislation.

Past Development Assistance

The PERSGA member states have received assistance from numerous bilateral and multilateral sources during 1988-1998. These are well documented in the SAP Country Reports and National Fisheries Reports. The countries and agencies that have provided most of the assistance are the Abu Dhabi Fund, AFSED, Denmark, EU, GEF, IDA, IFAD, Japan, the Kuwait Fund, the former Soviet Union and the World Bank. Main areas of assistance have included:

- Infrastructure projects: Jetties, harbour facilities, roads, fish landing facilities, ice plant/ cold storage facilities, slipways and workshops.
- The artisanal sector: Landing facilities, shore facilities, boats, engines and credit schemes in both the Red Sea and Gulf of Aden areas.
- The industrial fishing industry: New vessel purchases, restructuring, economic appraisals, joint venture arrangements.
- The fish processing industry: Large international development loans to establish fishmeal plants and canneries; training in processing and marketing; installation of cold storage facilities, chill rooms, freezers and ice plants.
- In fisheries research: National research institutions have been established with help of external funding; technical assistance, training schemes and research vessels have been provided; stock assessment studies and been carried out.
- In training: Establishment of national training institute, funding for exchange schemes, scholarships, etc.

Future Development Assistance Priorities

Some types of assistance received in the past are no longer required. In Saudi Arabia for example, the private sector has amply demonstrated in recent years that it is capable to develop and expand commercial activities in fishing, marketing and the necessary supporting services. There is no need for further direct involvement in any commercial activities. This should also include the cooperative sector since it is no longer an extended arm of the fisheries administration. The fragmentation of the cooperative structure makes it increasingly difficult to distinguish between the cooperative and private sector in artisanal fisheries. Future development needs to switch from stimulation of the fisheries to greater management (see Box 8).

One of the main areas in which external assistance, through government interventions, will play an important role in the future is infrastructure. Coastal and access roads need to be constructed to better integrate fishing villages with the national

BOX 8. ARCHITECTURAL FEATURES FOR GOOD FISHERIES MANAGEMENT

The principles for an ideal system for good fisheries management would surely be one:

- Based on a clear, precise definition of use rights.
- With a broad, well defined and stable set of aims and objectives.
- Developed at an appropriate geographical scale.
- Involving all major stakeholders within the policy community.
- Using relatively simple and transparent procedures.
- Involving a well integrated combination of regulatory measures.
- Implemented, as far as possible, through responsible user-group organizations.
- With effective means of surveillance and enforcement.
- Amenable to effective monitoring.
- Subject to periodic review and capable of rapid response to changing circumstances.

Despite the apparent simplicity of this list of requirements for good management, most systems fall short of this ideal situation.

mainstream of economic and social activities. National governments are often short of funds and there are ample opportunities for external contributions. Fisheries harbours and landing facilities are insufficient to meet the needs of the artisanal fishing fleet and need to be improved and expanded. Earlier inputs of this kind have not always been successful and it is very important to clarify why some of the provided facilities are not being used before starting on new ones.

Infrastructure development is often driven by civil engineering concerns and important customs, patterns of behavior or other social factors might have been overlooked or not sufficiently taken into account. In some cases, development assistance has been donor-driven and facilities have been provided to cater for a development that 'should' take place rather than to meet actual requirements.

Sudan, Yemen and Somalia are in need of immediate financial assistance to rehabilitate and improve shore infrastructure but would also benefit from technical assistance in preparing a long-term rolling master plan for future development as a guide for government and international development cooperation agencies. Smaller landing areas should also be included in such a master plan.

Another important area for external support concerns technical assistance, education/public awareness and training, often supplemented with equipment components.

Research on fisheries and environment is also an important area needing support. The issues have been discussed previously. Considering the restrictions on government expenditures it is impossible for some national fisheries authorities to mobilize adequate resources for funding of overseas training and education. Therefore external funding sources should be sought. For assistance in research, a long-term twinning arrangement with a suitable foreign research institution should be considered for the advantages it could provide in consistency in the transfer of technology and training. Academic studies also could be coordinated through the twinning institution. An umbrella contract for a research assistance programme, with periodic tripartite reviews, would also provide for flexibility and facilitate the monitoring of progress to ensure that targets and objectives are met.

Another important area is MCS of fisheries, for which technical assistance, training and equipment is needed. The main components of MCS assistance would be preparation of new legislation, design of monitoring systems (data collection/ analysis, onboard observers, port inspectors, etc.), assessment of surveillance needs and Organization of suitable systems, training of inspectors and communication equipment. The assistance could be broken down into individual projects, but should be delivered as a package for consistency and effectiveness.

Legal assistance to draft new laws, by-laws and regulations, and suitable arrangements for fishing rights is required. Although considerable legal expertise is available in the Region, international assistance is required for drafting enabling legislation for accession to international conventions and agreements in support of improved fisheries and environmental management.

Sudan, Yemen and Somalia require assistance to improve fish handling and processing so as to meet the stringent criteria of developed markets such as the EU. Development assistance in implementing HACCP systems and generally improving fish handling, processing and packaging with regard to hygiene and quality standards will be required for at least for the short-term. It is envisaged that once the benefits of improved quality and therefore prices are more widely acknowledged, commercial pressures will lead to private investment in improved quality control.

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Appendix A

Main Target Species in the Red Sea and Gulf of Aden

English name	Species or family name
A. Invertebrate species	
Cuttlefish	*Sepia pharaonis*
Deep Sea lobster	*Puerulus sewelli*
Deep Sea shrimp	*Parapenaeopsis* spp.
Pearl oyster	*Pinctada margaritifera*
Rock lobster	*Panulirus homarus; P. versicolor*
Trochus	*Tectus dentatus, Trochus virgatus*
Shrimps	*Penaeus latisulcatus, P. japonicus, P. semisulcatus, P. monodon, Metapenaeus* spp.
Sea cucumber	*Holothuria scabra and Actinopyga* sp.
B. Finfish species	
Anchovy	*Stolephorus* sp.
Barracuda	*Sphyraena jello, S. barracuda*
Black marlin	*Makaira indica*
Blue marlin	*Makaira mazara*
Striped marlin	*Tetrapturus audax*
Black spot shark	*Carcharhinus sealei*
Blacktip reef shark	*Carcharhinus melanopterus*
Blacktip shark	*Carcharhinus limbatus*
Bluefin tuna or kawakawa	*Euthynnus affinis*
Bream	All species of family Sparidae
Catfish	*Arius thallasinus*
Cobia	*Rachycentron canadum*
Croaker	*Scianidae*
Dolphin fish	*Coryphaena hippurus*
Emperor	All species of family Lethrinidae; especially *Lethrinus nebulosus; L. mahsena, L. lentjan.*
Frigate mackerel	*Auxis thazard*
Goat fish	Family Mullidae
Goldspot herring	*Herklotsicthys punctatus*
Grouper	All species of family Serranidae; especially *Epinephelus chlorostigma; E. summana; E. areolatus; E. tauvina; Plectropomus maculatus; P. areolatus; P. pessulifera; Variola louti.*
Grunt	*Pomadasys* spp.
Guitarfish	*Rhinobatidae*
Halfbeak	*Hemirhamphus* spp.
Hammerhead Shark	*Sphyrna zygaena*
Horse mackerel	*Trachurus indicus, Decapterus maruddsi*
Indian mackerel	*Rastrelliger kanagurta*
Jacks, trevallies	All species of family Carangidae
Kingfish (Spanish mackerel)	*Scomberomorus commersoni*
Little tuna	*Euthynnus affinis*
Lizardfish	*Saurida undosquamis*
Longspine bream	*Argyrops spinifer, Evynnis cardinalis, Sparus majir*

English name	Species or family name
Longtail tuna	*Thunnus tonggol*
Mojarras	Family Gerridae
Mullet	*Mugil robustus; M. cephalus, M. capito, Valamugil seheli*
Needlefish or 'longtoms'	All species of the family Belonidae
Oceanic whitetip shark	*Carcharhinus longimanus*
Pacific mackerel	*Scomber japonicus*
Parrotfish	All fishes of family Scaridae; *Scarus ghobban, S. hareed*.
Pomfret	*Pampus argenteus*
Pristis Pectinata	*Sawshark*
Queenfish	*Corinemus* spp.
Rabbit fish	All species of the family Siganidae; such as *Siganus oramin, S. rivulatus*.
Red mullet	*Upeneus asymmetricus; U. tiagula; U. vittatus.*
Ribbonfish	*Trichiurus* sp.
Round herring	*Etrumeus teres*
Sailfish	*Istiophorus gladius*
Sand bar shark	*Carcharhinus plumbeus*
Sailfish	*Istiophorus platypterus*
Sardines	*Sardinella longiceps; Sardinella sirm; Sardinella gibbosa*
Scalloped hammerhead shark	*Sphyrna lewini*
Scavenger / emperor	*Lethrinus* spp.
Shortfin mako shark	*Isurus oxyrinchus*
Silvertip shark	*Carcharhinus albimarginatus*
Skipjack tuna	*Katsuwonus pelamis*
Snapper	All species of family Lutjanidae, such as *Lutjanus bohar, Aprion virescens, Pristipomoides* spp.
Threadfin bream	*Nemipterus japonicus*
Tiger shark	*Galeocerdo cuvier*
Unicorn fish	*Naso unicornis*
Whitetip	*Triaenodon obesus*
Wolf herring	*Chirocentrus* sp.
Yellowfin tuna	*Thunnus albacares*

Appendix B

Artisanal Fisheries Profile, Red Sea and Gulf of Aden

	No. Fisher-men	Huris	Sanbuks	Total Vessels	Principal Gear	Reference Year (Source)
Artisanal Fisheries: Red Sea						
Jordan	230			100	HL, LL, TP, GN, SP	1999 (Khalaf, 2000).
Egypt	9,024	n.a.	n.a.	820	HL, LL	1997 (PERSGA 1997)
Saudi Arabia	4,100			5,428	HL, GN	1997 (MAW, 1998)
Sudan	209	125	226	460	HL, ST,	1997 (PERSGA 1997)
Eritrea	N.a.	n.a.	n.a.	n.a.		
Yemen	16,000	1,610	620	2,230	SN, GN, TR, HL	1997 (PERSGA 1997)
Sub-total Red Sea	29,563	1,735	846	9,038		
Artisanal Fisheries: Gulf of Aden						
Djibouti	270	90	-	90	HL, GN, CN	1996 (PERSGA 1997c)
Yemen	19,700	n.a.	n.a.	5,800	SN, GN, TR, HL	1997 (MEP 1999)
Somalia	8,000	1,050	420	522	Sh.N, HL, GN, LL, TP, BS	2000 (Ministry of Fisher-ies, Ports and Marine Transport 2000; Ministry of Fisheries and Coastal Develop-ment, 2000)
Sub-total Gulf of Aden	27,970	1,140	420	6,412		
PERSGA Region and Eritrea total	57,533	2,875	1,266	15,450		

Notes: 'n.a.' – Data not available. Gear: LL – long-line; GN – gill nets; HL – hand line; BG – beach gleaners; TR – trawl; TN – trammel net; SN – small surround net; CN – Cast nets; Sh.N – shark tangle; nets; TP – traps; BS – Beach seine; ST – set nets; SP – spears.

Appendix C

Industrial Fisheries Profile, Red Sea and Gulf of Aden

	Est. no. Fisher-men	No. vessels:						Reference Year (source)
		Purse Seine	Trawl	Long-line	Hand Liners	Not Specified	Total Vessels	
Industrial Fishing: Red Sea								
Jordan	0	0	0	0	0	0	0	1999 (Khalaf, 2000).
Egypt	7,535	83	173	-	245	932	1,433	1995 (Barrania 1997)
Saudi Arabia	35	n.a.	n.a.	n.a.	n.a.	n.a.	130	1997 (MAW 1998)
Sudan	<100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1997 (PERSGA 1997)
Eritrea	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Yemen	n.a.	n.a.	78	n.a.	n.a.	n.a.	78	1997 (PERSGA 1997)
Sub-total Red Sea	7,570	83	251	-	245	932	1,641	
Industrial Fishing: Gulf of Aden								
Djibouti	0	0	0	0	0	0	0	1996 (PERSGA 1996)
Yemen	350	n.a.	n.a.	n.a.	n.a.	n.a.	65	1997 (PERSGA 1997)
Somalia	<100	0	0	0	0	0	0	
Sub-total Gulf of Aden	450	4	20	-	-	-	65	
PERSGA Region and Eritrea total	7,908	87	271	-	245	932	1,706	

Notes: 'n.a.' – data not available.

It should be noted that in some cases FAO database figures differ from estimates provided by national experts. FAO data for Saudi Arabia includes catches taken in the Gulf and data for Somalia include catches taken from the Indian Ocean (southern) coast.

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Country	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
A. Invertebrate species												
Egypt	Cuttlefish, bobtail squids	77	143	221	172	128	286	486	560	399	414	237
(Red Sea)	Marine crabs	-	-	-	-	-	-	-	10,049	<0.5	4	149
	Natantian decapods	455	582	594	759	435	614	572	763	644	639	436
Saudi Arabia	Cuttlefish, bobtail squids	4	27	20	20	39	35	353	308	578	598	1,561
	Marine crabs	282	96	27	29	169	256	1,126	1,035	1,060	1,371	448
	Octopus	-	-	-	-	-	-	-	-	-	1	<0.5
	Penaeid shrimps	5,016	5,400	3,415	2,144	3,163	2,658	4,282	5,941	7,423	7,011	8,316
	Tropical spiny lobsters	14	6	5	5	6	8	23	21	13	18	701
Sudan (Red Sea)	Pearl oyster shells	.	.	.	13	23	14	13	3	10	10	13
Eritrea	Cuttlefish, bobtail squids	.	.	.	.	.	.	.	.	51	<0.5	3
	Penaeus shrimps	.	.	.	.	.	.	15	13	2	<0.5	9
	Spiny lobsters	.	.	.	.	.	.	.	.	1	1	2
	Tectus shells	.	.	.	.	.	-	-	-	-	-	224
	Various squids	.	.	.	.	.	.	13	15	<0.5	<0.5	<0.5
Djibouti	Tropical spiny lobsters #	8	7	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Various squids	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Yemen	Cuttlefish, bobtail squids	2,169	2,170	3,352	2,122	695	906	306	1,313	1,884	8,657	8,440
	Natantian decapods	86	90	94	104	101	108	.	.	.	.	.
	Penaeus shrimps	273	219	152	183	89	358	722	981	665	601	590
	Sea cucumbers	29	30	63	140	48	65	63	60	60	60	60
	Tropical spiny lobsters	969	970	1,704	1,500	839	1,021	475	390	345	482	470
Somalia	Cephalopods	727	346	352	650	500	550	600	570	550	500	550
	Tropical spiny lobsters	500	550	543	550	500	450	400	380	400	400	400
TOTAL		10,609	10,636	10,543	8,391	6,735	7,329	9,449	22,402	14,085	20,767	22,609
B. Finfishes, by major groupings (Source: FAO Statistics, 2000)												
Jordan	Emperors (=Scavengers)	.	.	.	.	.	.	.	.	.	.	2
(Red Sea)	Fusiliers	.	.	.	.	.	.	.	.	.	.	15
	Marine fishes	2	2	2	20	30	45	60	75	90	100	3
	Scads	.	.	.	.	.	.	.	.	.	.	20
	Spinefeet (=Rabbitfishes)	.	.	.	.	.	.	.	.	.	.	10
	Tunas	.	.	.	.	.	.	.	.	.	.	70
Egypt	Barracudas	-	-	-	-	-	-	-	12	3	1	-
(Red Sea)	Chub mackerel	164	278	412	810	185	453	3,041	1,926	2,042	2,392	810
	Demersal percomorphs	99	12,194	7,131	16,101	5,562	5,600	12,092	.	.	.	.
	Emperors (=Scavengers)	.	.	.	.	.	.	.	429	425	574	577
	Groupers	18	99	78	-	58	334	247	387	647	689	722
	Indian mackerel	.	.	.	.	.	.	.	1,363	1,151	1,914	652
	Jacks, trevallies	2,927	2,545	5,849	6,919	4,841	14,361	11,823	.	.	.	.
	Lizardfishes	854	1,932	2,884	4,776	5,820	6,073	4,845	4,696	4,151	5,117	7,994

Country	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Marine fishes	18,003	19,247	17,230	8,896	19,170	13,597	-	7,331	10,542	16,520	12,797
	Meagre	88	48	31	-	-	-	158	45	<0.5	<0.5	19
	Mullets	28	-	10	-	-	-	-	31	67	59	352
	Narrow-barred Spanish mackerel	16	49	86	-	191	-	1,242	1,297	8,880	8,503	9,933
	Needlefishes	.	.	.	.	.	.	.	123	48	32	17
	Porgies, seabreams	12	50	86	.	.	.	.	4,012	2,428	2,175	1,282
	Sardinellas	5,415	6,198	4,307	2,860	1,613	3,763	2,973	2,822	6,833	5,639	4,973
	Sharks, rays, skates, etc.	18	69	9	61	29	30	69	137	122	180	135
	Snappers, jobfishes	.	.	.	.	.	.	4,875	5,053	4,044	5,165	8,784
	Spinefeet (=Rabbitfishes)	.	.	.	.	.	.	.	185	128	129	175
	Spotted seabass	.	.	.	.	.	.	.	101	2	35	36
	Striped bonito	-	-	-	-	-	-	-	131	318	755	841
	Surmullets (=Red mullets)	276	146	996	583	668	689	777	1,077	716	744	439
Saudi Arabia												
	Angelfishes	-	-	-	-	-	-	-	-	-	-	16
	Barracudas	1,917	1,960	1,843	1,801	1,913	1,990	2,249	1,065	1,251	1,246	1,352
	Blue sea chub	-	-	-	-	-	-	-	-	-	8	<0.5
	Carangids	4,954	5,379	4,182	4,251	4,444	4,920	5,730	4,547	5,524	5,125	5,173
	Clupeoids	-	186	416	333	346	369	391	259	201	560	2,329
	Cobia	23	58	35	33	52	48	71	124	155	155	100
	Demersal percomorphs	.	.	.	.	.	.	.	7	40	50	34
	Emperors (=Scavengers)	7,511	7,775	6,453	6,513	7,715	8,281	7,524	6,598	7,314	6,904	4,773
	Flatfishes	31	30	26	26	30	30	42	51	58	75	89
	Flatheads	-	-	-	-	-	-	-	-	-	-	121
	Goatfishes	10	10	9	9	10	10	52	65	83	73	228
	Groupers, seabasses	5,889	5,827	5,072	4,625	5,731	5,752	5,707	3,514	4,207	4,403	4,978
	Grunts, sweetlips	284	367	226	303	254	351	489	814	1,063	1,014	2,554
	Indian mackerel	899	1,727	1,579	1,579	1,658	1,741	3,240	3,069	1,549	1,990	2,078
	Indo-Pacific sailfish	-	-	-	-	-	-	-	-	-	-	3
	Lizardfishes	82	4	69	69	72	76	195	195	172	188	215
	Marine fishes	3,997	3,116	3,733	4,348	4,578	4,325	3,074	1,480	1,205	820	817
	Milkfish	-	-	-	-	-	-	10	137	130	70	83
	Mojarras (=Silver-biddies)	5	86	4	4	4	5	164	337	360	438	539
	Mullets	-	202	22	143	145	112	29	400	320	369	527
	Needlefishes	-	-	-	-	-	-	461	324	96	111	393
	Pelagic percomorphs	.	.	.	.	.	.	.	.	.	.	.
	Percoids	190	210	153	166	183	242	176	837	777	906	469
	Porgies, seabreams	818	653	692	735	845	1,064	1,910	1,469	1,722	2,481	2,796
	Queenfishes	.	.	.	.	.	.	154	312	349	385	297
	Rainbow runner	-	-	-	-	-	-	-	-	-	415	98
	Rays, stingrays, mantas	-	-	-	-	-	-	-	-	-	-	4
	Sea catfishes	23	151	192	192	201	212	226	303	302	366	319
	Seerfishes	9,362	9,243	8,662	8,768	9,872	10,374	10,851	6,279	5,277	5,634	5,491
	Sharks, rays, skates, etc.	642	696	38	38	40	42	125	467	398	543	1,527
	Silver pomfret	-	-	-	-	-	-	5	41	31	16	60

Country	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Snappers, jobfishes	3,048	2,757	2,423	2,771	2,712	3,019	3,054	1,662	1,704	2,148	2,391
	Snubnose pompano	-	-	-	-	-	-	-	-	-	-	4
	Spadefishes	-	-	-	-	-	-	-	-	-	-	1
	Spinefeet(=Rabbitfishes)	444	865	1,063	868	1,385	1,388	1,887	2,341	2,779	2,173	1,823
	Surgeonfishes	-	-	-	-	-	-	68	113	238	173	252
	Swordfish	-	-	-	-	-	-	-	-	-	-	2
	Therapon perch	-	-	-	-	-	-	-	-	-	-	205
	Threadfin breams	-	-	-	-	-	-	21	221	131	87	305
	Triggerfishes, durgons	-	-	-	-	-	-	-	-	-	26	8
	Tuna-like fishes	288	319	272	517	343	713	923	1,190	1,091	1,339	628
	Wrasses, hogfishes, etc.	.	.	.	.	.	.	.	165	108	105	66
Sudan (Red Sea	Marine fishes	1,200	1,200	1,500	1,500	2,000	2,500	4,000	4,000	4,500	5,000	5,500
Eritrea	Barracudas	.	.	.	.	.	.	37	109	185	21	57
	Batfishes	.	.	.	.	.	.	-	-	-	<0.5	1
	Bigeyes	.	.	.	.	.	.	<0.5	5	<0.5	-	-
	Carangids	.	.	.	.	.	.	48	697	815	13	184
	Cobia	.	.	.	.	.	.	2	10	38	2	6
	Emperors (=Scavengers)	.	.	.	.	.	.	217	1,010	767	90	104
	Flatheads	.	.	.	.	.	.	18	14	<0.5	<0.5	<0.5
	Goatfishes	.	.	.	.	.	.	61	7	2	1	1
	Groupers	.	.	.	.	.	.	14	83	141	95	117
	Grunts, sweetlips	.	.	.	.	.	.	61	469	367	13	47
	Guitarfishes, etc.	.	.	.	.	.	.	3	1	<0.5	<0.5	-
	Indian halibut	.	.	.	.	.	.	9	4	8	1	<0.5
	Indian mackerel	.	.	.	.	.	.	40	75	58	2	<0.5
	Indo-Pacific sailfish	.	.	.	.	.	.	-	-	-	<0.5	1
	Kawakawa	.	.	.	.	.	.	.	.	.	.	6
	Lefteye flounders	.	.	.	.	.	.	-	-	-	<0.5	1
	Lizardfishes	.	.	.	.	.	.	651	166	3	5	<0.5
	Longtail tuna	.	.	.	.	.	.	.	.	.	.	22
	Mackerel-like fishes	.	.	.	.	.	.	7	34	.	.	5
	Marine fishes	.	.	.	.	.	475	451	456	211	215	212
	Milkfish	.	.	.	.	.	.	<0.5	2	<0.5	2	3
	Mullets	.	.	.	.	.	.	.	.	3	4	2
	Spanish mackerel	.	.	.	.	.	.	.	.	181	174	182
	Porgies, seabreams	.	.	.	.	.	.	12	22	12	<0.5	<0.5
	Queenfishes	.	.	.	.	.	.	.	.	8	4	.
	Rainbow runner	.	.	.	.	.	.	.	.	3	-	<0.5
	Requiem sharks	.	.	.	.	.	.	13	6	15	13	17
	Sea catfishes	.	.	.	.	.	.	52	60	9	<0.5	149
	Snappers	.	.	.	.	.	.	43	205	281	219	294
	Snappers, jobfishes	.	.	.	.	.	.	2	<0.5	43	59	69

Country	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Spinefeet (=Rabbitfishes)	.	.	.	.	.	.	-	-	<0.5	<0.5	1
	Threadfin breams	.	.	.	.	.	.	928	206	4	15	<0.5
	Triggerfishes, durgons	.	.	.	.	.	.	9	1	<0.5	<0.5	<0.5
	Tuna-like fishes	.	.	.	.	.	.	.	.	4	29	81
Djibouti	Barracudas	15	9	10	12	13	14	15	16	20	19	20
	Carangids	53	19	17	13	14	15	16	18	20	19	20
	Groupers	101	95	83	77	84	92	98	107	110	104	105
	Jacks, trevallies	-	5	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Marine fishes	110	27	18	8	9	10	11	12	10	9	10
	Mullets	7	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Porgies, seabreams	43	37	29	28	31	34	36	39	40	38	40
	Seerfishes	26	37	57	48	52	57	61	67	65	61	60
	Snappers, jobfishes	59	143	121	55	60	65	69	76	80	76	80
	Tuna-like fishes	32	11	20	11	12	13	14	15	15	14	15
Yemen	Barracudas	1,102	634	1,766	1,873	2,670	3,279	2,716	2,356	1,813	1,900	1,850
	Demersal percomorphs	3,329	3,000	3,836	4,258	4,131	4,000	4,000	5,383	5,022	5,250	5,120
	Emperors (=Scavengers)	2,909	3,670	2,256	3,399	3,275	5,478	4,390	3,214	2,437	2,550	2,490
	Frigate and bullet tunas	58	21	22	24	23	25	25	20	20	20	20
	Groupers, seabasses	1,023	1,761	1,584	1,376	2,038	2,487	2,400	2,260	1,743	1,820	1,770
	Grunts, sweetlips	72	116	74	313	569	754	1,147	1,813	1,318	1,380	1,350
	Indian halibut	170	121	134	327	368	89	422	974	724	760	740
	Indian mackerel	5,363	5,820	6,542	7,301	6,567	6,000	6,500	6,958	752	790	770
	Indian oil sardine	.	.	.	.	.	.	.	.	4,120	4,310	4,200
	Jack and horse mackerels	823	820	855	949	921	990	990	4,412	1,380	1,440	1,400
	Jacks, trevallies	345	815	556	125	509	174	480	431	413	430	420
	Kawakawa	1,315	1,252	1,569	1,601	1,615	504	1,164	1,226	1,183	1,240	1,210
	Longtail tuna	552	563	1,276	651	1,324	1,707	2,291	2,204	1,887	1,970	1,920
	Mullets	364	280	311	834	<0.5	<0.5	<0.5	391	380	400	390
	Narrow-barred Spanish mackerel	2,273	2,273	3,118	3,207	2,551	3,092	3,255	3,047	3,521	3,680	3,580
	Pelagic percomorphs	44,374	40,000	43,117	43,564	36,134	38,104	35,664	52,407	59,344	62,304	60,740
	Rays, stingrays, mantas	-	-	-	-	-	-	-	156	<0.5	<0.5	<0.5
	Sea catfishes	413	154	206	532	1,364	1,411	1,043	1,697	1,700	1,780	1,740
	Seerfishes	295	446	465	516	500	538	538	500	500	520	510
	Sharks, rays, skates, etc.	704	1,329	639	2,749	6,067	6,537	6,455	4,480	4,878	5,100	4,970
	Skipjack tuna	<0.5	12	13	14	13	14	14	15	88	90	90
	Snappers, jobfishes	1,006	1,268	669	1,428	1,815	3,575	2,660	2,006	1,460	1,530	1,490
	Swordfish	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Threadfin, dwarf breams	1,840	3,118	2,092	2,377	4,279	3,592	3,718	3,170	2,504	2,620	2,550
	Tuna-like fishes	48	262	273	303	294	316	316	300	300	310	300
	Yellowfin tuna	1,252	667	695	771	748	804	804	800	800	840	820
Somalia	Marine fishes	16,500	18,450	20,000	22,000	20,000	18,000	16,000	15,000	14,800	14,500	14,800
TOTAL		156,113	172,914	170,201	181,362	180,750	194,754	195,020	192,831	202,377	214,970	216,458

Appendix E

Landing Facilities for Fishing Vessels in the Red Sea

Landing Site	Facility												
	Workshops/ repair	Cold storage	Ice plant	Electricity	Forklift	Freshwater	Fuel oil	Derrick/ Crane	Boat-building/repair	Auction facilities	Quay/ pier	Fish processing	Slipway
JORDAN													
Sidra													
EGYPT													
Ataka Port (Suez)	X	X	X	X	X	X	X	X	X	X	X	X	X
Sakala (Ghardaqah)			X				X				X		
Ghardaqah	X	X	X	X		X	X		X	X	X		X
Safaga			X		X			X			X		
Quseir	X	X	X				X				X		X
Shalateen			X										
SAUDI ARABIA													
No details of landings sites available													
SUDAN													
Mohammed Gol			X										
Port **Sudan**		X	X	X	X	X	X	X	X	X	X	X	X
Suakin fishing harbour			X										
ERITREA													
Massawa													
Asmara													
Assab													
DJIBOUTI													
Boulaos													
Escale													
Tadjoura													
Obock													
YEMEN													
Red Sea coast:													
Hodeida port	X	X	X	X		X	X		X	X	X	X	
Khobha harbour													
Gulf of Aden coast:													
Fukum	X	X	X	X		X			X	X		X	X
Aden port	X	X	X	X	X	X	X	X	X	X	X	X	X
Zingibar													
Shuqra		X	X	X		X				X	X	X	X
Bir Ali	X	X	X	X		X				X	X	X	

Landing Site	Facility												
	Workshops/ repair	Cold storage	Ice plant	Electricity	Forklift	Freshwater	Fuel oil	Derrick/ Crane	Boat-building/repair	Auction facilities	Quay/ pier	Fish processing	Slipway
Mukalla, Kalf port		X	X	X		X	X			X	X		
Shihr		X	X	X		X	X		X	X		X	
al-Hami		X	X	X		X	X		X	X		X	
al-Qarn		X	X	X		X	X		X	X		X	
Qusayair		X	X	X		X	X		X	X		X	
Musaini'a		X	X	X		X	X		X	X		X	
Sayhut		X	X	X		X	X		X	X		X	
Nishtun	X	X	X	X	X	X	X	X	X	X	X	X	X
SOMALIA													
Bereda	X			X		X			X		X		X
Xabo	X	X	X	X		X			X		X		X
Qandala	X	X	X	X		X			X		X		X
Bosaso	X	X	X	X		X			X		X		X
Laas Qoray	X	X	X	X		X			X		X		X
Berbera	X	X	X	X		X			X		X		X

*Note: In **Somalia** most of these facilities have been destroyed during the civil strive and are no longer operational.*

Appendix F

Socio-economic Indicators

JORDAN			
Land area	88,884 km^2	Continental shelf (to 200 m)	<100 km^2
Length of coastline	27 km	Population	5.7 million (1993)
Employment in primary catching sector	230 fishermen (2000)	Employment in secondary sector	n.a
Public sector employment: management and research	n.a.	Public sector employment: training, extension and services	n.a.
Annual fish production	450 mt (1999)	Value of fisheries exports	Negligible.
Gross domestic product	USD 6.105 billion (1993)	GNP per capita	n.a.
Fisheries contribution to GDP	Negligible.	Per capita fish consumption	2.7 kg/year (1998)
EGYPT			
Land area	1.01 million km^2	Continental shelf (to 200 m)	8,400 km^2
Length of coastline	1,800 km (Red Sea coast)	Population	61.4 million (1998)
Employment in primary catching sector	18,000 fishermen (1995)	Employment in secondary sector	At least 10,000 - processing, marketing and ancillary services (1995)
Public sector employment: management and research	400 (1995)	Public sector employment: training, extension and services	53 (1995)
Annual fish production	58,000 mt (1998 – Red Sea)	Value of fisheries exports	USD 12.2 million (1998)
Gross domestic product	USD 84.3 billions (1998)	GNP per capita	USD 1,290 (1998)
Fisheries contribution to GDP	n.a.	Per capita fish consumption	4-6 kg/year (1999)
SAUDI ARABIA ***Source: PERSGA 1997***			
Land area	2.25 million km^2	Continental shelf (to 200 m)	77,859 km^2
Length of coastline	1,840 km	Population	20.7 million (1998)
Employment in primary catching sector	4,145 fishermen (1997)	Employment in secondary sector	At least 6,700 (processing, marketing and ancillary services (1997) including Saudi and non-Saudi workers.
Public sector employment: management and research	-	Public sector employment: training, extension and services	n.a.
Annual fish production – Red Sea only	26,000 mt (1998)	Value of fisheries exports	USD 4.8 million (1998)
Gross domestic product	USD 125.8 billion (1998)	GNP per capita	n.a.
Fisheries contribution to GDP	0.13% (1999)	Per capita fish consumption	8.0 kg/year (1993)

SUDAN *Source: PERSGA (1997)*			
Land area	2.51 million km^2	Continental shelf (to 200 m)	9,800 km^2 (800 km^2 deep water trawling grounds, 9,000 km^2 artisanal grounds)
Length of coastline	853 km	Population	28.3 million (1998); 685,000 (Red Sea State, 1993 census)
Employment in primary catching sector	943 fishermen (1994)	Employment in secondary sector	At least 104 - processing, marketing and ancillary services (1994)
Public sector employment: management and research	70 (1994)	Public sector employment: training, extension and services	n.a.
Annual fish production	1,500 mt (1998)	Value of fisheries exports	n.a.
Gross domestic product	USD n.a. (1998)	GNP per capita:	USD 290 (1998)
Fisheries contribution to GDP	Negligible (<1%, 1997)	Per capita fish consumption	1.2 –2.0 kg/year (1997)
DJIBOUTI *Source: PERSGA Country report: Djibouti. (1996)*			
Land area	23,200 km^2	Continental shelf (to 200 m)	2,280 km^2
Length of coastline	370 km	Population	650,000 (1998)
Employment in primary catching sector	n.a.	Employment in secondary sector	n.a.
Public sector employment: management and research	n.a.	Public sector employment: training, extension and services	n.a.
Annual fish production	450 mt. (1998)	Value of fisheries exports	negligible (1998)
Gross domestic product	USD 0.51 billion (1998)	GNP per capita	n.a. (1998)
Fisheries contribution to GDP	Negligible (1996)	Per capita fish consumption	1.8 kg/year (1992)
YEMEN *Sources: MEP (1997). Fourth Fisheries Project: Fish Sector Review. MFW 2000.*			
Land area	527,970 km^2	Continental shelf (to 200 m)	Gulf of Aden shelf – 20,255 km^2; Red Sea shelf – 11,200 km^2.
Length of coastline	2,200 km (Red Sea and Gulf of Aden)	Population	16.5 million (1998)
Employment in primary catching sector	36,050 fishermen (1997)	Employment in secondary sector	At least 10,000 - processing, marketing and ancillary services. (1997)
Public sector employment: management and research	617 (1997)	Public sector employment: training, extension and services	2,030 (1997)
Annual fish production	128,600 mt (1998)	Value of fisheries exports	USD 11.1 million. (1996)
Gross domestic product	USD 5.4 billion (1998)	GNP per capita	USD 300 per capita (1998)
Fisheries contribution to GDP	1.4% (1996)	Per capita fish consumption	40 kg/year (1997)
SOMALIA			
Land area	627,340 km^2	Continental shelf (to 200 m)	8,400 km^2 (northern coast only)
Length of coastline	1,300 km (northern coast)	Population	9.1 million (1998)
Employment in primary catching sector	2000 fishermen (1997)	Employment in secondary sector	n.a.
Public sector employment: management and research	n.a.	Public sector employment: training, extension and services	n.a.
Annual fish production	4,000 mt (1998)	Value of fisheries exports	USD 1.5 million (1998)
Gross domestic product	n.a. (1998)	GDP per capita:	n.a. (1998)
Fisheries contribution to GDP	2% (1997)	Per capita fish consumption	0.25 kg (1996)

Appendix G

National Institutions Involved in Fisheries and Environmental Management

Name of Authority	Main Function
JORDAN	
Marine Science Station, Aqaba.	Fisheries and marine research.
Ministry of Agriculture.	Policy and management.
EGYPT	
Egyptian Environmental Affairs Agency (EEAA)	Monitoring and protection of the marine environment.
Egyptian Organization for Standardization (EOS)	Maintenance of standards for domestic products, provides training in compliance with national standards.
General Authority for Fish Resource Development (GAFRD)	Fisheries management, development and conservation; enforcement, MCS, data collection, training and extension; aquaculture development.
National Institute of Oceanography and Fisheries (NIOF)	Primary research institute for marine fisheries.
Ministry of Defence	With Frontier Guard Corp, issue fishing permits and monitor vessel activities, crewing levels etc.
Ministry of Health	Examination of agricultural and fisheries foodstuffs in regard to chemical and biological safety levels.
Ministry of Scientific Research	Supervises the IOF and its two research stations in Suez and Ghardaqah.
Ministry of Supply and Trade	Supervision of fish quality and monitoring landings quotas in Suez, Red Sea and South Sinai Governorate.
Ministry of Supply and Trade, Dept. of Food Inspection and Quality control.	Quality assurance for all agricultural, food (including seafood) and industrial products.
Ministry of Supply and Trade, General Organization for Control of Export and Import (GOCEI)	Concerned with Quality control of all agricultural and industrial exports.
SAUDI ARABIA	
Faculty of Marine Sciences of King Abdulaziz University.	Involved in research activities.
Fisheries Research Center, Jeddah	Involved in research activities.
MEPA (Meteorology and Environmental Protection Administration)	Jurisdiction for prevention of pollution in the territorial sea including effluent from landfill, pollution monitoring; jurisdiction for oil spill response; responsible for setting standards for the environment.
Ministry of Agriculture	Responsible for fishery management, agricultural development, development of groundwater resources and seawater desalination
Ministry of Agriculture and Water: Dept. of Fisheries Affairs	Management and administration: marine fisheries, aquaculture and the marine environment, licensing, regulations, credit facilities for fishermen, imported fishing and farming equipment and research; Responsible for management of national parks; landfills;
Ministry of Agriculture, Sweet Water Conversation Corporation (SWCC), Ministry of Petroleum (Saudi Aramco, oil companies), Ministry of Municipalities and Rural Affairs (Sewage Authority), Ministry of Industry and Electricity (SCECO and industrial cities) and RCJY	Control activities that emit pollutants into the Territorial Sea
Ministry of Defence	Jurisdiction of military activities within the Territorial Sea
Ministry of Industry and Electricity	Responsible for industrial development and electricity generation
Ministry of Municipal and Rural Affairs	Responsible for municipal development, flood water management and disposal of waste
Ministry of Petroleum	Jurisdiction over oil production and marine mineral extraction activities in the Territorial Sea

Name of Authority	Main Function
Ministry of Transport	Responsibility for Marine Navigation in the Territorial Sea
NCWCD	Responsible for management of protected areas
Royal Commission for Jubail and Yanbu	Responsible for industrial development within the two industrial cities; also responsible (under a Memorandum of Understanding with MEPA) for environmental management in those cities
Saudi Coast Guard	Jurisdiction between the border of the Territorial Sea (12 miles offshore) and 10 km inland
Sea Ports Authority	Responsibility for ports
Sea Ports Authority	Responsibility for ports
SUDAN	
Marine Fisheries Administration under the Red Sea State (Ministry of Animal Wealth).	Manages the fisheries sector and controls the observation of fisheries regulations.
Ministry of Animal Wealth	In overall charge of animal production and fisheries.
Red Sea University, Port Sudan.	Marine Research and education.
The Marine Fisheries Research Center (MoAW)	Provides scientific information for the management of fisheries resources. Field station at Dongonab and 2 laboratories at Port **Sudan**. Over the last 15 years, it has been concentrating on pearl system production.
The Wildlife Research Center (MoAW).	In charge of providing the scientific background for wildlife conservation and management.
University of Khartoum, Suakin Marine Laboratory	Biological research and training.
University of Khartoum, Faculty of Economic and Social Studies	Research on resources and development
University of Khartoum, Institute of Environmental Studies	Research on environmental issues.
DJIBOUTI	
Inter-ministerial coordination, Commission on the Protection of the Marine Fauna and the Sea Bottom.	Maritime conservation.
Ministry of Agriculture and Hydraulics Direction de l'Elevage et des Pêches (DEP), Directorate of Stock-farming and Fisheries	Fisheries administration and management.
Ministry of Tourism Office National du Tourisme et de l'Artisanat (O.N.T.A. National Office for Tourism, Arts and Crafts)	Tourism development
Ministry of Transport and Telecommunications, Direction des Affaires Maritimes (D.A.M., Directorate of Maritime Affairs)	Maritime transport.
National Council of the Sea	According to a decree of 5 July this is presided over by the Prime Minister. Policy towards the marine sector.
Presidency of the Republic Institut Supérieur d'Etudes et de Recherche Scientifiques et Techniques (I.S.E.R.S.T., Institute of Higher Studies, Scientific and Technical Research)	Research and postgraduate training.
Primature, Service de l'Aménagement et de l'Environnement (S.A.E., Service for Management and Environment):	Environmental conservation
YEMEN	
Coastal Fisheries Corporation – MFW	Catching, processing and exporting rock lobster
Environmental Protection Council (EPC)	Council of ministers with responsibility for environmental matters. coordinates and monitors environmental protection and conservation policy.
Fisheries Manpower Development Center (FMDC) - MFW	Manpower training; extension services,
Marine Science and Resources Research Center (MSRRC) – MFW	Fisheries and oceanographic research
Ministry of Fish Wealth (MFW)	Fisheries management and administration; fisheries legislation, fish quality control.
National Corporation for Services and Fish Marketing – MFW	Fish purchase and marketing, services (fuel, ice, cold stores), extension services, market operations, fishing port management, fish storage and processing, management of vessel repair facilities.

Name of Authority	Main Function
SOMALIA	
Ministry of Fisheries and Marine Resources	Development and management of fisheries resources; production, planning, research, marketing, personnel and administration.
Ministry of Marine Transport and Ports	Development of maritime transport and the improvement of port facilities; environmental control of coastal areas, including ports, prevention of marine pollution and safety of navigation; implementation of the Maritime Code, other laws and regulations related to the marine environment, and implementation of regional and international conventions.
Ministry of Minerals and Water Resources	Two main responsibilities included the development of mineral resources including mining and geological survey, and the development of water resources.
Ministry of Tourism	Was in charge of establishing MPAs. Legislation, following the Kenyan model, has been prepared for a network of protected areas.
National Marine Affairs Committee	Oversees the overall development of the fisheries sector. Committee chaired by Ministry of Marine Transport and Ports and members included following ministries: Minerals and Water Resources, Fisheries and Marine Resources, Foreign Affairs, Education and Defence.
National Range Agency (Ministry of Livestock, Forestry and Range)	Was responsible for National Parks.
Somali Ports Authority and the Somali Shipping Agency (Min. Marine Transport and Ports)	Port and shipping matters.

Note: Since the civil strive these institutions are no longer functioning.

Appendix H

Fisheries Overview for the PERSGA States

Djibouti

Present Situation

Fisheries are entirely artisanal in Djibouti. Activity is concentrated north and south of the Gulf of Tadjoura. The north area has no ice or cold storage facilities and is distant from Djibouti city and therefore is the most productive area. Living marine resources are largely under-exploited, however in over-exploitation is reported in areas near the capital including Doralé, Khor Ambado, Arta Plage and the islands of Musha, Maskali and Waramous. The pressure on these areas is due to a combination of extensive sport fisheries and artisanal fisheries. These are at the same time the areas where reef destruction is most severe caused by dynamite fishing and anchors of boats on reefs.

Shark resources are heavily fished. An unknown amount of illegal shark fishing by unlicensed national and foreign boats takes place for production of fins for the east-Asian shark-fin market. Illegal capture of marine turtles and the collection of turtle eggs is wide spread.

A new National Maritime Law and appropriate regulations are required. It is important to strengthen enforcement of existing regulations relating to the management of coastal and marine areas and resources. The enforcement of legislation related to the management of coastal and marine areas is currently weak. A national Integrated Coastal Zone Management Plan is urgently needed. Institutions involved in the management of coastal and marine resources and in law enforcement need assistance in this regard. Mangroves are currently under threat and in need of protection. A management programme is also required for the existing MPAs (Parc Territorial de Musha, Réserve Intégrale des Maskali-Sud). Areas for additional MPAs could include the Sawabi Islands, Ras Bir and the mangrove of Godoriya.

A framework for visitors to coral reef areas is needed including guidelines and mooring boats in coral areas. Management and conservation of living marine resources are of prime importance for Djibouti, however current monitoring of fishing activities and tourist activities is lacking.

No fisheries management plans are currently in force. Fish stock assessment is not undertaken. A study conducted on the collection and export of ornamental fish for the aquarium trade has been completed and indicates potential for this industry.

An environmental data base containing information on biological resources is required. Fisheries data collection systems are needed in support of fisheries management and enforcement activities. Institutions involved in applied research need strengthening.

In 1990 a sub-regional contingency plan for the Gulf of Aden was developed. An oil spill response mutual aids center was established for Djibouti, Yemen and Somalia. In 1992, the Maritime Administration issued rules for the management of MPAs. The exploitation of reef associated species was strictly regulated. New fisheries regulations were introduced in 1994 with regard to a sustainable development of this resource. In 1996, Djibouti became a signatory to the Convention on Biological Diversity.

Institutions and Financial Arrangements

The Ministry of Agriculture and Development is responsible for fisheries through the Direction de l'Elevage et des Pêches. The Institut Supérieur d'Etudes et de Recherche Scientifiques et Techniques (ISERST) undertakes applied research and provides scientific training. The Service de l'Aménagement et de l'Environnement (SAE) is the responsible agency for environmental affairs and conservation.

Legal Framework

Fisheries and environmental legislation is well developed in Djibouti. The economic and social orientation law of 1990-2000 (150/AN/91 2½ L of 10 February 1991) and the orientation plan for economic and social development projects of 1991-1995 (law 207/AN/92 2½ L of 14 May 1992) indicate that the Government of the Republic of Djibouti is committed to the protection of marine fisheries and the environment.

The present fisheries law was drafted before independence, with the exception of some useful but insufficient general dispositions, which are part of the Code of the Maritime Administration. These are, among others, the articles 148, 149 and 220 to 225 enacted by law 212/AN/82, and the articles 16 to 19 of law no. 52/AN/78 of 18 January 1979. According to these regulations, certain fishing techniques, such as the use of explosives and poisons, are illegal. They determine the conditions for the exploitation of fishery resources including fishing zones and closed seasons. They also include sanctions in case of violation of these regulations by fishermen.

National regulations on the protection of the marine environment include provisions on marine pollution, protection of endangered species and the creation of protected areas. Djibouti is also a signatory to the CITES Convention. Decree 80-62/PR/MCTT of 25 May 1980 provides for the protection of the seabottom and the marine fauna. The capture of marine mammals and turtles is illegal, as well as the trade with or export of these animals. It is also forbidden to collect turtle eggs. According to this decree spearfishing is also illegal in Djibouti.

Marine Protected Areas are currently restricted to the 'Parc territorial de Musha' and the 'Réserve intégrale de Mascali.' Musha parc was first established by regulation 72-1363/SG/CG of 20 September 1972, which prohibits the collection of corals and molluscs. Further on decree 80/062/PR/MCTT of 25 May 1980 extended the protection to the Maskali reserve. This latter one was modified by decree 85/103/PR/AG of 28 October 1985 to strengthen conservation of these areas. Only artisanal fisheries of edible species is allowed in these zones. A number of regulations provide for the protection of the coastal zone.

Conscious of the importance to protect the marine environment and to fight all kinds of pollution, a number of international conventions have been signed. The United Nations convention on the Law of the Sea was approved by law of 11 June 1985. At the regional level, Djibouti has signed an agreement with Yemen and Somalia on the establishment of a sub-regional center to combat oil pollution in the Gulf of Aden. Oil spill response facilities are stored at Djibouti. Yemen and Djibouti are currently negotiating a bilateral agreement regarding the use of this equipment.

Jordan

Present Situation

With only 27 kilometers of coastline and around 100 artisanal fishing vessels, Jordan's fisheries sector is very small. Collection of fisheries statistics and most development interest ceased in 1985 with the loss of access to the fishing grounds in neighboring states. Since 1985 Jordan's artisanal fishery has undergone a sharp decline. Production in 1999 was estimated at around 450 metric tons, mostly comprising various tunas and small shoaling pelagic species.

Institutions and Financial Arrangements

Fisheries policy and management is the responsibility of the Ministry of Agriculture. Fisheries research is the responsibility of the Marine Science Station at Aqaba. A number of Jordanian universities also undertake ad hoc marine and fisheries research. There is no formal training or extension services provided for the sector. Financial support is available through commercial banks in the same way as any other economic activity.

Legal Framework

Law no. 25 is the basic law which sets forth the organization of fisheries in Jordan. No specific resources are devoted to MCS of the sector given its small size.

Egypt

Present Situation

Fish is a traditional and important component of the Egyptian diet and contributes around 20 percent to the national diet of animal protein. Artisanal fishing is concentrated in the Gulf of Suez. The industrial; fleets comprises shrimp and demersal fish trawlers and purse seiners targeting small pelagics species. Total domestic harvest in 1998 was around 546,000 metric tons, mostly originating in the Nile, Mediterranean, northern lakes inland fisheries and fish farms. Only about 10 percent (around 58,000 metric tons) comes from Red Sea marine fisheries. nearly 90 percent of Red Sea catches are landed in Ataka Port near Suez, principally bound fresh on ice for the Cairo market.

The sector accounted for around 7 percent of the total value of agricultural production in 1996. Employment accounts for 3.7 percent of total agricultural workers just under half being involved in marine fisheries. exports are small, only 2,137 metric tons in 1998. Exports have been static during the 1990s. The country is a major importer of fish, with 24 percent of national consumption being imported in 1998 the form of small pelagics.

Egypt's main institutional constraint is the shortage of qualified staff. While control of the artisanal fisheries especially in the Gulf of Suez is a concern, the focus of fisheries management attention is the activities of industrial trawlers targeting shallow water shrimp and demersal fish species in the Gulf of Suez and also in neighboring waters. Offshore patrol vessels, coupled with onboard observers are needed to patrol these activities. However, because of the severe shortages of qualified manpower and funds, Egypt requires both a clear economic justification for such a large investment, and an assured capability to operate and maintain such activities.

Assistance is required in the design and application of more effective fisheries and environmental management systems, primarily through training of staff and technical assistance. cooperation and liaison with the industrial trawl, purse seine and industries will be necessary. The existing fisheries data collection and analysis system require upgrading and extension. Also no fish stock assessment has been conducted since the eighties. Whether the fisheries sector warrants the purchase of dedicated vessels for fisheries research and fisheries surveillance and enforcement should be addressed through the benefits such a vessel would bring in relation to operational costs. The industrial shrimp fishery could be a primary subject for the application of high tech monitoring using satellite based vessel monitoring systems (VMS), although the technical expertise and hardware required would require donor assistance to procure.

A national licensing scheme is in operation. This could usefully be extended to artisanal fisheries. Co-management systems should be examined whereby local communities could greatly assist in managing their own resources.

cooperation with Saudi Arabia, Yemen and Sudan on crustacean, molluscan and coastal finfish fisheries and tuna and shark fishing should be supported.

Institutions and Financial Arrangements

GAFRD of Ministry of Agriculture is responsible for fisheries and aquaculture management, development, MCS, enforcement of regulations, data collection, training and extension. Training is provided for fisheries managers and fishermen from cooperatives. Training workshops focus on fishing technology, fisheries management, project preparation and appraisal, fish culture, cooperative management and legislation. The Institute of Oceanography and Fisheries and the universities have long experience in developing training and extension programmes. Study tours are arranged in a regular basis to the United States, southeast Asia, Italy and elsewhere.

Fisheries research is conducted by a number of institutes, but the Institute of Oceanography and Fisheries is the focal institute primarily involved in fisheries research. The Red Sea branch of the IOF operates field stations at Suez and Ghardaqah with well equipped laboratories for physical and chemical oceanography, marine and fisheries biology, pollution monitoring and mariculture (shrimps). Egypt has no fisheries research vessel. Universities involved in fisheries research include Suez Canal University and the University of Alexandria.

Law enforcement is the responsibility of GAFRD in cooperation with the Frontiers Corp (Ministry of Defence). No information is available on the level or efficiency of MCS and enforcement activities. The Frontier Guard Corps is based at the fishing ports and main landing centers. They issue permits to fishing vessels and record trip lengths, area fished and names of fishermen on each boat. The Ministry of Scientific Research supervises the IOF that, in turn, supervises the two research stations at Suez and Ghardaqah.

A number of institutions are involved in fish inspection and quality control. The Department of Inspection and Quality Control and the General Organization for Control of Export and Import (Ministry of Supply and Trade) are responsible for quality assurance of all agriculture food (including sea products) and industrial products. Laboratories are maintained at all airports and provincial centers.

Legal Framework

Law no. 124 (Fisheries) of 1983 sets forth the Organization and provides for the regulation of fisheries and aquaculture. Main articles prescribe allowable grounds and gear, technical measures such as allowable mesh sizes, minimum allowable size, and provides for protection of the environment from pollution. Law No. 4 (Environmental Protection) provides for the management and conservation of the environment. It provides for water pollution land, air and water protection and sets forth the terms of reference for the Egyptian Environmental Affairs Agency. The EEAA has power to set principles and procedures for Environmental Impact Assessment's for development projects.

Saudi Arabia

Present Situation

Saudi Arabia has a sizeable artisanal and industrial fishery. All vessels are owned by Saudi nationals and crewed entirely by immigrant fishermen. Landings from the Red Sea in 1997 comprised 17,420 metric tons for the artisanal fleet and 8,405 metric tons. for the industrial fleet (comprising trawlers targeting shrimp and demersal species on the Farasan Bank, and pelagic purse seiners. The Saudi Fishing company dominated the Red Sea industrial fishery. Catches from the Red Sea have exceeded those taken from the Gulf in recent years. Contribution of fisheries to GDP is very small, around 0.13 percent. The Kingdom imports around 50,000 metric tons of fish per year to meet national demand.

A well developed fisheries data collection system in place which allows well defined statistics for national fishing activities. However, stock assessment research is not undertaken. Saudi Arabia's fishing grounds extend all along the coast and its industrial vessels operate over considerable distances throughout the Red

Sea. Consequently there are more extensive patrol requirements but little in the way of MCS is undertaken. Patrol vessels and aircraft are currently unavailable for fisheries surveillance.

Saudi Arabia hosts the PERSGA Secretariat and SAP Programme Management Unit. As a regional power, it is in a position to assist other states to cooperate on fisheries data transfer and management issues on important shared fisheries, such as demersal fishes, pelagics and shrimps with a view to reaching practical arrangements for the control of these fisheries. Joint surveillance patrols with Egypt and Yemen and common fisheries research methodologies and shared databases would be very beneficial. The operation of fisheries patrol vessels and aircraft to ensure cost-effective and comprehensive surveillance is complicated by the lack of clear jurisdiction over marine waters and political realities.

Saudi Arabia's lead role in the formation and hosting of PERSGA underlines its potential important position in the development of regional marine fisheries conservation initiatives on transboundary stocks, such as tuna and sharks.

Institutions and Financial Arrangements

A Deputy Minister at the Ministry of Agriculture and Water heads the Department of Fisheries Affairs assisted by a General Supervisor and three Director General for marine fisheries, aquaculture and marine environment. The Department is in charge of all matters related to the development of fisheries. This includes management, licensing, regulations, MCS and research.

The Meteorology and Environmental Protection Administration (MEPA) is the central environmental agency in Saudi Arabia. It has not, however, been given the extensive enforcement and regulatory authority found in European or north American environmental agencies. Instead, Saudi Arabia has chosen to distinguish between the setting of environmental criteria such as standards, and actual operational management. Thus operational agencies such as the Ministry of Petroleum, Ministry of Agriculture and Ministry of Industry and Electricity retain actual regulatory control over activities carried out under their respective mandates, while MEPA sets environmental performance standards, monitors the activities of operational agencies and serves as a central coordinator for environmental management.

MEPA is also the lead agency for coastal zone management. However, institutional authority for centralized coastal zone management planning has not been fully achieved. Instead, each individual agency operates under its own specific mandate and numerous overlaps and potential conflicts abound. Day-to-day coordination mechanisms and central planning authority specific to the coastal zone are lacking. A draft proposal for development of a national coastal zone management plan was submitted and approved for final promulgation by the Ministerial Committee for Environment in July 1997.

Applied research studies are designed and executed by the Marine Research Center of Jeddah. Other academic studies relating to fish biology, oceanography and marine ecology were conducted by researchers of the Faculty of Marine Sciences of King Abdulaziz University. National researchers have undertaken training in various countries for long term and short term training in order to improve their skills in different fisheries disciplines. On the job training is also in use according to the available international expertise. There are approximately 15 enumerators collecting basic catch data at sites along the coast. No fisheries offshore surveillance and enforcement is conducted.

The conservation activities of the marine environment mainly involves the supervision of the regulations application in respect to the following: (a) fishing gears specifications including banning of drifting nets and monofilament nets; (b) the implementation of a closed season for shrimps between April and July every year and (c) closing of nursery areas for fishing and the control of land reclamation and sea dredging along the coast. The marine environment protection also involves the collaboration with MEPA to the control of pollution generated by different sources.

The government provides credit to fishermen and investors in marine fishing and aquaculture in addition to other assistance such as free tax import of fishing and farming equipment, land at a low cost for fish farming.

Legal Framework

Ministry of Agriculture and Water is the main body responsible for fishery management, management of national parks, jurisdiction for fishery activities under Royal Decree No 7/505M, dated 28/3/1406 and Royal Decree No M/9, dated 27/3/1408. The Saudi Coast Guard has jurisdiction between the border of the Territorial Sea (12 miles offshore) and 10 kilometers inland (Royal Decree No 33, dated 27/7/1377). MEPA is responsible for environmental standards and for carrying out a program of environmental impact assessment; designated coastal zone management agency under Royal Decree No 7/M/8903, dated 2/14/1401)

A code for fishing regulations has been prepared by the Ministry of Agriculture and Water since the early eighties. The code is revised and updated regularly according to the prevailing situations.

Somalia

Present Situation

Somalia, one of the poorest countries in Africa, is currently suffering from the effects of the civil war that broke out in 1988 and resulted in a collapse of the central government and a breakdown of the national economy. The conflict led to the destruction of dwellings, water points, crops, industrial installations, looting of livestock and the planting of millions of land mines. A major proportion of the rural population has been displaced. In May 1991, former British Somaliland declared itself independent and a government was installed, but the 'Republic of Somaliland', which controls the western part of the northern coastline, is not recognized internationally. The remainder of the northern coast is known as 'Puntland'.

Fisheries, along with the rest of the economy, has suffered. Fishing along Somalia's northern coastline is entirely artisanal. Reliable data are not available. In 1998 production was estimated at between 2,000-4,000 metric tons. Sharks are the main target group, for food and for production of dried shark fins for export. Rock lobster fishing and trolling for yellowfin and other tunas is also undertaken.

The international community is assisting in rehabilitation and reconstruction. FAO, in collaboration with other international agencies and NGO's, is currently operating relief and rehabilitation programmes (FAO 1995). In the present situation there are no fisheries or environmental initiatives, but even before the collapse of government such initiatives were hampered by a lack of knowledge on resources and habitats, a lack of legislation, training and monitoring capacities.

Institutions and Financial Arrangements

Control of the fisheries sector by the Ministry of Fisheries discontinued following the collapse of the Government of Somalia in 1990. The country has no national policy for the exploitation of marine resources. In the present situation there is no fisheries management or support for the sector. Laws and regulations are not enforced and the national institutions are of no relevance. Here below the status in 1988 is summarized:

A National Marine Affairs Committee had been established to oversee the overall development of the sector. Chaired by the Ministry of Marine Transport and Ports its members included the ministries of Minerals and Water Resources, Fisheries and Marine Resources, Foreign Affairs, Education and Defence. The Ministry of Marine Transport and Ports was responsible for environmental control of coastal areas, including ports, prevention of marine pollution and safety of navigation. The implementation of the Maritime Code, other laws and regulations related to the marine environment, and implementation of regional and interna-

tional conventions were under the responsibilities of this ministry. The Ministry of Fisheries and Marine Resources was established in 1977 with the objective of developing and managing Somalia's untapped fisheries resources. It received support by staff from the Soviet Union and later on by FAO. It is the Focal Point for PERSGA.

The Ministry of Tourism was in charge of establishing MPAs. Legislation, following the Kenyan model, has been prepared for a network of protected areas.

Since the outbreak of civil strife, hardly any fisheries development work has been carried out. In the absence of government, Regional and District Councils and Councils of Elders take up the role of principal coordinating organizations for the inflow of aid to their respective jurisdictions. International agencies and NGOs work in coordination with the Councils of Elders in the development of a sustainable institutional base. Institutional coordination is achieved through the District and Regional Councils to ensure a reasonable level of public accountability. In the case of research, extension or credit accountability has to be established (FAO 1995).

One of the institutions of the 'Republic of Somaliland' is the Ministry of Fisheries and Coastal Development. Created in 1993, this ministry aims to encourage public and private investment for the exploitation of marine resources; increasing fisheries production within the MSY; protection of the coastline and sea from environmental degradation; initiation and development of research and training facilities for the fisheries sector; and the development of employment opportunities in the marine sector.

Legal Framework

Basic marine fisheries legislation is contained in the Maritime Code of 1959. In 1983 the Ministry of Fisheries and Marine Resources issued a joint venture guideline and in 1985 the National Fisheries Law.

Somalia has signed the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (1993). It has ratified the following Conventions and Protocols which are relevant to the marine environment: the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (1988); the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1985); the Convention on the Conservation of Migratory Species of Wild Animals (1986); the Protocol Concerning cooperation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region (1988); the Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region (1988); the Protocol Concerning Regional cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1988); the Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (1988); and the United Nations Convention on the Law of the Sea (1989).

Sudan

Present Situation

Sudan's fisheries include artisanal, semi-industrial and industrial sectors. Most artisanal craft are locally made, employing traditional methods. The level of mechanization is low. Handlining and gill netting for reef associated species accounts for 80 percent of the annual catch of 1,500 metric tons. The industrial sector comprises pelagic purse seiners and shrimp trawlers. Their catches are however very low, due to poor fleet management and restricted trawling grounds. Fish landed close to Port Sudan are marketed fresh on ice to the local market. The contribution of fisheries to GNP is negligible, the backbone of the local economy being marine transport (national shipping and Sudan Line).

Sudan's fisheries policy is to try and improve the standard of living for coastal communities that depend heavily on fisheries for a livelihood. According to the National Strategy 199202002, Sudan is committed to

the pursuit of sustainable development and environmentally sound resource management. However the authorities are faced with a contracting public service and budget, the loss of large numbers of experienced staff, obsolete facilities for fisheries management, poor physical infrastructure and high illiteracy rates in the artisanal fishermen.

Data collection is poorly organized. Very little stock assessment or applied marine research is conducted. No surveillance activities are conducted. The fisheries legislation is not effectively enforced.

At the local level, mechanisms to involve fishing association and communities in the management process are required. The fishermen face considerable hardship, including lack of access to affordable credit, lack of fish handling and processing facilities, unpaved roads and poor communications. There are no harbours or sheltered areas along large stretches of the coast except Suakin fishing harbour, although some coastal lagoons and sheltered bays or 'marsas' form natural harbours and landing places. Maintenance and repair workshops are very scarce. What few ice plants and cold stores there are suffer from water shortages and electricity shortages. Basic living conditions are generally bad and clean drinking water is a scarce commodity. The lack of ice making facilities outside of Port Sudan results in heavy pressure on resources that can be marketed without preservation such as trochus, pearl shell, bêche-de-mer. Fish catches in remote areas (Halaib in the north and Aqiq in the south) are consequently dried or wet salted. Credit is not available to many fishermen to allow investment in intermediate-technology fishing craft which would allow exploitation of the known more distant fishing grounds to the north and south or Port Sudan and thus restricts fishing to the narrow coastal area.

A review of existing policies and support for the artisanal fisheries sector is urgently required. MCS is lacking and thus Sudan's waters are poached by vessels from a number of other states. The Ministry of Defence is in charge of Naval Forces, which are responsible for MCS. The police share maritime protection responsibility. However a lack of equipment, finance and training impairs effective MCS and enforcement in Sudan. The Fisheries Administration performs enforcement of regulations and local ordinances (regulation of landing sites, fish markets etc.) from its Port Sudan head office and field offices. Level of enforcement is ad hoc on land and virtually non-existent at sea because of lack of patrol vessels, trained personnel, equipment and finance. However increase reports of offenders being apprehended indicates an improvement in surveillance in recent years.

Training needs include fish handling and processing, support for cooperatives and the services they can supply especially credit lines, and marketing. Illiteracy rates are high, thus public awareness campaigns are required aimed at educating fishermen of the need for and long-term benefits of fisheries management and resource conservation. Government officials require assistance in planning and policy formulation. Most of the available fisheries resources are best exploited by artisanal craft and methods. Artisanal fishing is thus of paramount socio-economic importance in the rural areas. The best prospects for future development probably lie in revitalizing artisanal fisheries through rehabilitating previous programmes and infrastructure that have proved successful in the past.

Institutions and Financial Arrangements

The Ministry of Animal Wealth is in overall charge of animal production and fisheries. The Marine Fisheries Administration is the main department responsible for fisheries resource management, scientific research and extension services. The MFRC has a field station at Dongonab and two laboratories in Port Sudan. In the past 10 years research has focused solely on pearl oyster culture. Since the conclusion of the Sudan-ODA and Sudan-FAO projects, the Marine Fisheries Administration has not been particularly active in fisheries development and extension services. NGOs active in environmental matters include the Sudanese Environment Conservation Society (Port Sudan and Suakin), the Sea Friends Association (Port Sudan) and OXFAM United Kingdom/Ireland (Port Sudan and Tokar). The Sudan Marine Conservation Committee (SMCC) is a semi-NGO and plays an important role in awareness raising and forming legislation.

The Red Sea University at Port Sudan undertakes marine research and education. The Faculty of Marine Science and Fisheries offers undergraduate courses in marine and fisheries sciences. The Marine Research Institute conducts oceanographic and marine environment research. The University of Khartoum has a laboratory and several research and training activities on Red Sea fisheries. Suakin Marine Laboratory undertakes marine biological research and trains undergraduates from University of Khartoum and other universities. The Institute of Environmental Studies conducts environmental research and supervises graduate students in freshwater and marine environments. The Faculty of Economic and Social Studies has several departments that conduct research on resources and development including coastal and marine areas. The University of Juba offers fisheries, natural resource and environmental studies.

LEGAL FRAMEWORK

The main law governing resource exploitation and environment is the Marine Fisheries Ordnance of 1937 (amended in 1975 and 1978). The Ordnance provides powers for police, custom officers, Navy officers and port authorities to board, search and detain any vessel suspected of violating the fisheries law. However there is virtually no fisheries MCS in the country, and reliance is made on Sudan Line for intelligence of marine industrial fishing activity. The Ordnance provides for the establishment of closed/ restricted fishing areas, fisheries licensing and prohibits collection of shells, aquarium fishes and coral. It prescribes minimum allowable sizes for fish species and allowable methods of fishing.

The legislative framework requires updating. A maritime law for Sudan has been drafted by the Maritime Administration but its status is unclear.

Yemen

PRESENT SITUATION

With a total catch in 1998 of around 128,000 metric tons Yemen is by far the largest marine fish producer in the Region mostly comprising small coastal pelagics and yellowfin tuna. Eighty two per cent of this was taken by the large artisanal sector. Fish is an important constituent to the national diet, with per capita consumption at around 40 kilograms per year. Industrial fisheries for cuttlefish and artisanal fishing for rock lobster in the Gulf of Aden have traditionally been important earners of exports revenues. Fisheries contributed 1.4 percent to GDP in 1994 However the present ban of fish to the European market, imposed by the European Commission in July 1998 because of inadequate quality control and hygiene measures, has negatively impacted on export revenues.

Despite the importance of the fisheries sector, problems include a shortage of operating funds for government management, research and regulatory agencies, poorly paid and trained staff, and inadequate equipment, including vessels, vehicles, and communications equipment. There has been no significant assessment of fish and invertebrate stocks since the 1980s, which undermine attempts to implement fisheries management. Yemen's research vessel R/V Ibn Majid is beyond its economic life. The R/V Donafa requires many repairs and in any case is too small to undertake regional survey work. Information systems currently lack Organization and integration. A GIS system is operational and biological survey equipment is available at the Marine Science and Resources Research Center in Aden, procured under the Fourth Fisheries Development Project.

The fisheries policy framework requires strengthening into a cohesive set of principles and measures which could guide resource management and allocation decisions in a transparent and manageable manner.

Yemen's main high value fisheries for cuttlefish and rock lobster along the Gulf of Aden coast are concentrated along the coast considerably reducing the cost of patrol requirements. However a lack of equipment and finance means that fisheries MCS and enforcement of regulations and licence conditions is virtually non-existent. The Red Sea demersal shrimp and fish fisheries are more disparate, and are more complex to

police and control. Considerable progress has been made in implementing a vessel registration system, especially for the Red Sea artisanal fleet.

Training is needed in all aspects of fisheries management, including data collection, analysis, stock assessment methodologies, management planning, MCS operations and enforcement. The Fisheries Training Institute (FTI) in Aden lacks basic teaching facilities and expertise. Creation of an integrated fisheries information system would support management operations and MCS cost accounting leading to financially sustainable MCS.

Significant poaching by unlicensed foreign trawlers and purse seiners is reported, especially in the area east of Mukalla on the Gulf of Aden. The importance of the valuable shrimp stocks in Yemen's Red Sea area to the artisanal fleet is being undermined by fishing by industrial trawlers, mainly from Egypt and Saudi Arabia, operating either under licence or illegally. Licensed national cuttlefish trawlers habitually operate close to shore in this area targeting spawning aggregations of cuttlefish. These vessels ignore licence conditions that prohibit trawling in shallow waters, causing damage to the spawning ground, destruction of eggs attached to substrate and damage to fishing gear belonging to artisanal fishermen.

Closer cooperation is required with near neighbors, Saudi Arabia and Egypt in the Red Sea on the assessment and management of shared stocks, especially prawns, demersal fish and pelagics. Shark fisheries are of particular importance and require special attention, due to the particular biological characteristics of sharks. Yemen and Somalia share important stocks such as rock-lobster and yellowfin tuna. Chartering surveillance assets for joint patrols of the Red Sea could be cost-effective. MCS assets are not available.

Institutions and Financial Arrangements

The Ministry of Fish Wealth is responsible for fisheries management, resources utilization, conservation and protection of fish resources, implementation of programmes for fisheries, development of a national strategy for the management of coastal resources and environment, issues licenses for industrial and semi-industrial fishing vessels, legislation in its fields of competence, monitoring of environmental problems and education, training and awareness building with regard to the environment. The Department of Inspection and Control is responsible for fisheries MCS. Fisheries statistics are collected by the Marine Science and Resources Research Center and collated by the Ministry of Fish Wealth Statistics Unit. A national fisheries advisory committee is charged with providing management and policy advice to the Minister, but has had little impact in improving fisheries management. Fisheries research is carried out at the MSRRC (Ministry of Fish Wealth). There is one institute for fisheries training, the Fisheries Training Institute. Fisheries credit facilities are provided by the Cooperative and Agricultural Credit Bank. This has been highly successful in funding an expansion of artisanal fisheries, especially in the Gulf of Aden with almost 100 percent record of repayments and is a model of success in providing finance to the fisheries sector, especially to disadvantaged and poorest fishermen.

Legal Framework

Law no 24 of 1979 is the main fisheries legislation. It provides for licenses, stipulates the powers of inspectors and observers, lists serious infringements and offences and sets penalties. It also provides for various regulations for fishing by foreign vessels in Yemeni waters, rules and terms for licenses, mesh sizes and management measures for artisanal fisheries. During 1996, some minor amendments were made in the area of licensing. However, the law and regulations are not comprehensive and do not provide a satisfactory basis for fisheries management. Penalties for infringements are too low to act as an effective deterrence. The powers of authorized officers is not defined. The Fisheries Law requires strengthening with the incorporation of internationally recognized norms, especially the FAO Code of Conduct for Responsible Fisheries. A complete review of the legal framework was undertaken in 1994 under the Fourth Fisheries Development Project, but these have not been acted upon. Yemen's maritime boundaries with its neighbors have not yet been resolved.

Appendix I

Fisheries and Environmental Legislation in Force

Law, Ordinance, Regulation	Concerned Agency	Year (in force)
JORDAN		
Law no. 25 for the Organization of Fishing	Council of Ministers	1943
EGYPT		
Law No. 124 (Fisheries): Regulation of fisheries and aquaculture	GAFRD	1983
Law No. 4 (Environmental Protection): Protection of environment and conservation.	Egyptian Environmental Affairs Agency (EEAA)	1990
SAUDI ARABIA		
Council of Ministers decision No 157: Jurisdiction for prevention of Pollution in the Territorial Sea	MEPA	dated 20/11/1411
Royal Decree 7/B/13307: Jurisdiction for oil spill response (coordination mechanism established)	MEPA	dated 22/7/1411
Royal Decree No 33 on Jurisdiction between the border of the Territorial Sea (12 miles offshore) and 10 kilometers inland	Saudi Coast Guard	dated 27/7/1377
Royal Decree No 7/505M, Responsibility for ports	Sea Ports Authority	dated 28/3/1406:
Royal Decree No 7/505M: Jurisdiction for fishery activities	MAW	dated 28/3/1406
Royal Decree No 7/505M: Jurisdiction for prevention of pollution including effluent from landfill ports.	MEPA	dated 28/3/1406
Royal Decree No 7/505M: Responsible for fishery management	MAW	dated 28/3/1406
Royal Decree No 7/505M: Responsibility for ports	Sea Ports Authority	dated 28/3/1406
Royal Decree No 7/M/8903: Responsible for setting standards for the environment and for carrying out a program of environmental impact assessment; designated coastal zone management agency	MEPA	dated 2/14/1401)
Royal Decree No M/22: Responsible for management of protected areas	NCWCD	dated 12/9/1406)
Royal Decree No M/9,: to enforce a moratorium on landfill ports	MAW	dated 27/3/1408
Royal Decree No M/9: Responsible for fishery management	MAW	dated 27/3/1408
SUDAN		
Amendments to Marine Fisheries Regulations	Marine Fisheries Administration	1975, 1978
Amendments to Marine Fisheries Regulations	Marine Fisheries Administration	1975, 1978
Environmental Health Act	Ministry of Health and Local Councils	1975
Environmental Policy Act	HCENR and Attorney General	Draft proposal 1996
Marine Fisheries Ordinance	Marine Fisheries Administration	1937
Sudan Marine Conservation Committee Regulations	Ministry of Environment and Tourism	1975, 1995

Law, Ordinance, Regulation	Concerned Agency	Year (in force)
Sudan Maritime Law	Maritime Administration	Draft proposal 1996
DJIBOUTI		
CITES Convention	Maritime Administration	?
Decree 80/062/PR/MCTT extended the protection to the Maskali reserve. This latter one was modified by decree 85/103/PR/AG of 28 October 1985 to strengthen conservation of these areas. Only artisanal fisheries of edible species is allowed in these zones.	Maritime Administration	1980
Decree 80-062/PR/MCTT on protection of the seabottom and the marine fauna, establishment of South Maskali Islands Integral Reserve	MCTT	1980
Decree 85/103/PR/AG on MPAs	Maritime Administration	1985
Decree 89-085/PR/AE on oil spill response	Maritime Administration	1990
Decree 89-085/PR/PM on passage of foreign vessels	Maritime Administration	1989
Economic and social orientation law of 1990-2000 (150/AN/91 2º L of 10 February 1991)	Maritime Administration	1991
Law 137/AN/85, on hydrocarbon pollution	Maritime Administration	1985
Law 212/AN/82, fisheries regulations	Maritime Administration	1982
Law 52/AN/78 article 16-19, fisheries regulations	Maritime Administration	1979
Law 76-599 on ship based pollution	Maritime Administration	1976
Law 76-600 on pollution caused by combustion	Maritime Administration	1976
Law 9/AN/82, on hydrocarbon pollution	Maritime Administration	1982
Law no. 64/83, which includes the approval of four international conventions on maritime navigation	Maritime Administration	1983
Law no. 94/AN/89 2º L approves the London Conventions of 1971, 73 and 69	Maritime Administration	1989
Law of 11 June 1985 approves the United Nations Convention on the Law of the Sea.	Maritime Administration	1985
Regulation 72-1363/SG/CG establishes Musha Parc and prohibits the collection of corals and molluscs.	Maritime Administration	1972
Regulation 72-1363/SG/CG, establishment of Musha Territorial Park	Maritime Administration	1972
Regulation 90-0534/MPAM on passage of foreign vessels	Maritime Administration	1990
YEMEN		
Environment Protection Law	Environmental Protection Council	1995
Free Zone Law (Law No. 4)	Free Zone Authority	1993
Law No. 10 Maritime Law	MFW	1988
Law No. 2 on Amendment of Law No. 8 of 1970	MFW	1972
Law No. 24 on Organizing Fishing and Exploitation of Aquatic Living Organisms and their Protection issued on 22/10/79 Published in the Gazette No. 50 on 13/12/79	MFW	1979
Law No. 45 on Territorial Sea, EEZ, Continental Shelf and other Sea Areas - Gazette issue 51 on 22/12/1977. This law was issued on 17/12/1977	MFW	1977
Law No. 6 concerning the Protection of the Marine Environment against Pollution	MFW	1980
Law No. 8 on Territorial Water and the Continental Shelf of the Republic of South Yemen 9/2/70 Published in the Gazette issue 14 on 2/4/1970	MFW	1970
Maritime Law for the Republic of Yemen (Presidential Decree No. 5)	Public Corporation for Maritime Affairs	1995

Law, Ordinance, Regulation	Concerned Agency	Year (in force)
Ministerial Decree for Specifications of Fishing Vessels and Gear (No. 101)	Ministry of Fish Wealth	1995
Presidential Resolution on Fishing, Exploitation and Protection of Living Aquatic Resources (Law No. 42)	Ministry of Fish Wealth	1991
Presidential Resolution on the Territorial Sea, Adjacent Waters, the Exclusive Economic Zone and the Continental Shelf (Law No. 37)	Ministry of Defence, MFW	1991
Prime Ministerial Decree No. 4 of 1996 establishing Socotra as a protected area	Ministry of Planning and Development	1996
Protection of the Marine Environment from Pollution (Presidential Decree No. 11)	Public Corporation for Maritime Affairs	1993
SOMALIA		
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region;	In abeyance	1988
Convention on International Trade in Endangered Species of Wild Fauna and Flora;	In abeyance	1985
Convention on the Conservation of Migratory Species of Wild Animals;	In abeyance	1986
Fisheries Law No. 13	Ministry of Fisheries and Marine Resources	1985
Joint venture guideline and the National Fisheries Law	Ministry of Fisheries and Marine Resources	1985
Law on Somali territorial sea and ports, No. 37	Ministry of Marine Transport and Ports	1972
Maritime Code (Basic marine fisheries legislation)	Ministry of Marine Transport and Ports	1959
Protocol Concerning cooperation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region	In abeyance	1988
Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region;	In abeyance	1988
Protocol Concerning Regional cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency	In abeyance	1988
Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment	In abeyance	1988
Sewage and Drainage Law No. 3	Water Development Agency	1983
Tourism Development Act	Ministry of Tourism	1984
United Nations Convention on the Law of the Sea	In abeyance	1989