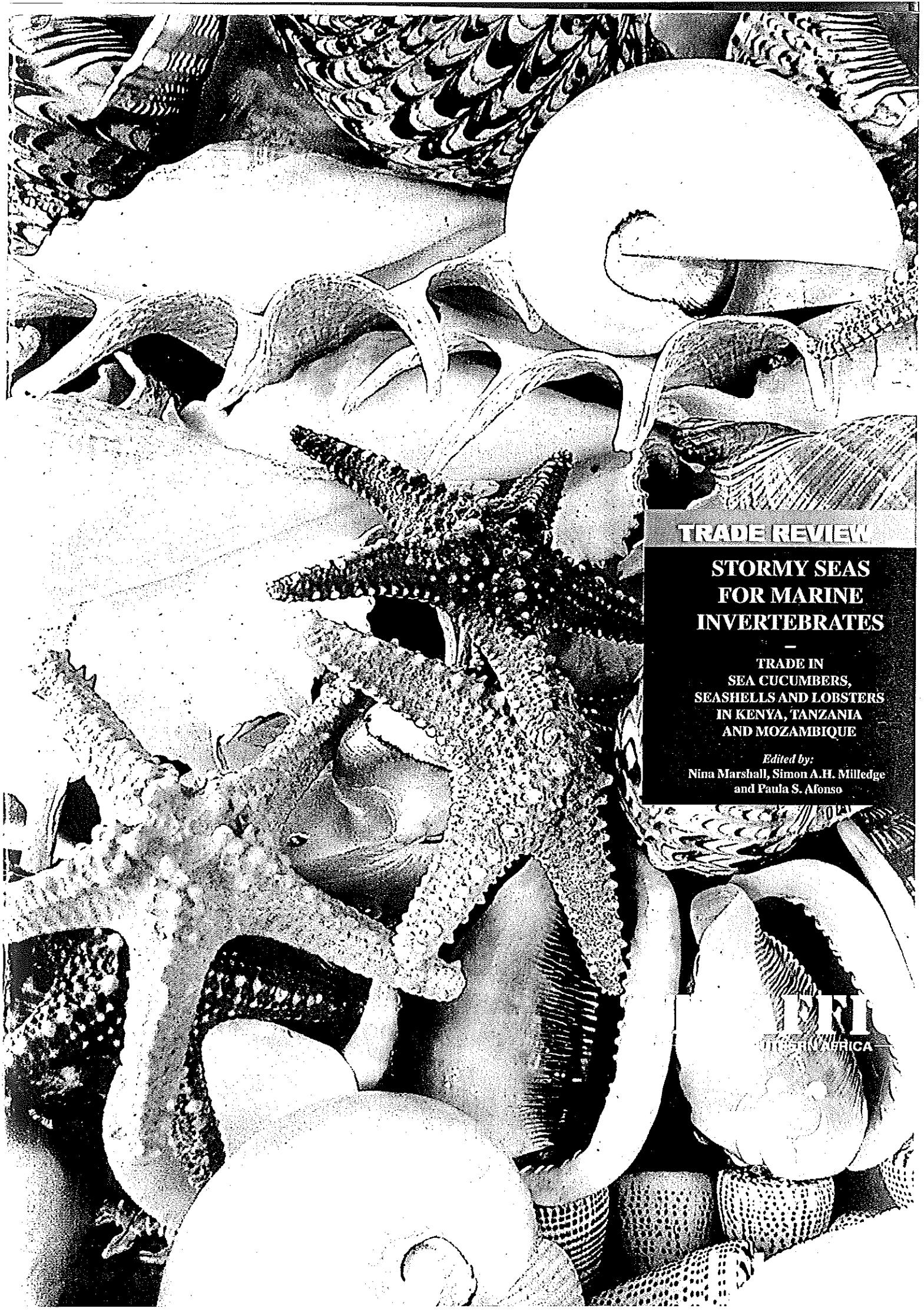

TRADE REVIEW

STORMY SEAS FOR MARINE INVERTEBRATES

– TRADE IN SEA CUCUMBERS, SEASHELLS AND LOBSTERS IN KENYA, TANZANIA AND MOZAMBIQUE

Edited by:
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TRAFFIC EAST/SOUTHERN AFRICA

STORMY SEAS FOR MARINE INVERTEBRATES:

TRADE IN SEA CUCUMBERS, SEASHELLS AND LOBSTERS

IN KENYA, TANZANIA AND MOZAMBIQUE

FINAL REPORT FOR PROJECT NO. 9F0070
SUBMITTED TO THE RUFFORD FOUNDATION

MARCH 1999

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ACKNOWLEDGEMENTS

Many individuals and institutions have been instrumental in providing assistance during the course of this survey. Countless fishermen and traders in all three countries featured in this report provided valuable information and insight. To these people were are sincerely grateful. In Kenya, special thanks are due to Daniel Ndanyi for assistance throughout the project. Thanks are also due to George Wamukoya and Joseph Eriya of the Kipini Community Conservation and Development Programme and Julie Church and her team of the WWF Kiunga Marine Project, all of whom expended considerable effort to collect essential information from fishermen along the Kenya coastline. Staff at the Kenya Fisheries Department, both in Nairobi and in Mombasa, were also extremely helpful. We would also like to express our appreciation to Abdulrahman Issa of IUCN who assisted with the Tanzania component of the project. In Tanzania, special thanks are due to Mr. Issa and Ms. Bishara of the Department of Fisheries, Zanzibar, and Thomas Maembe and Eronika Lyimo of the Fisheries Division. We are also grateful for assistance provided by Daniel Masoko of the District Fisheries Office in Kilwa, and Julius Francis and Narriman Jiddawi of the Institute of Marine Sciences, Zanzibar. Others in Tanzania who provided information and assistance include Lucy Kashaija and H. Mambosho of WWF, Eric Allard, Abdilaziz Ameir, Martin Guard, Chris Horrill, Ho Ho Kung, Rashid Mushehe, Haji Osman, Katia and Massimo Pallazo, Shum Yee Chung, and Jean-Luc de Solandt. In Mozambique, Rabia Abdula of the Institute for Fisheries Research is due sincere thanks for providing information and stimulating discussion. Others whose assistance was very much appreciated include Antonio Reina of Endangered Wildlife Trust-Mozambique for his initial encouragement, Issufo Mussa for seashell information and logistical assistance, and James Wilson for valuable advice. Acknowledgement is also due for information provided by the National Directorate for Forestry and Wildlife, the Institute for Fisheries Research, the Maputo Customs Office, PESCOM International, the Sociedade Moçambicana LDA and MICOA. As this project involved compilation of information from around the globe, we also are sincerely grateful to contributions from members of the TRAFFIC Network, for not only providing advice and support, but also for spending long hours collecting and compiling trade statistics for this project. Of special note are Rob Barnett, Ashish Bodasing, Tom Milliken and Claire Patterson of TRAFFIC East/Southern Africa. From other TRAFFIC offices we would like to thank Steve Broad, Elizabeth Fleming, Andrea Gaski, Craig Hoover, Chen Hin Keong, Hisako Kiyono, Rob Parry-Jones, Marcus Phipps and Caroline Raymakers. We would also like to thank Chantal Conand for overall advice and support relating to sea cucumber fisheries and biology. To Rodney Salm of the IUCN Eastern Africa Regional Office, we express our heartfelt gratitude, not only for his guidance and expertise throughout the project, but also for his unending enthusiasm which was a continual inspiration. Finally, we are extremely grateful to The Rufford Foundation, UK, for providing financial support for this initiative.

INTRODUCTION

The Western Indian Ocean has for centuries been an important source of food and other products for the people of Kenya, Tanzania and Mozambique. Many of these products have been traded regionally and beyond, and in recent decades this trade has expanded substantially. Harvest for local use and for export today represents an important source of revenue for local communities, traders and governments. At the same time, it is recognised that fisheries departments are understaffed in all three countries, and management effort necessary to ensure the sustainable harvest of marine resources is in many instances insufficient. These observations first became apparent when TRAFFIC East/Southern Africa conducted a review of the trade in sharks and shark products in the Western Indian Ocean (Marshall and Barnett, 1997). This review, conducted in 1995 and 1996, revealed that shark fisheries throughout the region are substantial, but are largely unmanaged and unregulated, and that exploitation is being carried out with minimal information on the status of the resource and the resulting conservation implications. TRAFFIC's research into the shark trade revealed the need for improved resource management and collection of production and trade statistics in order to ensure a sustainable fishery. This research also suggested that other marine resources exploited in the region are similarly unmanaged and poorly documented. Before recommending substantial alterations to current fisheries management procedures, TRAFFIC felt that it was necessary to expand existing knowledge of marine resources exploitation and management, so that recommendations could focus on addressing the more generic problems inherent in fisheries management in this region.

With this in mind, TRAFFIC East/Southern undertook a review of the trade in lobsters, sea cucumbers and seashells in Kenya, Tanzania and Mozambique in 1997 and 1998, with the overall aim of improving the future management, conservation and regulation of these marine resources, in order to ensure that utilisation proceeds on a sustainable and legal basis. These resources are traded both locally and internationally in all three countries, and there is minimal information about the conservation implications of this trade on the species concerned. This report presents the results of this trade review.

METHODS

The objectives of the study were to identify and obtain quantitative data on production and trade in all target taxa in each of the three Western Indian Ocean nations, in order to ascertain the volume and value of the trade, the source areas of key species, and the impact of this harvest and trade on the species. To this end, the following tasks were completed in each country:

- compilation of available statistics and information on the harvest, consumption and trade in the taxa under consideration;
- examination of Customs data from importing countries for comparative analysis;
- identification of species in trade;
- examination of legislation, regulations and controls over these fisheries;
- documentation of the role of commercial and artisanal fishermen in the exploitation of these resources through interviews and on-site visits to fish markets, landing location and fishing ports; and
- assessment of the conservation implications of the current levels of exploitation and trade.

BACKGROUND

The area covered during this survey spans approximately 4,450 km, from the Kenya-Somali border through Tanzania to Mozambique's southern border with South Africa (see Figure 1). Kenya's population is estimated at over 25 million, with 6% living on the coast. Kenya's main ports are Mombasa and Malindi. Tanzania's population is 28 million with 25% on the coast (Richmond, 1997), and the main ports are Tanga, Dar es Salaam, Mtwara and Zanzibar. Mozambique has a population of over 12 million, and 42% of the population inhabits coastal areas (Anon., 1998). The principal international ports are Maputo, Beira and Nacala.

Kenya's coastline is about 880 km in length (Coppola, 1982), is relatively indented and is characterized by fringing coral reef platforms that are almost continuous along a narrow belt close to shore (Richmond, 1997). Where breaks occur in the reef, sand and mud shores are apparent (Yarish and Wamukoya, 1990). The continental shelf extends approximately 18 km from shore, and an offshore bank, the North Kenya Bank, is present from about 35 km southeast of Lamu north to the Somali border (Ardill and Sanders, 1991). The Kenya coastline is punctuated by several river

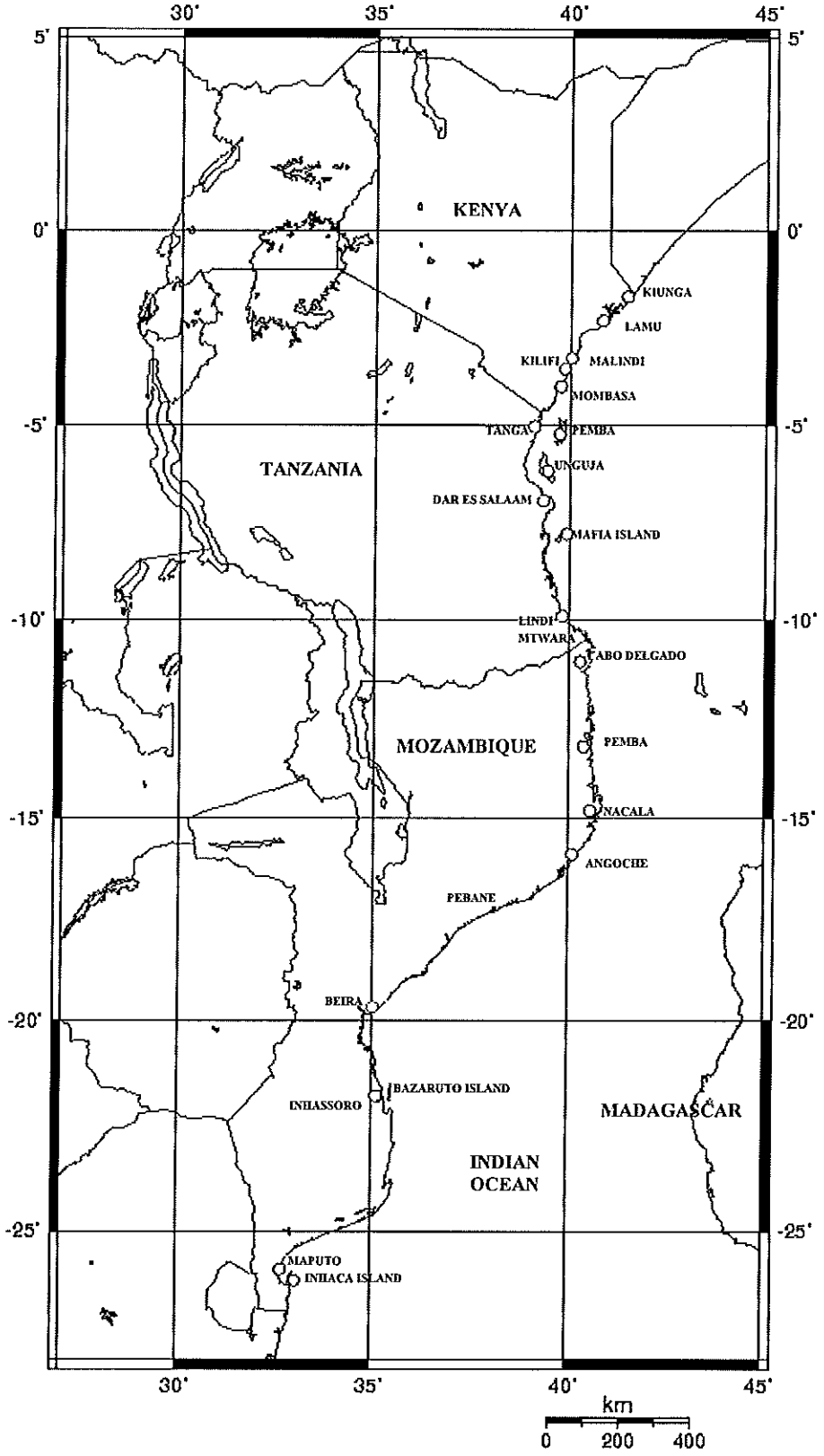
systems, most notably the Tana River and the Sabaki River, as well as a number of offshore islands, some of which are inhabited on a permanent basis.

Tanzania's coastline extends some 800 km, with about two-thirds characterized by fringing reefs and river outlets, the largest of which are the Pangani, Rovuma, Rufiji, Ruvu and Wami rivers. The continental shelf covers an estimated 19,000 km^2, and can be as narrow as 3.2 nautical miles (nm) in certain areas but can reach 34.5 nm around Mafia Island and the islands of Unguja and Pemba which comprise Zanzibar. The Zanzibar Channel is approximately 22 miles wide, and separates Pemba and Unguja Islands from the mainland (Barnett, 1997; Nhwani, 1987).

Mozambique's coastline measures approximately 2,770 km (around 1,430 nm) and is characterised by a wide diversity of habitats, including sandy beaches, coral reefs, estuary systems, bays, mangroves and seagrass beds. The Mozambique Channel separates Mozambique from the island of Madagascar; it is 400 km wide at its narrowest point. Madagascar shields Mozambique from the influences of the open ocean, except in the extreme south (south of latitude 25° S) and in the extreme north, where Cabo Delgado is directly exposed to the Indian Ocean. The continental shelf averages 15 to 25 km in width, however, it can be as narrow as 100 m off Pemba in northern Mozambique, and as wide as 145 km on the Sofala bank (Sousa *et al.*, 1997). The distribution and abundance of the living aquatic resources, as well as the fishing methods used to exploit them, are largely dependent on the physical characteristics of the coast (Premegi *et al.*, 1997).

Figure 1
Map of study area

The Mozambique coast is a compound shoreline and can be divided into four main natural regions (Massinga and Hatton, 1997). It consists of *coral coast* where in the north, hermatypic reef formations extend about 770 km from the Rovuma river to the Primeiras e Segundas archipelago in the south (17° 20'S). Coral areas also occur in the south from Bazaruto Island to South Africa, but these are found in relatively deeper waters. The southern limit for shallow water fringing coral is reported from Inhaca Island, at latitude 26° S. *Swamp coast* occurs in the central section of Mozambique, between Angoche and Bazaruto Island and characterised by simple linear to arched beaches, swamps


30°
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KENYA
TANZANIA
MOZAMBIQUE
MADAGASCAR
INDIAN OCEAN
KIUNGA
LAMU
KILIFI
MALINDI
MOMBASA
TANGA
PEMBA
UNGUJA
DAR ES SALAAM
MAFIA ISLAND
LINDI
MTWARA
CABO DELGADO
PEMBA
NACALA
ANGOCHE
PEBANE
BEIRA
BAZARUTO ISLAND
INHASSORO
MAPUTO
INHACA ISLAND
km
0
200
400

and estuaries. Twenty-four rivers discharge into the Indian Ocean along this central zone, each with an estuary supporting well-established mangroves and swamps. The beaches between Pebane and the Zambeze River are of black sand and are rich in the minerals ilmenite and rutile. This area extends about 978 km. *Parabolic dune coast* is situated between Bazaruto Island and Ponta de Ouro, this section is characterized by high parabolic dunes, north-oriented capes and barrier lakes. It extends approximately 850 km. Finally, there is *delta coast,* and this area is situated in Zambeze Delta River and Save Delta River.

The survey area is characterised by a tropical humid to sub-humid climate, with two distinct seasons dominated by the northern and southern monsoons, which effect rainfall, winds and temperature. The air temperature generally does not drop below 20°, and the seawater temperature fluctuates between 20° and 30°. The period of the northern monsoon corresponds with the short rains in Kenya and Tanzania, between November and March, while the rains become more prevalent between March and June (Richmond, 1997). In Mozambique, rainfall occurs throughout the year, with maximum precipitation between November and March. The highest annual average is recorded for the central sector of Mozambique and the lowest along the southern sector. The mean surface sea temperature is about 25.5°C in the north (Mocimboa da Praia) and 21.4°C in the south (Maputo) (Massinga and Hatton, 1997).

The coastal region of East Africa provides a wealth of economic opportunity for its inhabitants. Not only does the region offer great potential for exploitation of marine resources, but it also serves as an important transport route for goods destined for the interior. This last factor has been instrumental in the rapid development of large coastal cities such as Maputo, Dar es Salaam and Mombasa which support diverse industries and busy ports which are essential to national economies (Coughanowr *et al.*, 1995).

Rapid human population growth is occurring in many of the coastal, urban areas in East Africa, a result of migration from inland, rural areas towards the attraction of industrialised, urban centres. This factor exacerbates the overall economic situation of East Africa, which is classified as poor, with an annual per capita GNP of less than USD580 (Coughanowr *et al.*, 1995). The result of high population growth and poverty has been poor standards of living and basic needs including medical care, education and sanitation. Environmental degradation (pollution, habitat destruction, overfishing, coastal erosion and flooding) is severe without the resources to effectively manage the coastal environment.

HISTORY OF EXPLOITATION AND TRADE IN THE REGION

The Western Indian Ocean region has for several thousand years been a very active trade zone, dominated by the Swahili people who formerly occupied coastal settlements from Mogadishu south to Cabo Delgado in Mozambique. The Swahili were famous for their role as middlemen trading food, spices, slaves, ivory, housing materials and other products across the ocean to Arabia and throughout Asia. Most of these products originated from the African interior, with only a few products sourced from coastal areas or plantations (i.e. mangrove poles, spices, grains, cowries) (Middleton, 1992). Today, trading activities throughout the region have diversified with regard to the products traded and parties involved.

Information on trade in marine resources from the Eastern African region in centuries past is poorly documented, although there is evidence of trade in shells and in particular in cowries from Zanzibar (Middleton, 1992). In this century, it is known that shells such as the Money Cowrie *Cypraea moneta* were used as a currency (Saul, 1974 in Wells, 1981), and that helmets *Cassis* spp. were traded to Europe for the cameo industry (Boss, 1969 in Wells, 1981). Zanzibar was an important centre of the shell trade, and both Kenya and Tanzania exported large quantities of shells (Wells, 1981). It is likely that East Africa was a source for mother of pearl, especially from the Black-lipped Pearl Oyster *Pinctada margaritifera*, used in button manufacture. This industry began in the 1870s in Japan when it became fashionable to fasten kimonos with buttons rather than sashes, but subsided in the 1950s when use of plastic caused the industry to collapse. Only since the 1970s have mother of pearl buttons regained some of their former glory, again the result of fashion (Nash, 1988). There are several shell species used for mother of pearl production, but in this region the most likely species is the Black-lipped Pearl Oyster. Mozambique's role in the early shell trade is unknown.

The advent of sea cucumber exploitation in the region generally coincides with the influx of Asian nationals, many of whom arrived as part of the industrial fishing industry. Chinese immigrants arrived in Mozambique in the early 1940s, and holothurian collection commenced initially in the Cabo Delgado region, and later in the south when fishing

camps were established at Govuro, Inhassoro, Ponta S. Sebastiao, Maxixe and Costa do Sol. The first camps in Inhassoro region in Inhambane Province were set up around 1950 (Aslak *et al.*, 1995). Sea cucumber harvest in Maputo Province (Inhaca) began in the 1960s (Montecino, 1989) and in Nampula around 1981 (Silva, 1984). Following independence in 1975, the Chinese monopoly on sea cucumber trade subsided as foreigners departed the country (Aslak *et al.*, 1995). The Government of Mozambique promoted holothurian harvest through the national company, PESCOM International, and provided diving gear and training to small-scale fishermen, many of whom had worked previously in the Chinese fishing camps. Between 1981 and 1987, PESCOM International exported about 500 mt of dried sea cucumber to Singapore and Hong Kong. Local consumption or use of sea cucumbers within the region has not been recorded; this fishery is solely export-oriented.

The sea cucumber industry in Tanzania and Kenya has roots similar to that of Mozambique, with large-scale collection, preparation and export initially carried out by Chinese settlers who arrived in the 1960s. In Tanzania, the industry was first centred in Zanzibar, with collection concentrated around Unguja, Pemba and Mafia Islands and near Dar es Salaam. By the early 1970s, exporters of Chinese and Indian origin were operating from Zanzibar, Dar es Salaam, Tanga and Mombasa. At this time, the trade was dominated by a few high quality large-sized species, Sand Fish *Holothuria scabra* and Teat Fish *H. nobilis*. During the 1980s, the players involved in the export market diversified to include Tanzanians (primarily Zanzibaris), and entrepreneurs set up lucrative export businesses in particular in Mtwara in southern Tanzania to exploit the vast stocks of Mozambican sea cucumbers. By the 1990s, however, it appears that sea cucumbers were no longer available in such large sizes and quantities; exports from Tanzania have declined since 1992, and Kenya has seen a similar reduction in trade with no official exports at all for the period 1994 to 1997. In 1997, the industry received an additional blow from the Asian economic crisis, which reduced demand.

Exploitation of the lobster resource is relatively new in all three countries in the region. While harvest for local consumption has occurred for thousands of years, commercial exploitation and trade has only taken place over the last 40 years. Figures for production in the early years of the fishery are not country specific, however it is estimated that catches for the entire East African seaboard in 1963 were 60.1 mt for *Panulirus ornatus*, 40 mt for *P. versicolor*, and 30 mt for *P. longipes* (Postel, 1964 in Bwathondi, 1980).

In Kenya, the lobster fishery commenced in the late 1940s on a very small scale. The first exploration of the lobster environment using non-indigenous techniques, such as pots and traps, took place in 1954. In 1964 tangle nets were used to conduct lobster surveys, and in 1966 surveys of the reef, creek and coastline were conducted with trammel nets. During the period 1960 to 1970, lobster production increased 18% per year. Production was in 1970 regarded as being well below what it could be because fishermen were reluctant to use modern fishing methods (such as trammel nets) and preferred to use goggles and dive for lobster; the fishery was regarded as being underdeveloped and primitive (Brusher, 1971). For the period 1972 to 1991, the spiny lobster catch was relatively stable at about 70 mt per year (Okechi, 1995).

Tanzania's lobster fishery is primarily artisanal. Exploitation for commercial purposes commenced in the mid-1960s, and before that time all lobster consumption was by fishermen or foreigners residing in-country (Bwathondi, 1980). In 1968 production was recorded at 60 mt, but declined to 21.9 mt in 1972, and then increased to about 40 mt in 1976. The decrease in production, according to the Ministry of Natural Resources and Tourism, was apparently due to poor data recording, while the rise corresponded to improved data collection (Bwathondi, 1980). Despite this observation by the Ministry, Bwathondi (1980) also notes that the decrease in production was due to a drop in prices and the consequent abandonment of the fishery by the fishermen, and the rise was due to efforts of the Tanzania Tourist Corporation in increasing tourism and demand for lobsters. In the late 1970s, a survey ascertained that the most important lobster fishing grounds were Tanga (58.8%), and for the remainder, Bagamoyo, Dar es Salaam and Mtwara (Bwathondi, 1980). Until trade liberalisation in 1985, exports of lobster from the mainland were controlled by the Tanzania Fisheries Corporation (TAFICO), and from Zanzibar by the Zanzibar Fisheries Corporation (ZAFICO). Zanzibar's exports from the late 1970s to 1984 were mainly destined for hotels and exporters in Kenya and Dar es Salaam. In the mid 1980s, export destinations increased, as did the number of hotels, however by 1987 market competition favored the tourist industry over exporters, and by 1988 exports from Zanzibar ceased. Local sales continue to dominate Zanzibar's lobster industry. Tanzania mainland exports have risen continuously due to a growing overseas demand; Tanzania has successfully met EU import standards for sanitation and health controls.

Little is known about the history of the inshore lobster fishery in Mozambique, although it appears that commercial exploitation gained momentum in the late 1960s. Growth in the commercial fishery was prompted by foreign individuals and enterprises, primarily from South Africa. In 1980, the industrial deep water lobster trawl began with one Japanese vessel operating (primarily fishing for crab), and this expanded in 1985 to at least eight South African trawlers targeting deep water lobster and prawns. At present, most lobster is exported, and only a small portion of the catch is consumed locally, mostly by the hotel industry.

THE LOBSTER FISHERY

All lobsters are marine species, apart from the superfamilies of freshwater crayfishes (Astacoidea and Parastacoidea). Lobsters occur in nearly all temperate and tropical oceans. Few species enter brackish water. They occur from the intertidal zone to very deep waters, and have been found at a depth of 3,000 m (Holthuis 1991). A total of 14 lobster species have been identified as traded during this survey. These include spiny lobsters (primarily *Panulirus* spp.) harvested from the inshore waters, and several genera of deep water lobsters caught by industrial trawlers (*Ibacus*, *Metanephrops*, *Nephropsis*, *Palinurus*, *Puerulus*, *Scyllarus* and *Thenus*). In 1980 it was surmised that the major spiny lobster fisheries were in South Africa, Australia, New Zealand, Cuba, Brazil, Mexico and the United States. The South African industry is dominated by the Cape Rock Lobster *Jasus lalandii* (Bowen, 1980). This species occurs off the coast of southern South Africa and Namibia; its distribution does not extend into Mozambique (Holthuis, 1991).

Lobsters represent an important artisanal fishery but also support a significant commercial fishery worldwide. Most spiny lobsters have a high market value which compensates for the low numbers of individuals caught for some species. Spiny lobsters are caught with nets, pots, traps, spears, scuba, and skin diving. Some are deep sea species which require specially outfitted vessels. However, most spiny lobsters are caught in shallow water using traps or pots (Lipcius and Cobb, 1994). In 1990, it was found that of the average annual figure for the period 1985 to 1988 of the world lobster catch, Palinuridae constituted 40.7% (84,486 mt), Nephropidae comprised 58.4% (121,329 mt), and the slipper lobsters, Scyllaridae, comprised a mere 1.0% (1,989 mt) (FAO, 1990, in Lipcius and Cobb, 1994). The average annual lobster catch for this same period was 207,804 mt, which was approximately 5% of the total crustacean catch (which includes shrimps, prawns, galatheids, lobsters, crabs, krill as well as freshwater and other miscellaneous crustacean species). The global annual lobster catch as reported by FAO for subsequent years is presented in Table 1.

Table 1
Annual global catch (mt), including landings in Kenya, Tanzania and Mozambique, 1989-1995

YEAR	GLOBAL CATCH	AREA 51 CATCH	KE	TZ	MZ	REGIONAL TOTAL
1989	208,367	5,700	74	0	330	404
1990	212,755	6,481	74	0	675	749
1991	218,055	6,442	66	0	550	616
1992	205,732	4,503	52	0	434	486
1993	206,162	4,911	47	0	756	803
1994	214,963	4,297	44	0	568	612
1995	215,545	4,012	119	0	427	546

Source: Anon., 1997a.

It should be noted that the figures for Tanzania which indicate no catch at all, are not representative of the current situation and it is evident that Tanzania has not submitted figures to FAO.

Spiny Lobsters
Lobsters in the family Palinuridae are commonly known as "spiny" or "rock" lobsters. The family comprises eight genera (*Jasus*, *Justitia*, *Linuparus*, *Palinurus*, *Palinustrus*, *Panulirus*, *Projasus* and *Puerulus*) (Holthuis, 1991). Some species inhabit inshore waters, while others are deep water species. Spiny lobsters are thought to have a long life cycle with a larval stage of approximately 3 to 12 months (phyllosoma stage). This is followed by the puerulus stage where they are similar to adults but measure only about 2.5 cm. From this stage it is estimated that the young lobsters require about four years before they reach saleable size which is 0.5 kg (Brusher, 1971). Morgan (1980) notes that estimating the age of a spiny lobster is impossible, and that population dynamics are best considered by using carapace length (CL) to gauge sexual maturity. The size of females at first maturity varies by species (Morgan, 1980).

The predominant spiny lobster genus exploited in all three countries is *Panulirus*. This genus is comprised of 19 species, all of commercial interest. Seven species occur in the Western Indian Ocean, and five have been recorded from the East African coast: *P. homarus*, *P. longipes*, *P. ornatus*, *P. penicillatus*, and *P. versicolor* (Berry, 1971; Holthuis, 1991). The most important species in the lobster fishery of all countries in this survey is the Ornate Spiny Lobster *Panulirus ornatus*. Inshore species recorded during this survey are presented in Table 2.

Table 2
Inshore spiny lobster species (*Panulirus* spp.) found in trade in Eastern Africa

SPECIES	DISTRIBUTION	DEPTH	MAXIMUM SIZE
Panulirus homarus	East Africa to Japan, Indonesia, New Caledonia	1-90 m; usually in shallow waters of 1-5 m	12 cm CL; 31 cm total; average total 20-25 cm
Panulirus longipes	East Africa to Japan and Polynesia	1-18 m (but reported at 122 m)	12 cm CL; average CL 8-10 cm; 30 cm total; average total 20-25 cm
Panulirus ornatus	East Africa to Japan, PNG and New Caledonia	usually 1-8 m (but reported at 50 m)	50 cm total; average total 30-35 cm
Panulirus penicillatus	Red Sea, East Africa to Japan, Hawaii, Galapagos, western Mexico	1-4 m	40 cm total; average total 30 cm
Panulirus versicolor	Red Sea, East Africa to Japan and Polynesia	1-15 m	40 cm total; average total <30 cm

Source: Holthuis, 1991.

Deep Water Lobsters
Several species were identified during this survey as being caught by industrial trawlers. *Palinurus delagoae* is exploited in Mozambican waters. This species is gregarious and migratory, and as a result has at times been landed in very large quantities (several tonnes) by trawlers (Berry, 1971). Also present in Mozambique is *Metanephrops mozambicus*, a langoustine previously referred to in FAO data as *M. andamanicus*, and *Nephropsis stewarti*, another species of langoustine (Holthuis, 1991). Other species reported in Kenyan trawls include *Ibacus novemdentatus*, *Metanephrops andamanicus*, *Puerulus angulatus*, *Scyllarides squamosus*, *S. tridacnophaga* and *Thenus orientalis*. Mutagyera (1984) notes the presence of the following additional deep water species in Kenyan waters: *Linuparus somniosus*, *Palinustrus mossambicus*, and *Ibacus incisus*. Information about the biology of deep water lobster species is not extensive by any means, nevertheless data on distribution and depth preference of the species identified during this survey are presented in Table 3.

Table 3
Deep water lobster species found in trade in Eastern Africa

SPECIES	DISTRIBUTION.	DEPTH	MAXIMUM SIZE
Ibacus novemdentatus	East Africa to Australia, Japan, Korea	37-400 m	3-7.7 cm CL; 19 cm total
Metanephrops andamanicus	East Africa, South China Sea, Andaman Sea, Indonesia	250-750 m, commonly 300-450 m	4.5-6 cm CL; 20 cm total
Metanephrops mozambicus	Kenya to South Africa, to Madagascar	200-750 m, commonly between 400-500 m	4.5-8.8 cm CL; 20 cm total
Nephropsis stewarti	East Africa, Gulf of Aden to Japan and Indonesia	170-1,060 m; usually between 500-750 m	2.2-7.1 cm CL (males); 1.4-7 cm CL (females); 15 cm total but common at 10 cm total
Palinurus delagoae	Mozambique, South Africa to Madagascar	0-400 m; usually between 180-324 m	17 cm CL; 35 cm total
Puerulus angulatus	Zanzibar to South Africa, to Japan, Indonesia	274-536 m	7.3 cm CL; 21 cm total
Scyllarides squamosus	East Africa to Japan, Australia, Hawaii	common between 20-50 m; occurs to 80 m	15 cm CL; 40 cm total
Scyllarides tridacnophaga	Red Sea, East Africa to Thailand	5-112 m	6-12 cm CL; 30 cm total
Thenus orientalis	East coast of Africa to Japan, China, Philippines, Australia	8-70 m; usually 10-50 m	8 cm CL; 25 cm total

Source: Holthuis, 1991.

THE LOBSTER FISHERY IN KENYA

Current Fisheries

Kenya has both an artisanal and an offshore lobster fishery. The artisanal sector is the most significant, and there are an estimated 6,500 fishermen operating along the coast using canoes and outrigger boats (Anon., 1995a). Artisanal fishermen target a diversity of species and use a variety of gear including castnets, gillnets, beach seines and handlines (Ardill and Sanders, 1991). The offshore fishery consists of foreign and Kenyan vessels. The offshore lobster harvest is not a directed fishery, rather it is by-catch from the commercial prawn trawl.

During this survey, a total of 310 fishermen were interviewed to collect information on the Kenyan lobster fishery. Interviews took place at 15 designated landing sites and a further 25 private (unofficial) landing sites, covering an area from Vanga on the Tanzanian border north to the Lamu archipelago. Interviews with fishermen operating in the area from Lamu north to the Somalia border were also undertaken; this area is important due to the presence of the Kiunga Marine Reserve, and its proximity to Somalia.

The Kenyan lobster fishery was found to be carried out exclusively by men, 30% of which fish full-time for lobsters. Part-time lobster fishermen also target sea cucumbers, seashells, octopus and fish, depending on demand and the season. Lobster fishing is undertaken throughout the year, but is extremely difficult during the period of the Southeast monsoon (March to September) due to high winds and rough seas. For the area stretching from Vanga north to Lamu, on average each fishermen records a landing of 10 to 15 kg of lobsters per day. A total of nine species of lobsters have been reported to be caught by artisanal fishermen, the most prevalent being *Panulirus ornatus*. Other species harvested, in descending order of importance, are *Panulirus versicolor*, *P. longipes*, *P. homarus* and *P. penicillatus*. Other comparartively less important species caught include: *Scyllarides squamosus*, *S. tridacnophaga* and *Thenus orientalis*. Fishermen north of Lamu, fishing in the Kiunga area, reported variable daily catches, ranging from five kg during rough seas to ten times as much when the water is calm. In general though, fishermen stated that the catch was very dependent on weather, as well as competition from other fishermen. Methods of harvest include traps, bottom set gillnets or by diving and frightening the lobster out of its lair with a dead octopus into a handnet. Most fishermen access fishing grounds with small boats.

Kenya's lobster production has been relatively stable at about 70 mt annually for the period 1972 to 1991. In recent years, the reported artisanal catch has declined to about 50 mt per year. The commercial catch (deep water species), which is by-catch from the prawn trawl, varies considerably from year to year, with no landings in some years, while for others is quite significant. Mutagyera (1984) reported that the deep water lobster fishery area was small, catch rates extremely variable, and therefore that the fishery was not viable in the long-term. This situation remains the case today, with four prawn trawlers opportunistically catching deep water lobsters in Ungwana Bay, Malindi Bay, and the waters north of Lamu. Species harvested include: *Metanephrops andamanicus*, *Puerulus angulatus*, *Scyllarides* spp. and *Ibacus novemdentatus*. The estimated catch is between 20 and 60 kg/hour. Official landings and export figures for both the artisanal and the offshore sectors are presented in Table 4.

Table 4
Kenyan lobster production (kg), 1990-1997

YEAR	TOTAL PRODUCTION (KG)	ARTISANAL PRODUCTION (INSHORE)	PRODUCTION FROM TRAWLERS (DEEP WATER)
1990	72,912	72,912	--
1991	59,000	59,000	--
1992	52,335	52,335	--
1993	45,965	45,965	--
1994	43,886	43,886	--
1995	118,959	38,835	80,124
1996	176,535	53,308	123,227
1997	135,716	53,440	82,276

Source: Fisheries Department, Ministry of Tourism and Wildlife.

In 1971, the main spiny lobster fishing areas were recorded as being Lamu, Mombasa and Shimoni/Vanga, and when combined these three areas produced 97.5% of Kenya's lobsters, with Lamu alone producing 60.2% (Brusher 1971). The principal species harvested was *Panulirus ornatus*, a situation which has not changed as evidenced by subsequent surveys in 1975 to 1978, in which the species comprised over 80% and sometimes 100% of the catch (Mutagyera, 1978), and in 1992 to 1993 on the south coast at Gazi Bay where *P. ornatus* made up 94% of the catch from artificial shelters and 72% from the reef region (Okechi and Polovina, 1995). Important artisanal lobster fishing grounds in 1998 were reported to be Vanga, Shimoni and Funzi on the south coast, Tudor Creek in Mombasa District, Takaungu and Kilifi Bofa in Kilifi District, Malindi Bay in Malindi District, Ungwana Bay in Tana River District, and Manda Bay, Kiunga, and Ziwayuu/Tenewi in Lamu District.

While some fishermen landed their lobster catches at official landing sites, many did not and instead sold the lobsters directly, a situation that results in under-reporting of national production. In 1994, when official landings were reported to be 70 mt, it was estimated that actual harvest was closer to 100 mt per year (Okechi and Polovina, 1994). This survey supports this conclusion given the prevalence of unofficial landing sites.

Information on abundance of lobsters and availability of sizable specimens was collected from fishermen. Reports of scarcity of lobsters in inshore waters were frequent among fishermen along the entire coastline, with the main reason given as competition from an ever-increasing number of fishermen, resulting in over-exploitation of the resource. Declines in sizes caught were reported for some species, in particular *Panulirus ornatus*, *P. versicolor* and *P. homarus*. In the Kiunga region north of Lamu, some fishermen reported declining sizes of *Panulirus ornatus* and *P. penicillatus*. However, most stated that the sizes were the same and that the main issue was the increasing difficulty in locating and catching lobsters, and that this was due to the high number of fishermen operating in the area.

During this survey there was no evidence of declines in size of any of the deep water species caught as by-catch in the commercial prawn trawl.

Trade

Lobsters harvested by artisanal fishermen are sold to individuals, hotels, or dealers. In the past, most of the spiny lobster catch was consumed within Kenya, primarily by the tourist industry. The deep water catch is reportedly exported in its entirety to Europe (L.N. Thairo, pers. comm. to N. Marshall, 1998). In 1997 and 1998, Kenya suffered extensive damage from the El Niño phenomenon, including severe coastal flooding and damage to infrastructure, resulting in a drastic decline in tourist arrivals. Many hotels have closed and consumption of lobster is down. This situation has caused dealers to search for new markets, and in 1998 it was reported that exports of frozen spiny lobster tails commenced (L.N. Thairo, pers. comm. to N. Marshall, 1998). Import data for Europe however, indicates that this trade has been ongoing for several years at least.

Prices paid to fishermen vary by season, and in Kiunga the low season price was reported to be KSH 100/kg (USD1.00 = KSH 59). This price rises to KSH 450-500/kg in the high season when tourists are plentiful. Lobsters from Kiunga are generally sold to dealers who transport them by air to Malindi and Mombasa. South of Lamu, the price varies as well, with *Panulirus ornatus* fetching the highest price (KSH 600/kg) and the other spiny lobster species ranging from KSH 350-450/kg. The slipper lobsters (*Scyllarides* spp.) command the lowest price (KSH 250/kg), which is probably because they are used for meat only and are not as presentable for dishes requiring a whole intact lobster.

Purchasing prices vary as well, and it appears that most pricing is set by the bargaining ability of vendors and buyers. Purchasing prices reported by coastal hotels ranged from KSH 350-700/kg, depending on the size. While some hotels refuse to purchase small lobsters for conservation reasons, others buy a range because they prepare platters that have lobsters of different sizes, to provide variety to the diner and a more beautiful display. Gravid lobsters are also offered for sale despite being illegal, and some hotels refuse to purchase these, while others buy them and use the eggs to make bisque. Hotels in general hand pick lobsters brought to them by fishermen or middlemen who arrive by bicycle or bus. Lobsters are sold fresh or frozen; some hotels report decreasing availability of fresh lobsters, indicating local unavailability and that lobsters have been transported from some distance. This is the case on the South Coast, where lobsters are often imported unofficially from Tanzania, and have been frozen for the journey.

A survey of Nairobi retail shops in August 1998 revealed that prices for fresh and frozen lobster are the same. At the City Market prices per kg varied from KSH 750-800 (USD 12.70-13.50), while more upscale retail shops such as the Yaya Centre and those in Westlands ranged from KSH 950-1,250/kg (USD 16.10-21.18/kg).

Imports
In recent years Kenya has not reported any imports of lobsters. However, fishermen, hotels and dealers report significant imports from both Somalia and Tanzania. Tanzanian vendors frequently travel up the coast from Tanzania by bicycle, bus or other vehicle to sell lobsters to Kenyan restaurants and hotels. These lobsters are often frozen for the journey. Quantities of imports are unknown.

Exports
Kenya consumes a significant portion of its spiny lobster catch, however exports are also evident. The main importer is the EU, and during this survey no other imorting countries were identified. Available data appear to be conflicting and often unreliable, as can be seen from comparison of EU import data with official export figures (Table 5). It appears that exports have occurred continuously during this decade, although these are not recorded in Kenyan fisheries statistics. Furthermore, while it is reported that there is a new and growing trade in frozen lobster tails from Kenya, it is evident that this trade has been in existence for several years already, as indicated by the symbol "+", which refers to imports of tails (see note below). The EU commenced recording imports of lobster tails in 1995. Kenya's deep water lobster exports are reported by the Fisheries Department to be exported exclusively to Italy, but there is no indication that Italy has reported these imports. It would therefore appear that both datasets are represent a fairly unreliable assessment of the current trade situation.

Table 5
Kenyan lobsters exports, and EU-reported lobster imports (kg), 1990-1997

YEAR	SPINY LOBSTER EXPORTS	DEEP WATER LOBSTER EXPORTS	EU-REPORTED LOBSTER IMPORTS FROM KENYA
1990	no data available	--	26,400 (*)
1991	14,000	--	14,100 (*)
1992	70,000	--	18,100 (*)
1993	--	--	14,000 (*); 700 (#)
1994	17,335	--	5,400 (*)
1995	--	80,124	1,600 (+); 2,000 (&); 600 (#)
1996	--	123,227	1,400 (+); 2,400 (&); 1,300 (#)
1997	2,310	82,276	1,300 (+); 1,100 (&); 2,800 (#)

Source: Eurostat data; Kenya Fisheries Department data.
Note: * = "030611" Frozen rock lobster and other sea crawfish, whether in shell or not, incl. rock lobster and other sea crawfish in shell, cooked by steaming or by boiling in water.
+ = "03061110" Frozen crawfish tails, whether in shell or not, incl. crawfish tails cooked in shell, cooked by steaming or by boiling in water.
& = "03061190" Frozen rock lobster and other sea crawfish "Palinurus spp., Panulirus spp. And Jasus spp.", whether in shell or not, incl. rock lobster and other sea crawfish in shell, cooked by steaming or by boiling in water (excl. crawfish tails).
# = "03062100" Rock lobster and other sea crawfish, whether in shell or not, incl. in shell, cooked by steaming or by boiling in water (excl. frozen).

Legislation
As per *The Fisheries Act, 1991*, all dealers of crustacea are required to possess a license. In addition, this Act prohibits fishing or possessing any lobster, crab or crayfish in a gravid state. Apart from this restriction, there are no other regulations pertaining to lobsters. It should be noted that the prohibition on lobsters in a gravid state is rarely adhered to, as restaurants often purchase gravid lobsters because the eggs are used as an ingredient in soup, specifically seafood bisque which retains a reddish tint derived from the eggs.

In addition, fishermen are required to have a fishing license, and if they have a vessel, they must have a local fishing vessel license. During this survey it was found that a large number of fishermen do not have licenses although they are aware of the requirement.

Conservation Implications

Declines in lobster sizes have been recorded along the Kenya coast. This observation is not new, however. Brusher (1971) noted declines and surmised that 50% of the fishery consisted of undesirable undersized lobsters that were not preferred by local or overseas commercial markets. Size limit restrictions were suggested as an immediate need, and an 8.0 cm carapace size limit proposed for *P. ornatus* on the north coast. This recommendation was not adopted. Mutagyera (1978) also recommended that a minimum carapace length be imposed, and he suggested 9.0 cm because the mean length of females of *Panulirus ornatus* caught at that time was 7.4 cm, but the mean carapace length of berried females was 9.8 cm, with none measuring less than 8.0 cm. It was further found that 88.6% of all *P. ornatus* females were below 8.0 cm carapace length, thereby indicating that a significant percentage of the catch was not sexually mature, and that overfishing was taking place. The size limit was recommended to allow females to breed before capture. During the current study, reports of small sized lobsters were very frequent, confirming the continued harvest of under-sized specimens. Reports by fishermen of size declines as well as increased difficulty in locating lobsters also support this premise.

THE LOBSTER FISHERY IN TANZANIA

Current Fisheries

Like Kenya's lobster fishery, Tanzania's is primarily artisanal and is similarly dominated by *Panulirus ornatus*. Other species in trade include *Panulirus longipes, P. versicolor, P. homarus, P. penicillatus and Thenus orientalis*. Mutagyera (1975) found that the catch composition in Zanzibar consisted of 87.7% *P. ornatus*, 7.3% *P. versicolor* and 4.7% *P. longipes*. In another survey carried out in the late 1970s on Tanzania mainland, *P. ornatus* made up 54.8% of the catch, and the rest consisted of *P. longipes* (29.9%), *P. versicolor* (14%), *P. homarus* (1.8%) and *P. penicillatus* (0.3%) (Bwathondi, 1980). According to the records of the main lobster exporter in Tanga, catch constitution remains similar in 1998, consisting of *Panulirus ornatus* (50%), *P. longipes* (20%), *P. versicolor* (20%), and the remaining ten percent comprised of *P. penicillatus* and *P. homarus* (E. Allard, pers. comm. to S. Milledge, 1998). Darwall (1996) reported that the most commonly caught species in Songo Songo were *P. versicolor* and *P. ornatus*. All fishermen interviewed during this study concurred that the most common species caught is *Panulirus ornatus*.

During this study, 54 fishermen and four exporters were interviewed from 19 different sites along the Tanzania coastline. These sites were located near Dar es Salaam, Tanga, Pangani, Zanzibar, Mtwara, Msimbati, Kilwa Kivinje, Kilwa Masoko, Kilwa Kiswani, Songo Songo, Nyuni, Jibondo Island and Mafia Island.

Lobster fishing in mainland Tanzania and Zanzibar is primarily carried out using the net and octopus method. A live octopus, which is the lobster's main predator, is attached to the end of a 1 to 2 m long stick, and pushed into crevices to scare lobsters out of hiding. Several small nets are placed strategically to catch the fleeing lobster. This method has been in practice for over 25 years, and remains the preferred tactic not only for its simplicity, but also because the lobsters remain intact without loss of limbs. Specimens may either be kept in a sack or net or returned to a waiting boat. Other techniques include the use of traps and nets, and to a far lesser extent, spear guns because their use is banned. Spear guns also cause significant damage to the lobster, and these specimens command lower prices. In 1989, 466 lobster guns were in use on Zanzibar (Anon, 1990a). This survey revealed that whilst scuba gear is used primarily for sea cucumber collection it may be used secondarily for lobster and seashell collection.

Interviews with fishermen during this survey revealed that the average catch per person was between 5 and 20 kg/day when targeting lobsters, with all specimens over 250 g collected. In Songo Songo, fishermen can harvest an average of 7 to 10 kg in 3 to 4 hours of snorkelling, with lobsters ranging in size from 100 g to 5 kg (Darwall, 1996). Divers submerge to depths between four and 12 m over coral and muddy bottoms, preferably during spring tide. Lobsters normally are a secondary or tertiary source of income to divers. Data collected during 1975 and 1976 show that production was highest from January to June with a maximum in April (Bwathondi, 1980). Interviews with traders revealed that fishing continues all year but is greatest between February and September. Traders also claimed that there is a prevalence of different species during different seasons, with *Panulirus ornatus* and *P. versicolor* being more numerous from April to October, and *P. longipes* and *P. penicillatus* more numerous from November to March.

In Tanzania, most lobsters in trade are frozen. While lobsters may be kept alive underwater in cages or in aerated tanks, there are numerous problems associated with maintenance and transport. For instance, aerated tanks are

expensive to install and maintain (and require electricity), and underwater cages must be protected from theft by humans and marine predators. Survival of lobsters under the above-mentioned conditions is limited in Tanzania. Transport of live lobsters (traded locally) involves wrapping the animal in newspaper with the tail tucked underneath, placing it in a box padded with wood shavings, and keeping it cool with ice blocks. If packaged properly lobsters can survive for up to 36 hours.

Regarding markets, adequate storage and transport are required to ensure the arrival of live lobsters, and these factors are often irregular, resulting in stock loss. In overseas markets, tropical lobsters command lower prices than their temperate cousins, and importers often lack appropriate facilities for tropical species. As a result, the trade in live specimens is minimal compared with trade in frozen lobsters. Frozen lobster tails are becoming more popular amongst exporters. They are time consuming to prepare but very cost effective, weighing one third of whole lobsters but selling for three times as much.

Other problems associated with the lobster trade include rotting when freezer facilities malfunction, contamination due to packing with dirty sand, and inferior transport infrastructure (i.e. poor roads and insufficient airline services). Travel by boat to and from some lobster producing areas can take up to eight days; onboard ice boxes last only five to seven days.

Figures for landings of lobster in Tanzania are incomplete. Mainland Tanzania does not record lobster landings in their national fisheries statistics. Figures are available, however, for Zanzibar and are presented in Table 6. Nonetheless these have not been submitted for inclusion in FAO production statistics. A notable decline in landings in Zanzibar is apparent, with over 450 mt landed annually in the early 1990s, dropping to just over 55 mt in 1996.

Table 6
Landings (mt) of lobster in Zanzibar, 1990-1996

YEAR	PEMBA LANDINGS	UNGUJA LANDINGS	TOTAL FOR ZANZIBAR
1990	5.9	458.3	464.2
1991	12.6	462.8	475.4
1992	31.6	16.0	47.6
1993	16.5	42.1	58.6
1994	19.4	110.3	129.7
1995	11.0	22.6	33.6
1996	16.3	38.9	55.2
TOTAL	113.3	1,151.0	1,264.3

Source: Anon., 1998b.

The main lobster production areas in Tanzania appear to have changed since the 1970s. Bwathondi (1980) reported that Tanga was the most important area for lobster production, whilst interviews during this study revealed that Kilwa Kivinje is believed to be the most productive, followed by Songo Songo, Somanga, Mafia, Tanga and Zanzibar.

Trade
Trade in Tanzanian lobsters is to a large extent domestic, with lobsters sold primarily to tourist hotels and restaurants, but also to dealers and individuals. *Panulirus* spp. make up the bulk of the trade, with only sporadic reports of other genera appearing in mainstream trade. The trade is primarily in frozen specimens, although live lobsters can be found at local markets and small quantities are exported. The majority of lobsters landed in Tanzania are transported to Dar es Salaam, although a portion are transported across the border to markets in Kenya.

Lobsters are the most highly valued marine product in Tanzania. Prices paid to fishermen for spiny lobsters *Panulirus* spp. range from USD 2.30 to USD 4.10/kg, with no differentiation between live and dead lobsters. Selling prices do vary though and decrease with increasing distance from main ports because of transport costs. Undersized specimens, which are difficult to market, yield the lowest price, approximately USD 1.15/kg. Middlemen sell to exporters at between USD 7.60 and USD 8.40/kg for live lobsters, and between USD 4.50 and USD 6.80/kg for frozen whole lobsters. Frozen headless lobsters command the highest price, which ranges from USD 13.70 to USD 16.80/kg. Zanzibar's prices for whole frozen lobster are slightly higher than mainland prices, probably because of the increased presence of tourist hotels (USD 7.60 to USD 9.10/kg). Prices paid by importers, and by consumers in restaurants, are

significantly higher representing large profits by vendors. The only price recorded for a species other than *Panulirus* spp. was USD 5.30/kg paid by a restaurant in Zanzibar for the purchase of *Thenus orientalis*.

Imports
Tanzania has not recorded any imports of lobster since 1992, however this survey revealed that Mozambique supplies Tanzania with lobsters via Mtwara. Lobsters are then transported by air to Dar es Salaam. The volumes traded from Mozambique are unknown.

Exports
While mainland Tanzania does not record lobster landings, statistics are available for exports from both the mainland and from Zanzibar. It is extremely likely that the figures presented are underestimates. For example, the total reported exports from Tanzania to Kenya between 1992 and 1997 were 120 kg in 1996, yet many hotels and restaurants in Kenya report purchasing lobsters of Tanzanian origin. It is evident that trade between the two countries is significant but poorly documented. Available export figures are presented in Tables 7, 8 and 9.

The major importing nations during 1992 and 1997 have been Portugal (39.4%), United Kingdom (18.4%), Italy (9.8%) and Hong Kong (8.4%). Smaller quantities are exported to other European and African countries. In general, export quantities have increased from 8.4 mt in 1989 to 36 mt in 1997 with some fluctuation (Anon., 1989; Anon., 1990b; Anon., 1991; Anon., 1992; Anon., 1993; Anon, 1994; Anon., 1997b). Over 51 mt was exported in 1996.

Table 7
Lobster exports (kg) from mainland Tanzania by country of import, 1992-1997

COUNTRY	1992	1993	1994	1995	1996	1997
Belgium		1,528.0	3,230.7	1,085.0		
Botswana	100.0		80.0		970.0	1,020.0
Burundi	100.0	365.0	100.0	80.0		
Canada		5.0				
Ethiopia						454.0
Europe				3.0		
France	1,270.0	1,000.0				
Germany			24.0			
Greece	774.0		60.0	1,242.0		2,120.0
Hong Kong			20.0		1,620.0	9,051.0
Italy	2,500.0	2,469.0		3,532.0	3,808.0	90.0
Kenya					120.0	
Korea				8.0		
Malawi	210.0			60.0		30.0
Mauritius	70.0			240.0		4,276.0
Netherlands					315.0	
Portugal				3,926.0	38,874.8	7,260.3
Rwanda						22.0
Saudi Arabia						10.0
Spain						2.0
South Africa				820.0		
UAE	1,400.0			3,160.0	11.0	
UK	515.0	1,112.0	1,008.0	7,021.0	4,834.0	8,866.0
USA					6.0	
Uganda	605.0	125.0	39.0	190.0	265.0	615.0
Zambia					150.0	800.0
Zimbabwe	500.0		32.0			
Unspecified	50.0	651.0	20.0		60.0	
TOTAL	**8,094.0**	**7,255.0**	**4,613.7**	**21,367.0**	**51,033.8**	**34,616.3**

Source: Anon., 1997b.

A total of 4,420 live lobsters were exported from Tanzania mainland between 1992 and 1997 with large annual fluctuations (Table 8). Hong Kong has been the main recipient of these exports in the last two years.

Table 8
Live lobster exports (pieces) from Tanzania mainland, 1992 to 1997

COUNTRY	1992	1993	1994	1995	1996	1997
Hong Kong					670	1210
France		100				
Italy		1720				
Netherlands				270		
Uganda		300				
UK						150
TOTAL	0	2120	0	270	670	1360

Source: Anon., 1997b.

Exports of lobster from Zanzibar have fluctuated between 0.7 mt and 8.3 mt per annum during 1974 and 1997 with the exception of years 1992 and 1993 when exports increased to 11.7 mt and 23 mt respectively. It can be seen that only a low proportion of the landings on Zanzibar (Table 6) are exported, reflecting the high demand by lodges and hotels on Zanzibar. Zanzibar fisheries statistics do not specify the destination country.

Table 9
Lobster exports (mt) from Zanzibar, 1974 -1982, and 1990 - 1997

YEAR	QUANTITY	YEAR	QUANTITY
1974	4.2	1990	7.4
1975	2.3	1991	1.7
1976	7.2	1992	11.7
1977	4.3	1993	23.0
1978	8.3	1994	1.0
1979	4.0	1995	3.6
1980	3.0	1996	3.1
1981	4.4	1997	0.7
1982	2.5		

Source: Anon., 1998a; Zanzibar Fisheries Corporation (ZAFICO), 1997.

Import data from EU countries is shown in Table 10. Import data were not available for any other countries (although import statistics for Japan were reviewed and no imports were reported from Tanzania). The EU import data show an increase in imports from 0.7 mt in 1990 to 24.5 mt in 1995, and dropping to 11.0 mt in 1997. For most years the majority of imports are frozen with the exception of 1993. These import data illustrate the discrepancies that exist between importing and exporting countries, in that in 1995 reported exports to EU countries were 16.8 mt while reported imports were 24.5 mt. In 1996, reported exports were 47.8 mt and reported imports were 16.8 mt. In 1997 exports were reported at 18.3 mt and imports at 11.0 mt. As most trade is in frozen lobsters it is possible that some exports may not be reported as imports until the following year, but at the same time it is apparent that there are discrepancies on both sides.

Table 10
Lobster imports to EU countries from Tanzania, 1990-1997 (mt)

PRODUCT	1990	1991	1992	1993	1994	1995	1996	1997
Frozen	0.7	1.8	3.7	6.1	8.5	23.0	16.8	11.0
Frozen - 1						7.8	2.1	7.9
Frozen - 2						15.2	14.7	3.1
Unfrozen			0.5	10.0	6.1	1.5		
TOTAL	**0.7**	**1.8**	**4.2**	**16.1**	**14.6**	**24.5**	**16.8**	**11.0**

Source: Eurostat data.
Note: Categories for "Frozen-1" and "Frozen-2" were introduced in 1995 and when totalled equal the category "Frozen".

Key: Frozen = "030611" Frozen rock lobster and other sea crawfish, whether in shell or not, incl. rock lobster and other sea crawfish in shell, cooked by steaming or by boiling in water.
Frozen - 1 = "03061110" Frozen crawfish **tails**, whether in shell or not, incl. crawfish tails cooked in shell, cooked by steaming or by boiling in water.
Frozen - 2 = "03061190" Frozen rock lobster and other sea crawfish "Palinurus spp., Panulirus spp. And Jasus spp.", whether in shell or not, incl. rock lobster and other sea crawfish in shell, cooked by steaming or by boiling in water (excl. crawfish tails).
Unfrozen = "03062100" Rock lobster and other sea crawfish, whether in shell or not, incl. in shell, cooked by steaming or by boiling in water (excl. frozen).

Legislation
According to *The Fisheries Act, 1970*, and the *Fisheries (General Amendment) Regulations, 1997*, separate licenses are required for traders (fishermen, collectors and dealers) and for exporters of lobsters (Table 11).

Table 11
Annual license fees (USD) for collection/fishing/dealing and export of lobsters from Tanzania

Type of License	Local individual/ company with approved shore based fish processing facilities	Local - individual/ company without approved shore based fish processing facilities	Foreigner - individual/ company with approved shore based fish processing facilities	Foreigner - individual/ company without approved shore based fish processing facilities
Collection, fishing, or dealing license	4.00	6.00	400.00	Prohibited
Export licence	30.00	33.00	400.00	

Source: Fisheries (General Amendment) Regulations, 1997.
Note: License fees are quoted by Tanzania in USD.

Table 12
Indicative Export Prices (IEP) for lobsters, 1996

Item	Grade	IEP (USD/kg)
Live lobsters		15.00
Frozen whole		7.00
Frozen tails	2-4 cm	8.00
	4-6 cm	9.00
	6-8 cm	9.50
	8-10 cm	10.50
	10-12 cm	12.50
	12-14 cm	14.00
	above 14 cm	15.00

Source: Indicative Export Prices for Fishery Products, dated 27 December 1996, Ministry of Natural Resources and Tourism.

The most recent Indicative Export Prices (IEP) for Fishery Products were issued in 1996 and are used as a minimum price gauge for calculating the Freight on Board (FOB) and royalty (5%) for all lobster exports. It can be seen that the IEP are similar to the exporters' buying prices, with the exception of live lobsters whose IEP value is approximately twice that of the exporters' buying price.

In addition, every district has its own Municipality tax. For example, lobster traders in Mafia District paid TSH 300/kg up until 1996 (Anon., 1996), but since 1997 have paid 5% buying price.

There is no Tanzania legislation specific to the lobster resource although size restrictions are to be incorporated into the Fisheries Act currently under revision (J. Rono, pers. comm. to S. Milledge, 1998). The use of harpoon guns and spear guns is banned under the *Fisheries Principle Regulations, 1989.*

Conservation Implications

The major concern affecting the Tanzania lobster fishery is that small specimens and gravid females continue to be traded. Observations of lobster catches from 15 different landing sites along the Tanzania coastline revealed lobster catches consisting of considerable numbers of small specimens weighing less than 500 g. While some exporters have a minimum required size limit of between 300 and 500 g, small lobsters are often sold to hotels, lodges or at local markets. Greater attention needs to be paid to the conservation implications of continued harvest of immature specimens.

According to the fishermen interviewed, large lobsters over one kg are still available throughout Tanzania waters except around Dar es Salaam. Forty-one out of 54 lobster fishermen (76%) believed that the average size of lobsters has not changed much in the last five years. All eight fishermen interviewed in Dar es Salaam, however, believed that lobsters in nearby waters were both rarer and smaller than five years ago.

It seems that lobsters around Dar es Salaam have been severely depleted whilst fishing grounds in southern Tanzania still contain viable numbers, mostly due to lower fishing pressure resulting from the logistical difficulties mentioned above. A major threat to lobster habitat is dynamite fishing which has devastated large areas of coral reef. The situation around Dar es Salaam suggests the need to have greater restrictions on fishing activities, perhaps a closed season, although more information is needed to substantiate such recommendations. There is a need to carry out resource assessments along the Tanzania coastline, to conduct research on lobster recruitment, and to analyse lobster catches by species and size composition. Furthermore, data gathering and management could be improved and expanded to include recording of lobster landings on the mainland, scrutiny of export data (especially on Zanzibar), and refinement of data categories in order to ascertain whether consignments/exports are comprised of whole lobsters or tails only.

THE LOBSTER FISHERY IN MOZAMBIQUE

Current Fisheries

Mozambique's lobster fishery consists of an artisanal sector targeting spiny lobsters (*Panulirus* spp.), and an industrial offshore fishery (both directed and by-catch) which catches *Palinurus delagoae*, and the langoustines *Metanephrops mozambicus* and *Nephropsis stewarti*.

Artisanal Sector

Spiny lobsters are exploited by artisanal fishermen in rock or coral regions along the entire length of the Mozambique coast. In 1994, the potential lobster resource was estimated at about 150 mt (Anon., 1995b). The main areas supporting lobsters are located in the northern provinces of Cabo Delgado and Nampula, as well as the southern province of Inhambane (Dionisio and Munguambe, 1993), at a depth of 5 to 15 m. During this survey four species were identified as being commercially important in the country, and are listed in Table 13.

Table 13
Presence and abundance of *Panulirus* spp. identified in trade in Mozambique, 1998

SPECIES	NORTHERN MOZAMBIQUE	SOUTHERN MOZAMBIQUE
Panulirus homarus	Present (Holthuis, 1991)	Abundant
Panulirus ornatus	Abundant	Abundant
Panulirus penicillatus	Present	Abundant
Panulirus versicolor	Present (Holthuis, 1991)	Present

Source: TRAFFIC survey data.

The number of lobster fishermen is currently unknown, as many operate without licenses. Lobster fishing is undertaken individually or in a group, and the most prevalent method is with a spear. Most fishermen do not have boats. Although lobsters occur in most places along the coast, lobster fishing is generally restricted to locations where tourists are found, or where there is an established trade and processing system. In general, fishermen do not have any facilities for preserving lobsters, and must sell their catch immediately to hotels or dealers. Lobsters deteriorate rapidly (i.e. they turn black) if not prepared properly or transported rapidly.

Lobster fishing is also carried out by boat owners who often operate with as many as 12 fishermen aboard. Fishermen use rudimentary diving equipment and spears made from local materials to harvest lobster, and fishing takes place for about 18 days per month. In the region of Mozambique Island, the average lobster catch per man per day is about 2.5 kg. In northern Mozambique, lobsters are only caught during the rainy season, however in Inhambane the best months for this resource are March to November, which corresponds to the dry season. In some locations lobster fishing is undertaken on order, usually from hotel owners but also from permanent buyers. Most boats have some sort of facility for processing the catch. This entails decapitating, cleaning, and immersing the animal for five minutes in a solution of metabil sulfate before cooling/freezing. With proper processing the product can be exported, which yields higher earnings.

Official landing records indicate that catches have decreased over time, however this information should be viewed with caution. It is likely that catch data are incomplete, due to lack of reporting, both intentional and out of ignorance. At the same time, it is possible that official data do reflect a real decline in the lobster resource. For example, in the region of Inhassoro, fishermen gradually moved to areas more distant from the landing site because of local depletion. Catch reduction can be caused by other factors though, such as a lack of buyers or necessary facilities for processing the catch, which in some areas (such as Mozambique Island and Angoche) has led to the abandonment of the industry. Catches can rise dramatically as well, as evidenced in June 1998 when a new buyer appeared in the region and indicated his willingness to purchase as much as 100 kg per day.

Table 14
Landings of *Panulirus* spp. (mt) in Mozambique by province, 1990-1994

PROVINCE	1990	1991	1992	1993	1994	TOTAL
Cabo Delgado	--	0	--	0	1	1
Nampula	203	2	26	6	12	249
Gaza	--	2	--	--	--	2
Inhambane	28	1	3	12	--	44
Maputo	--	1	30	93	121	245
TOTAL	231	6	59	111	134	541

Source: Anon., 1995b.

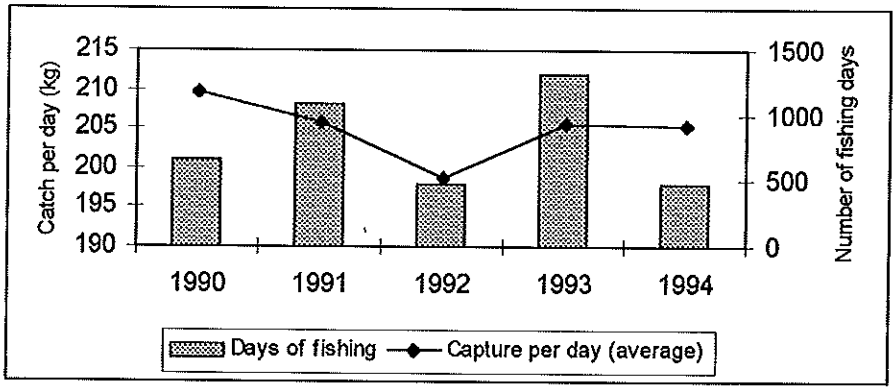
According to Table 14, the northern province of Nampula yields the highest percentage of the artisanal lobster catch. It has been reported that lobsters caught in this region are generally large in size, while in the south there are frequent reports of small specimens, some as small as 5 cm carapace length. This could be an indication of overfishing in the south.

Industrial Sector
Mozambique's deep water lobster catch results from both a directed fishery and as by-catch from the prawn fishery. The most important species caught is the deep water spiny lobster species *Palinurus delagoae,* with the majority of trawls aimed at the 200 to 400 m depth range. In 1994 potential production was estimated at 400 mt. *Palinurus delagoae* occurs south of 17° latitude and prefers a muddy substrate with an optimum depth of 260 to 300 m, although juveniles often occur at 400 m, and the species has been recorded from trawls at 600 m (Berry, 1971; Groenveld and Melville-Smith, 1995). Also important in the lobster fishery are the langoustines, which are considerably smaller than spiny lobsters. The main species caught is *Metanephrops mozambicus,* although the less commercially significant *Nephropsis stewarti* also appears in the catch. These species are caught in trawls at a depth of about 400 m. Both of these species are often recorded in official data as deep water prawns, thereby complicating analysis of catch and trade figures for lobsters.

According to Sousa (1996), only one vessel was specifically targeting *Palinurus delagoae* during the period from 1980 to 1992, although at present two vessels are operating, one of which is a Japan-Mozambique joint venture. These vessels use a cage to harvest the lobsters from the ocean floor. Fishing effort is directed at southern areas and primarily those south of 22° latitude (Brinca and Palha de Sousa, 1984). Catches and catch rates are seasonal, with the highest yield occurring between March and September (Groenveld and Melville-Smith, 1995). While surveys of the trawl off Mozambique and South Africa for the period 1988 to 1993 indicate that *cpue* as well as overall catches

have increased (Groenveld and Melville-Smith, 1995), some fishing enterprises have experienced declines in average daily yields in recent years. Data from one of Mozambique's major fishing enterprises are presented in Figure 2.

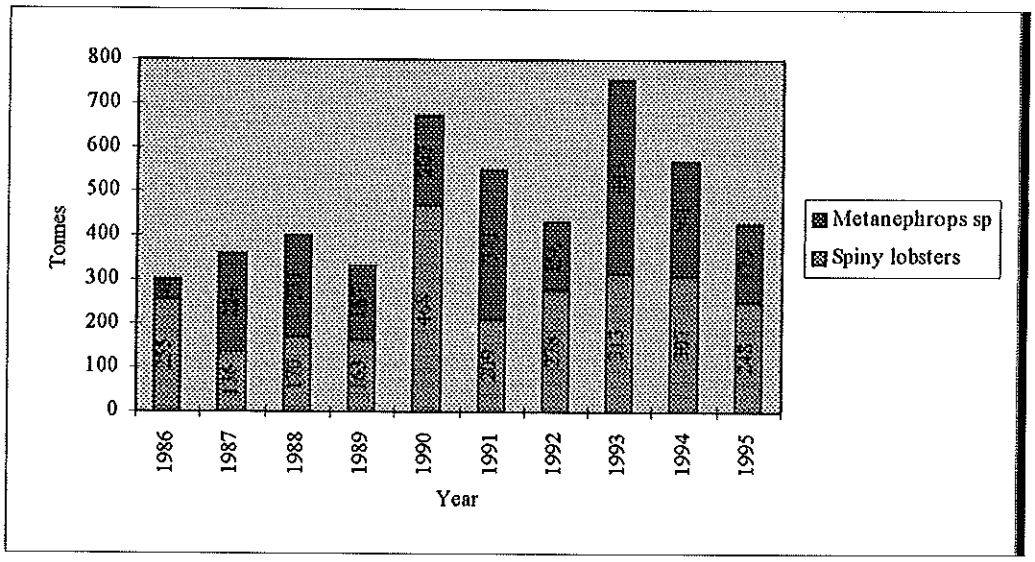
Figure 2
Relationship between the fishing effort (days) and the average daily yield, reported by one fishing enterprise



Source: Direcçao Nacional de Pesca data.

Data on production of spiny lobsters (*Palinurus delagoae* and *Panulirus* spp.) and *Metanephrops mozambicus* in Mozambique are presented below in Figure 3.

Figure 3
Landings of spiny lobsters and *Metanephrops mozambicus* in Mozambique, 1986-1995



Source: Anon., 1997a.
Note: Metanephrops mozambicus is reported as *M. andamanicus* in FAO statistics although it is acknowledged that the correct name should be *M. mozambicus* (M. Perotti/FAO, *in litt.* to N. Marshall, 1998).

Spiny lobster landings are comprised of the artisanal catch of *Panulirus* spp. and the industrial deep water catch of *Palinurus delagoae*. In general, it appears that catches have increased since 1987, which could be attributed to a rise in the number of vessels operating in the area, or to increased effort by prawn trawlers, although catches have declined in recent years.

Trade

Lobster is a high value marine product in Mozambique. Its high market price restricts local consumption and as a result most lobster is exported. Spiny lobsters harvested from inshore waters are occasionally available at local markets, but deep water *Palinurus delagoae* is generally exported. Prices for lobsters vary considerably by region, and in 1998 *Panuliris* spp. were found to cost USD 2.50/kg in Nampula, USD 5.00/kg in Inhambane and USD 6.00-13.00/kg in Maputo. The higher price in Maputo is attributed to proximity to the tourist market.

Exports

On the national level, lobster is the country's third most important export, following cashew nuts and prawns (INE, 1996). The principal importer of Mozambican lobster is Japan, followed by the EU. South Africa also imports small quantities although during this survey it was not possible to gather import data from this country. There are reports that portions of the artisanal harvest in Nampula and Cabo Delagado of spiny lobster are exported to Denmark. Export figures and reported imports into Japan and the EU are presented in Table 15. Exports of lobster from Mozambique have ranged in volume from 320 mt in 1989 to about 120 mt reported as imported in 1997. Japan is the most significant importer of Mozambican lobster (Table 15). It is apparent that exports have declined since 1995, but the reason for this is unclear.

Table 15
Exports and reported imports of Mozambican lobster (mt), 1986-1997

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
MZ exports	320	262	170	162	242	243	174	n/a	n/a
EU imports	n/a	7.8	0.6	2.2	21.2	93.1	54.1	59.7	25.4
JP imports	n/a	208.9	167.4	153.0	210.9	153.0	148.5	139.7	94.8
TOTAL imports	n/a	216.7	168	155.2	232.10	246.1	302.6	199.4	120.2

Source: Anon., 1995b; Eurostat data; Japan Customs Statistics, in H. Kiyono, *in. litt.* to N. Marshall, 23/9/98.

Legislation and Management

Under Mozambique's fisheries legislation, *Lei das Pescas, no. 3/90,* licenses are required for those wishing to undertake fishing activities in Mozambican waters. Industrial fishing licenses are issued by the National Directorate of Fisheries (DNP). Artisanal fishing licenses are also required, and DNP has delegated authority to issue these licenses to the local Marine Administrations. This law requires that all industrial fishing enterprises submit their daily vessel records to the Fisheries Research Institute. This measure does not apply to artisanal fishing activities.

Specific reference to lobster is made in the *Regulamento da Pesca Maritima, 1996,* which supplements *Lei das Pescas, no. 3/90.* In Article 103, minimum size limits are given for lobsters, crabs and bivalves, and prohibited activities for undersized specimens are listed. The minimum legal size for a lobster (referring to the spiny lobsters *Panulirus* spp.) is five cm carapace length , and if decapitated, 1.5 cm width for the second segment of the tail. Regulation of the minimum size requirement for *Panulirus* spp. is hampered by lack of control or inspection in certain regions of the country. Some fishermen operating along Mozambique's southern coast (Inhassoro) report that the number of fishermen has risen each year, with the result being increased pressure on the resource, which is reflected in a decrease of average daily yields.

Management measures addressing lobsters have been few in Mozambique, although there have been attempts at participatory management in Inhambane Province since 1996. For example, in 1996 in Inhassoro, an experimental four months' closed season from 1 May until 1 September was agreed upon by fishermen and the provincial fisheries authorities; this initiative was not well adhered to however due to lack of consensus among fishermen, as well as lack of controls to ensure effective implementation. A 1997 initiative also failed, due to absence of scientific support for the decision. Most recently, fishermen and provincial fisheries authorities decided to set a closed season from 1 November 1998 to 29 February 1999, in order to allow successful lobster spawning. Local fishermen, with the assistance of a local NGO, have agreed to collect biological data on effort, catch, and size to ascertain whether the time period selected is the most appropriate for a closed season (Santana Afonso, 1998).

Additional management efforts include a project which began in 1987 in the Ibo region aimed at developing the live lobster fishery, increasing exploitation of the resource through identification of new fishing grounds, and exploring development of the industry using artisanal fishing methods. This project was implemented by the Institute of Small-Scale Fisheries Development, and coordinated by the Ministry of Agriculture. During this project satisfactory catches were recorded using traps made of bamboo, however the project ceased due to lack of financial resources.

Management of the deep water lobster resource has not been extensive, although a 1980 resource evaluation concluded that the annual catch should not exceed 400 t, and that fishing should be performed with cages. This evaluation was based on estimating the potential yield with mortality and biomass data (Brinca and Palha de Sousa, 1984).

Conservation Implications
During this survey there have been reports of local depletions of spiny lobsters, as well as reports of declines in sizes. Methods of harvest, e.g. with a harpoon, are not conducive to a high market price and also contribute to spoilage if processing is not undertaken immediately. Overexploitation and wastage is therefore apparent in certain areas of the inshore fishery. Attempts at management, through participatory co-management between local communities and fisheries authorities, have not been successful to date but could be promising and should be encouraged. Use of closed seasons and involvement of fishermen in collection of relevant catch, effort and biological data would be extremely helpful in ensuring the long-term viability of this lucrative industry.

THE ORNAMENTAL SEASHELL FISHERY

International trade in shells involves a huge number of species, possibly as many as 5,000 (Wood and Wells, 1995). The trade can be categorized into the commercial shell trade, which includes shellcraft and mother of pearl, and the ornamental shell trade, which is characterized by trade in whole shells for decorative purposes, shellcraft, and as collector's items (Wells, 1989). The main markets for ornamental shells are USA, Japan, Taiwan, Canada and Europe, while for commercial shell (consisting largely of unworked mother of pearl) the main importers are Japan, South Korea, Singapore, Taiwan and Hong Kong (Wood and Wells, 1995). Most ornamental shells are gastropods, while commercial shells are often bivalves. Commercial or industrial uses of shells vary, but include additives in floor tiles, pottery, toothpaste, and poultry feed because of the concentration of calcium carbonate. Shells are also dredged up for construction of roads and buildings (Wells, 1981; Wood and Wells, 1995). Global trade in shells is difficult to quantify, as much of the harvest is artisanal, and data that do exist are frequently an amalgamation of products (Wood and Wells, 1995). The world's main shell suppliers in 1985 were found to be the Philippines, Indonesia, Thailand, Singapore, Taiwan, India, Mexico and Haiti, although some of Singapore's and Taiwan's exports may actually be re-exports. Africa appears to play a minor role in the global shell trade, although this fact does not diminish the importance of this trade to local economies or the conservation implications for the resource.

THE SEASHELL FISHERY IN KENYA

Current Fisheries
Kenya has a large artisanal shell fishery which is mainly directed at the tourist industry. As a prime beach destination for vacationers from Europe, shells have been collected and sold to tourists for decades. As early as the 1970s concern was voiced about declines in shell populations and the impact of this trade on Kenya's reefs (Evans *et al.*, 1977). Kendall (1985) reported significant reductions in shell populations and a trend towards importing shells from Somalia and Tanzania, and even suggested the need for an export ban. During this survey it was found that the shell fishery remains an important source of income for Kenya's coastal communities, despite continuing reports of resource depletion.

Interviews with over 310 fishermen along the entire length of Kenya's coastline revealed that shell collection is undertaken by men, women and children. While women and children often set out exclusively with the aim of shell collecting, shells are also harvested whenever they are spotted and therefore represent an added benefit for fishermen targeting other marine resources such as sea cucumbers, lobsters and finfish. Shells are traditionally collected at low tides by walking on reef flats or by snorkelling, but increasingly scuba gear is used to harvest shells from deeper waters. Collection occurs throughout the year, but is more prevalent from April to September when fishermen are restricted to inshore activities because of rough seas.

A wide variety of shells are collected from Kenyan waters, and collection takes places along the entire coastline. However, there is a notable concentration of collection of cowries on the South Coast at Kibuyuni, and also in the Lamu archipelago. Table 16 lists some of the main species collected.

Table 16
Some shell species traded in Kenya

Atrina vexillum	*Cypraea mappa*	*Lambis crocata*
Bursa bulbo	*Cypraea mauritiana*	*Lambis lambis*
Cassis cornuta	*Cypraea moneta*	*Lambis truncata*
Charonia tritonis	*Cypraea talpa*	*Mactra sp.*
Chicoreus ramosus	*Cypraea testudinaria*	*Ovula ovum*
Conus imperialis	*Cypraea tigris*	*Pleuroploca trapezium*
Conus litteralis	*Cypraecassis rufa*	*Stombus sp.*
Conus marmoreus	*Drupella rugosa*	*Tonna canaliculata*
Conus striatellus	*Glycymeris sp.*	*Tonna galea*
Cyprae histrio	*Harpa harpa*	*Tridacna squamosa*
Cypraea annulus	*Harpa major*	*Turbo marmoratus*
Cypraea caputserpentis	*Isognomon ephippium*	*Vasum turbinellus*
Cypraea lamarckii	*Lambis chiragra*	

Source: TRAFFIC survey data.

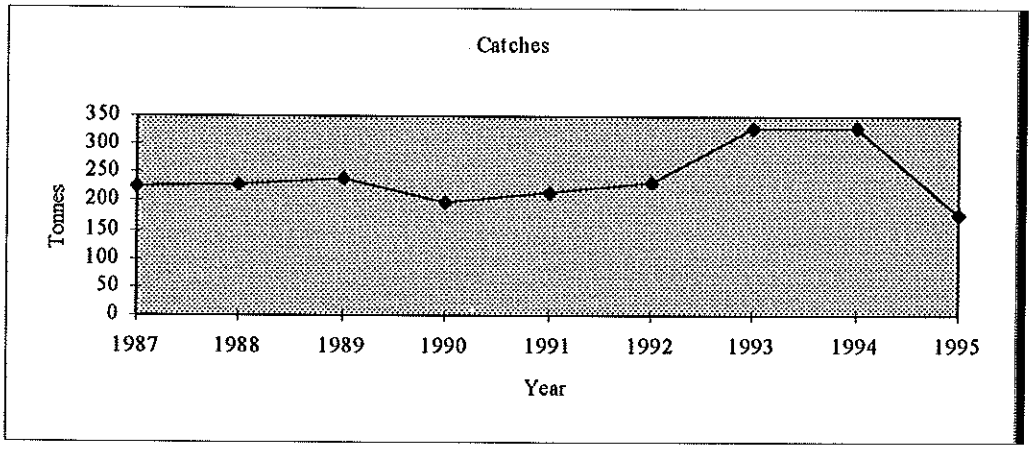
Fishermen report size declines in some shell species, in particular *Cypraea lamarkii,C. mappa, C. tigris, Harpa harpa,* and *Ovula ovum*. The Giant Triton *Charonia tritonis* and the Tiger Cowrie *Cypraea tigris* were reported as being less abundant than in the past.

Overall production of shells in Kenya is poorly documented. The fishery is artisanal and most sales are small-scale to tourists, and occasionally to dealers and exporters in Mombasa. Catch data are available from FAO and are listed in Figure 4. There is also some information on quantities transported from Lamu to Mombasa, which provide an additional indication of harvest. Data collected by the Fisheries Department from movement passes reveal that in March 1998 1,005 kg of shells were transported to Mombasa from Lamu. In April the amount was 420 kg, and in June the amount was 1,000 kg. No data were available for May 1998.

Trade
Local shells as well as those imported from neighbouring countries and even the Caribbean, the Philippines, Australia and Sri Lanka have been observed in curio shops over the years (Evans *et al.*, 1977). Shells collected by fishermen are sold in established curio shops along the coast, in market stalls in urban areas, and also by vendors who walk along the beaches carrying baskets of shells that they open for tourists to view and buy. Curio shops and most stalls are operated by licensed dealers, while the majority of beach vendors are unlicensed and are selling shells illegally. During this study, interviews were carried out with vendors of shells in Mombasa as well as at selected beach sites on the south and north coasts where tourists were prevalent, to identify shells sold and perceptions of scarcity. Efforts to determine which species were the most popular and sold in the largest volumes were hampered by extremely low sales in 1998 due to greatly reduced tourist arrivals. Therefore, most vendors complained of lack of business, and were unable to gauge volume of sales. It was stated though that *Cypraea annulus* is sold in enormous quantities for use in jewellery and other forms of decoration. This species occurs in very large numbers and there appears no cause for concern to the species. One other species, Tiger Cowrie *Cypraea tigris* was mentioned as being extremely popular among tourists and is also valued locally for decorative purposes. Reports of scarcity of this species varied and it was not possible to verify any decrease in supply.

Some vendors were able to list species that they felt were not available in as large sizes as they were in years past. These species are: *Bursa bulbo, Cassis cornuta, Charonia tritonis, Cypraecassis rufa, Lambis* spp., and *Tridacna squamosa.*

Figure 4
Catches of marine shells in Kenya, 1987-1995



Source: Anon., 1997a.

Imports
Reports of imports from Somalia and Tanzania are extremely frequent, although there are no official trade data to verify this claim. Species reported to originate from Somalia include *Lambis chiragra, L. crocata* and *L. truncata.* Species originating from Tanzania include *Cassis cornuta, Charonia tritonis, Conus marmoreus, Cypraea mappa, Cypraea* spp., *Cypraecassis rufa, Drupella rugosa, Isognomon ephippium,* and *Lambis* spp.

Exports
Kenya has exported shells for decades, however, the species composition of the exports is unknown (Table 17). Quantities exported vary considerably from year to year, and reports from traders indicate that this is due to fluctuations in the market and status of economies in importing nations. For example, it was reported that exports of ornamental shells were declining, due to economic woes in Europe. Nevertheless, official export figures indicate that despite fluctuations, exports remain substantial. While some traders report the origin of shell exports to be from Kenya, this is refuted by Fisheries Department officials who state that it is likely that nearly 90% of Kenya shell exports originate in Tanzania.

Table 17
Exports of marine shells from Kenya (mt), 1987-1997

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Quantity	80	n/a	242	n/a	216	232	24	33	258	152	214

Source: Fisheries Department data.

Legislation and Management
Under *The Fisheries Act, 1991*, fishermen and boats are required to have licenses. Specific reference to shells is made under the subsidiary legislation, Part III of *The Fisheries (General) Regulations*, which states that licenses are required for any individuals collecting or dealing in shells. Furthermore, an export license is required for an individual exporting "shell, cowries or corals", as per *The Imports, Exports and Essential Supplies (Exports) (Amendment) Order, 1991.* According to the Kenya Fisheries Department, individuals are allowed to take up to five kg of shells out of the country, but an export license is required, and shells must be purchased from a licensed dealer. Kenya is a Party to CITES (effective 13 March 1979) and therefore is required to issue CITES export permits for any shell species listed in the Appendices.

Management measures for the shell resource have been minimal in Kenya, although in Kilifi District a total ban on collection and trade in sea shells and sea shell products has been imposed by the Kilifi District Development Committee. This moratorium has reduced collection in the area, but the effects of this action on the resource are unknown.

Conservation Implications
Kenya has heard reports of seashell declines for years, and this during this survey these concerns continued to be voiced. Fishermen and vendors reported difficulties in encountering certain species, increased imports from Somalia and Tanzania and in particular Zanzibar, as well as reductions in size of some of the more commercially valuable species. At the same time, it appears that a large number of people continue to derive benefits from the seashell resource, and the impact of shell collection is unclear. A survey comparing shell densities in protected and unprotected areas carried out by McClanahan (1989) indicates that while the three protected areas surveyed (Kisite, Watamu and Malindi Marine Parks) support a higher density and diversity of commercially collected species, that the difference between these areas and unprotected sites is not statistically significant. It is also suggested that differences may be due to other factors including that populations in protected areas may not have recovered yet, poaching may be taking place in protected areas, and sampling may have been undertaken at sites and at times that might not have yielded accurate findings. MacClanahan (1989) does state that it is clear from the survey that most commercial shell species in the survey area occur at naturally low densities.

While the effect of shell collecting on the resource is subject to debate, local community management of the coastal zone and its marine resources should be encouraged at the very least to improve conservation of the reef habitat. This tactic would be beneficial to the heath of the area in general, and would also assist in ensuring better conservation and management of the seashell resource.

THE SEASHELL FISHERY IN TANZANIA

Current Fisheries
Tanzania's seashell fishery is artisanal, and is primarily carried out by women or by fishermen on an opportunistic basis while fishing for octopus and other marine resources. Collection is generally undertaken at low tide or during spring tides by skin-diving, and occasionally at night using lamps to glean the intertidal zone and exposed coral. Seashell collection is not the main source of income for most coastal peoples, and in Mafia Island it was noted that seashell collection involved low numbers of people, most of whom collected as their third job activity (Andersson and Ngazi, 1995).

The number of species collected and traded in Tanzania is large. Collection occurs for a number of reasons, such as sales to tourists or exporters, but also for food. Certain species of nutritional value have valuable shells (e.g. *Cypraea tigris*, *Chicoreus ramosus* and *Pleuroploca trapezium*).

One of the most important species is *Cypraecassis rufa*. This species is usually collected at low tide, often at night when they can be found on top of coral. The best season is April to October during the southeast monsoon, especially at low spring tides. Marketable specimens must be very clean, devoid of breaks, cracks and rough surfaces, and be without a black line on the orange lip. As with most shells, they are buried in sand for a week or two to rot, and are then cleaned thoroughly prior to sale. On Songo Songo, shell collection is dominated by *Cypraecassis rufa*, with fishing taking place approximately 14 days per month with an average daily catch of 10 kg per person (Darwall, 1996).

Neither Tanzania mainland nor Zanzibar report landings of seashells. However, from interviews carried out along the coast and islands, the main collection areas are the coral reefs around Mafia Island, Songo Songo, the Kilwas, Unguja and Pemba.

Trade
Seashells are both sold locally and exported. In Tanzania, seashell curios are available in hotel gift shops as well as in local markets. They may be sold as decorative shells, or fashioned into items such as ashtrays, picture frames and lamp holders. Seashells are purchased by tourists, residents and exporters. The largest shell market in Tanzania is at the Dar es Salaam fish market where over 30 shell vendors based at 13 stalls operate on a daily basis. A detailed

survey of the stalls revealed a total of 53 genera and 116 species on sale, including 23 species of *Conus* and 19 species of *Cypraea* (Table 17). However, small numbers of undocumented rare species are reported to be sold to specialist shell collectors. The total number of shells counted was 22,659 which included approximately 18,000 *Cypraea annulus* shells, mostly made into necklaces. Other species traded in large numbers included *Oliva lignaria* (syn. *O. ornata*) (663 specimens), *Harpa armouretta* (509), *Cypraea lynx* (390), *Cypraea tigris* (306) and *Conus generalis* (212). Vendors have a tendency to specialise in particular species.

Smaller markets are found in Tanga and Zanzibar Town. The Tanga market has only two stalls selling shells, whereas before 1997 there were four. Lack of buyers has prompted traders to switch to other merchandise. The Tanga vendors displayed significant quantities of *Cypraea tigris* and *Tonna perdix*, along with small numbers of *Cypraecassis rufa*, *Lambis lambis* and *Cassis cornuta*.

In 1989, the curio shells of most commercial importance were *Turbo marmoratus* (TSH 3,000-5,000/kg), *Cypraecassis rufa* (TSH 500 each), *Cypraea tigris* (TSH 50 each) and *Cypraea moneta* (Horrill and Ngoile, 1991). Currently, the shells of highest value are the rare collectors' items which can command very high prices.

Table 18
Shell species traded at Dar es Salaam fish market, 1998

Aequipecten opercularis	*Cymatium pileare*	*Mitra mitra*
Anadara maculosa	*Cypraea annulus*	*Mitra stictica*
Bolinus brandaris	*Cypraea arabica*	*Murex troscheli*
Bulla ampulla	*Cypraea caputserpentis*	*Mytilus perna*
Bursa bubo	*Cypraea carneola*	*Nautilus pompilius*
Bursa granularis	*Cypraea caurica*	*Nerita undata*
Casmaria erinaceus erinaceus form *vibex*	*Cypraea cinnerea*	*Neritina paracella*
Cassis cornuta	*Cypraea helvola*	*Oliva lignaria*
Cerithium nodulosum	*Cypraea histrio*	*Ovula ovum*
Charonia tritonis	*Cypraea isabella*	*Paphia amabilis*
Chicoreus palmarosae	*Cypraea lamarckii*	*Pinna inarwa*
Chicoreus ramosus	*Cypraea lynx*	*Piscania ignea*
Clanculus puniceus	*Cypraea mappa*	*Plicarcularia pullus*
Codakia orbicularis	*Cypraea moneta*	*Pterygia nucea*
Conus anemone	*Cypraea oryx var. adusta*	*Purpura persica*
Conus arenatus	*Cypraea talpa*	*Pyrene rustica*
Conus betulinus	*Cypraea testudinaria*	*Rhinoclavis sinensis*
Conus capitaneus	*Cypraea tigris*	*Spondylus barbattus*
Conus circumactus	*Cypraea vitellus*	*Strombus gibberulus gibberulus*
Conus ebraeus	*Cypraecassis rufa*	*Strombus lentiginosus*
Conus episcopus	*Dentalium vernedei*	*Strombus variabilis*
Conus figulinus	*Distorsio anus*	*Tectus dentatus*
Conus generalis	*Drupa morum*	*Terebra areolata*
Conus geographus	*Drupa rubusidae*	*Terebra crenulata*
Conus leopardus	*Duplicaria duplicata*	*Terebra dimidiata*
Conus lipidus	*Fasciolaria trapezium*	*Terebra maculata*
Conus marmoreus	*Fucinus colus*	*Terebra subulata*
Conus miles	*Harpa armouretta*	*Terebralia palustris*
Conus rattus	*Harpa articularis*	*Thais armigera*
Conus regius	*Harpa major*	*Tonna galea*
Conus striatus	*Lambis chiragra arthritica*	*Tonna perdix*
Conus suturatus	*Lambis crocata*	*Tridacna squamosa*
Conus textile	*Lambis lambis*	*Turbo argyrostomus*
Conus vexillum	*Lambis truncata truncata*	*Turbo marmoratus*
Conus virgo	*Lopha cristagalli*	*Turbo petholatus*
Conus zeylanicus	*Macinella macinella*	*Vexillum caffrum*
Cymatium parthenopeum	*Malea pomum*	

Source: TRAFFIC survey data.

Imports
Large quantities of shells, in particular *Cypraecassis rufa* and opercula, are known to come from Mozambique but are unrecorded as imports.

Exports
Shell exports from Tanzania have been dominated by the following species: *Turbo marmoratus, Cypraecassis rufa, Charonia tritonis, Cassis cornuta, Lambis* spp., *Murex* spp. and *Chicoreus* spp., *Ovula ovum, Cypraea tigris, Cypraea moneta, Cypraea annulus*, and the opercula from several species.

In 1990, 1.5 mt of *Turbo marmoratus* was exported and although traders claim to have exported since then, export statistics do not always list to species level. Prices in 1989 ranged between TSH 3,000 and TSH 5,000 per kg, rising to TSH 10,000 in 1995. The distribution of *Turbo marmoratus* is limited to deep water under coral and in crevices. According to traders, numbers of *Turbo marmoratus* have declined and this species is now rare being found mostly in the Kilwa area.

Cypraecassis rufa are sold in three grades depending on the thickness of the lip and overall density. Although weighing scales are rarely used in grading, Grade 1 specimens are reported to always weigh more than 500 g. Traders claimed the best grade specimens weighing between 750 g and one kg per piece come from Mozambique. The buying and selling prices for *Cypraecassis rufa* are shown in Table 19. Prices are reported to be highest in Mombasa, Kenya. Exporters prefer to buy the top two grades and Grade 3 specimens which have low profit to exporters are normally sold to tourists at market stalls. Thus, there were no Grade 1 specimens on sale at either Dar es Salaam or Tanga market shell stalls because they are sold directly to exporters.

Table 19
Buying and selling prices for different grades of *Cypraecassis rufa*, 1998

Grade	Buying price from fisherman per piece (USD)	Selling price to exporter per kg (USD)
1	0.40-0.80	1.50-4.60
2	0.20-0.50	0.80-2.30
3	0.10-0.20	0.20-0.60

Source: TRAFFIC survey data.

Grade quality does not necessarily reflect size since many Grade 1 specimens are smaller than lower grades. Lip size and overall density are probably a reflection on environmental conditions. Traders estimate that approximately 20 to 25% specimens traded are Grade 1, 25 to 30% are Grade 2 and 50% are Grade 3. The sales records of one trader in Kilwa showed that from a consignment of 1,957 kg *Cypraecassis rufa* sold to Mombasa in 1997, 756 kg (39%) were Grade 1.

Opercula are the horny or calcareous "trapdoor" attached to the animal's foot. They are removed easily by cutting off or boiling the shellfish in water. They are dried before weighing. Most opercula come from two species, *Chicoreus ramosus* and *Pleuroploca trapezium*, which sell at USD 12.00 to USD 23.00/kg (dry weight). Two smaller species, *Volema pyrum* and *Vexillum rugosum* are traded in much lower quantities at USD 7.60/kg. Small quantities of *Lambis lambis* are also traded. Webb (1948) notes that opercula of *Turbo* spp. are called "cats eyes", and are polished for jewellry. Some are brilliant deep green while others are white or with a granular surface. However, opercula of *Turbo* spp. were not reported in trade during this study. Jiddawi and Muhando (1995) report that the opercula of *Chicoreus ramosus* sell for around USD 50.00/kg in the Middle East.

During this survey it has been difficult to ascertain the exact use of opercula. Opercula are reportedly used in perfumeries in India (F. Hanfee, *in litt.* to N. Marshall, 1998), and are also referred to in the Judaic Talmud (Chapter 30:34) as a sweet-smelling ingredient in incense (A. Gaski, *in litt.* to N. Marshall, 1998).

Export statistics are available from both Tanzania mainland and Zanzibar, and are presented in Tables 20 and 21.

Table 20
Shell exports (mt) from Tanzania mainland, 1989-1997

TANZANIA MAINLAND EXPORTS	1989	1990	1991	1992	1993	1994	1995	1996	1997
India				25.8	111.5		36.0	75.0	142.0
United Kingdom					67.2	13.6			
Uganda						68.5			
Hong Kong						40.0			15.4
Italy				5.1				20.0	21.7
Singapore				15.2					4.0
Pakistan							18.0		
Germany				0.5					
UAE				0.04				0.2	
Unknown				2.3	4.6				
TOTAL	60.58	55.00	25.78	48.94	183.3	122.1	54.0	95.2	183.1

Source: Statistics Department, Fisheries Division, Tanzania mainland.

Shell exports from Tanzania mainland have fluctuated since 1989 reaching a low of 25.8 mt in 1991 and a high of 183.4 mt in 1993. The majority of shell exports are destined for India (57%). Exports to Italy are believed to consist primarily of *Cypraecassis rufa*. Tanzania mainland statistics lack detail on shell type with the exception of 68.5 mt "shell covers" (i.e. opercula) exported to Uganda in 1994. However, interviews with traders suggest that the majority of shells traded to India are a mixture of cowrie species.

Table 21
Shell exports from Zanzibar, 1990-1997

ZANZIBAR EXPORTS	1990	1991	1992	1993	1994	1995	1996	1997
Other shells	60.0	83.0	32.0	40.9		40.0	40.0	26.3
Opercula	82.2	4.0	2.7	0.1		0.1	1.3	0.4
Mussels/oysters	0.2	0.05	0.06		1.2			
Cypraecassis rufa	1.2		0.5				0.6	0.8
Cowrie shells			0.05		0.8			2.2
TOTAL	143.6	87.5	35.3	41.0	2.0	40.1	41.9	29.7

Source: Anon., 1998a.

Zanzibar fisheries statistics classify five different kinds of exported shells: 1) *Cypraecassis rufa*; 2) mussels and oysters; 3) opercula; 4) cowries and; 5) other shells. Most exports are classified as either shells or opercula. Closer analysis of export records for the period 1995 to 1998 indicates that the majority of shell exports were to India, but consignments of *Cypraecassis rufa* went to Mombasa. Almost all exports of opercula from Zanzibar were destined for Dubai, with small quantities to Mombasa and India. Traders claimed that the Zanzibar market for opercula is greater than Dar es Salaam because exporters living on Zanzibar tend to have stronger trade links with Arabic countries.

There were no data from importing countries for comparison with the exception of EU countries. Although these data group coral and shells together, discrepancies are highlighted in data recording with underreporting from Tanzania. For example, Tanzania reported exports to European countries (UK, Italy and Germany) of 5.5 mt, 67.2 mt and 13.6 mt during 1992, 1993 and 1994 respectively, considerably lower values than those seen in Table 22.

Table 22
Coral and shell imports to EU countries from Tanzania, 1990-1997 (t)

Category	1990	1991	1992	1993	1994	1995	1996	1997
Coral and similar materials, shells of molluscs, crustaceans or echinoderms, thereof, unworked or simply prepared but not otherwise worked or cut to shape.	26.8	8.1	29.7	105.7	99.8	113.3	10.5	31.7

Source: Eurostat data.

Legislation
The Fisheries Act, 1970, specifies that separate licences are required for traders (fishermen, collectors and dealers) exporters of seashells. The fees are identical to those for lobsters.

The Wildlife Conservation (Specified Activities) (Amendment) Government Notice No. 188, 1993, declares that a Certificate of Ownership is required for keeping shells. There are two fee rates, USD 1.50 for keeping a single shell and USD 2.00 for keeping a set of shells. However, in practice this regulation is rarely adhered to.

The most recent Indicative Export Prices for Fishery Products were issued in 1996 and are used as a minimum price gauge for calculating the Freight on Board (FOB) and royalty (5%) for all shell exports (Table 23). There is need for revision of the Indicative Export Prices for shells since many commercially important species are not included, nor are opercula.

Table 23
Indicative Export Prices (IEP) for shells, 1996

Item	IEP (USD/kg)
Mother of Pearl	2.00
Turbo marmoratus (Green snail)	10.00
Cypraea tigris Tiger Cowrie	3.50
Other cowries	0.50

Source: Indicative Export Prices for Fishery Products, dated 27 December 1996, Ministry of Natural Resources and Tourism.

Municipality tax varies in each district. In Mafia District, the Bullmouth Helmet *Cypraecassis rufa* and mussels are subject to municipality tax of 5% of the buying price (Anon., 1996).

Tanzania is a Party to CITES (effective 27 February 1980) and therefore is required to issue CITES export permits for any shell species listed in the Appendices.

Conservation Implications
Minimal work has been carried out to assess the shell resource in Tanzania although fishermen, traders, and recreational divers claimed that numbers have dropped in the last five years throughout Tanzania. The most affected species are the larger predatory species, *Lambis lambis, Cassis cornuta,* and *Charonia tritonis.* Traders report a more reliable supply of opercula, *Cypraecassis rufa*, cowrie and cone shells, and demand has continually been met. For example, according to Zanzibar fisheries statistics, 90.8 mt of opercula were exported during the years 1990 to 1997. Given that an estimated 200-500 opercula weigh one kg, this represents between 18 and 45 million individuals, a seemingly massive quantity although they are still eaten and traded in large quantities.

The exact status of wild populations of *Lambis lambis, Cassis cornuta,* and *Charonia tritonis* is unknown although the level of threat posed by commercial collection is thought to be detrimental. Resource assessments are needed as is a greater understanding of their role in the coral ecosystem. These larger species prey upon sea urchins and starfish and their removal may have far reaching ecological effects. Reef mortality due to the presence of large numbers of Crown of Thorns Starfish, *Acanthaster planci*, has been observed in Tanga region (UNEP, 1989). This may have been brought about by the overcollection of *Charonia tritonis.* Indeed, no *Charonia tritonis* were recorded on sale at the Tanga market suggesting a very low supply. At the same time, McClanahan (1989) suggests that starfish overpopulation may be due to overfishing of finfish, rather than gastropods.

Given that there is a decline is large specimens of some species, it may be appropriate to develop and implement certain controls relating to harvest. In order to ascertain appropriate size restrictions, more research is needed on the relationship between shell growth and age, environmental conditions and maturity. Long-term monitoring of the catches and sales of these larger species is advised, and could be carried out at the main market stalls to establish the number and size of specimens in trade.

THE SEASHELL FISHERY IN MOZAMBIQUE

Current Fisheries

The seashell fishery in Mozambique is artisanal. The catch can be divided into three use categories: 1) ornamental seashells collected by fishermen and other individuals who sell to tourists, collectors and exporters; 2) seashells harvested on a subsistence basis for their meat, with the shells being sold to tourists; and 3) seashells of nutritional value harvested for commercial trade, e.g. bivalves (oysters and mussels), whose shells may also be sold for construction and crafts purposes. Collection and sale of seashells in Mozambique is unregulated, and there are numerous curio shops in the country which offer seashells. Seashells and the products derived from them are purchased domestically as well as by foreign tourists in the case of ornamental shells. The shell fishery has not received a high level of attention in the country's fisheries sector strategy, largely due to its insignificant impact on the national economy.

Shell collection is carried out by several different groups of people in Mozambique. The largest group consists of women and children who scour seagrass banks and benches at low tide. In general, this activity is geared toward collecting invertebrates on a subsistence basis, with no specific resource targeted. Seashells are collected as they are encountered, with most ornamental shells harvested for their meat, and the valuable shells later sold to tourists. Other groups include the bivalve collectors targeting oysters, clams and mussels for commercial sale. These fishermen operate between tides, and harvest ornamental shells opportunistically at low tide. Ornamental seashell by-catch is also apparent among fishermen whose primarily fishery is finfish, lobster, sea cucumbers, ornamental fish or other marine resources, and shells are collected as a secondary activity. A directed seashell fishery exists on a small scale, and consists mostly of divers harvesting in deeper waters around corals, rocks and in channels. These divers by and large operate on a contract basis with vendors, collectors and exporters. Finally, tourists and in-country hobbyists collect shells; this group of collectors is minimal compared to the others mentioned above.

Areas of shell collection are typically those supporting corals, with the most noted areas being Cabo Delgado and Nampula, and especially the northern islands. In the south, key areas include Inhaca, Inhambane and Bazaruto. Zones supporting corals are particularly important for the harvest of commercially valuable shells such as cowries *Cypraea* spp., the Horned Helmet *Cassis cornuta*, Giant Clam *Tridacna* spp., and the Giant Triton *Charonia tritonis*. Sandy zones surrounding coral reefs yield Bullmouth Helmet *Cypraecassis rufa*, some species of cowries and cones *Conus* spp., Branched Murex *Chicoreus ramosus*, and Venus Comb *Murex pecten*. The littoral zone is the source of many of the commerically important bivalves, as well as harp shells *Harpa* spp., olives *Oliva* spp., and spiders *Lambis* spp.

The number of individuals involved in the shell fishery in Mozambique is unknown. Nevertheless, it is evident that the average daily harvest is strongly influenced by the environment and the presence and abundance of species. Although the activity is predominantly of a subsistence nature, this survey has revealed that collection levels are increasing. At present it is estimated that shell collection is carried out approximately 15 days per month by those active in the fishery. The number of species collected and traded is large; species identified during this survey are presented in Table 24.

Seashells destined for sale as curios are usually bought live from fishermen by middlemen, who prepare the shells by placing them in a dark area to spoil, or by burying them in the sand for two to three days. The shells are then washed in salt water, dried in the sun, and then washed in fresh water (tap water). Liquid paraffin or bleach is sometimes applied to preserve the shells.

Trade

Shells are collected and traded for a variety of purposes in Mozambique. The largest use is collection for meat, and subsequent sale of the shell if it is valuable. On the local level, some species of shell are used and traded for traditional medicine. For example, *Nautilis pompilius* is in demand by people of Asian origin; the price for one shell can be USD 60.00. Small shells such as cowries are used on a large scale by national craftsmen for manufacture of earrings, chains and bracelets. Large-sized shells are also used in craft work. *Cassis cornuta* in particular is valued for making illumination lamps. Seashells are also used in construction and road building, and in Bazaruto, *Pinctata imbricata* is used for these purposes. This species is also the focus of a small business enterprise aimed at pearl production.

Table 24
Seashell species identified in trade in Mozambique, 1998, with indications of abundance

SPECIES	ABUNDANCE	SPECIES	ABUNDANCE
Architectonica laevitaga	+	*Cypraea histrio*	++
Architectonica modesta	+	*Cypraea isabella*	+++
Architectonica perspectiva	+	*Cypraea lamarckii*	+++
Architectonica picta	+	*Cypraea lynx*	+++
Argonauta argo	+	*Cypraea mappa*	++
Cassis cornuta	+++	*Cypraea mauritiana*	+
Charonia tritonis	+++	*Cypraea onyx adusta*	+++
Chicoreus ramosus	+++	*Cypraea scurra*	+
Chlamys senatoria	+	*Cypraea talpa*	+
Conus betulinus	++	*Cypraea tigris*	+++
Conus chaldaeus	++	*Cypraea vitellus*	+++
Conus ebraeus	+++	*Cypraea zlczac*	+
Conus episcopus	Rare	*Cypraecassis rufa*	+++
Conus figulinus	Rare	*Fusinus sp*	+
Conus generalis	+++	*Harpa amouretta*	+
Conus geographus	+	*Harpa harpa*	+
Conus leopardus	++	*Harpa major*	+
Conus litteratus	+	*Harpa ventricosa*	+
Conus pennaceus bazarutensis	Rare	*Lambis chiragra*	+
Conus praelatus	++	*Lambis crocata*	++
Conus quercinus	Rare	*Lambis digitata*	++
Conus striatellus	Rare	*Lambis lambis*	++
Conus striatus	+	*Lambis scorpio*	++
Conus terebra	Rare	*Lopha cristagalli*	+++
Conus tessulatus	+	*Murex pecten*	+
Conus textile	++	*Nautilus sp*	+
Conus tulipa	Rare	*Oliva oliva*	+
Conus virgo	++	*Oliva tigrina*	+
Cymatium pileare	+	*Ovula ovum*	+++
Cypraea annulus	+++	*Phalium areola*	+
Cypraea arabica	+++	*Phalium glaucum*	+
Cypraea caputserpentis	+++	*Strombus aurestiana*	++
Cypraea carneola	+++	*Strombus gibberulus*	+
Cypraea clandestina	+++	*Strombus lentiginosus*	++
Cypraea diluculum	Rare	*Tridacna maxima*	++
Cypraea erosa	+++	*Tridacna squamosa*	+
Cypraea helvola	+++		

Source: TRAFFIC survey data.
Note: +++ Very abundant, ++ Abundant, + Present

The most important shell collection areas in Mozambique are located in the north, and include Cabo Delgado (Mocimboa da Praia, Ilha do Ibo), Ilha de Mozambique and Nacala. During this survey eight shell vendors operating in Maputo were interviewed about source, and it was found that 100% of the seashells offered for sale originated in Ilha de Mozambique and Nacala. Shells are usually purchased from fishermen by buyers who can be placed in one of three categories. The first is the buyer who is resident in fishing areas, who usually purchases shells directly from fishermen; this individual is considered to be a middleman and in turn sells shells to buyers linked directly with commercial enterprises. Second, there are buyers who are linked into a well-established commercial trade network, some of whom own craft workshops or export businesses. Lastly, there are buyers associated with large export companies or craft workshops; these buyers travel to source areas to purchase large quantities of shells.

Scientific information on the status of most of the seashells identified during this survey is incomplete and largely unknown. In an effort to understand more about the value of seashells to local economies, price information was collected, and where possible was correlated to shell size. Table 25 presents data on price variation at different stages of the commercialization process, and reveals that the prices paid to fishermen are well below those further along the chain. Sampling of three shell species sold at vendors' stalls in Ilha de Mozambique was conducted, with prices per size recorded. The results of these samples are presented in Figures 5, 6 and 7.

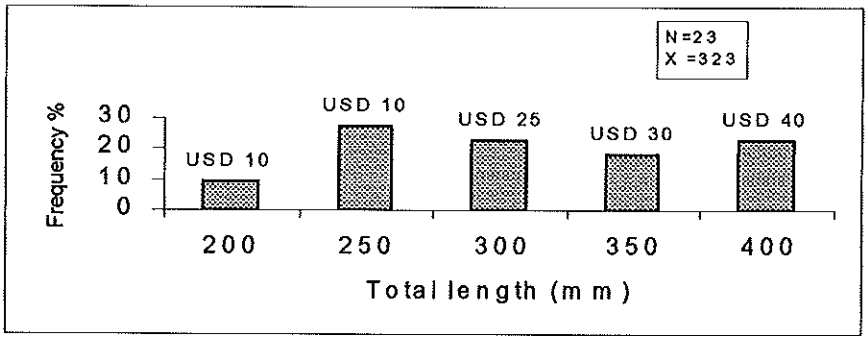
Table 25
Prices (USD) charged at various levels in the seashell trade in Mozambique, 1998

SPECIES	FISHERMAN	TRADER	CURIO SHOP
Tridacna sp.	3.00	80-100.00	17-80.00
Cassis cornuta	3-15.00	18.00	20.00
Cypraea tigris	0.30	1-4.00	1.00
Cypraecassis rufa	3-14.00	5-17.50	n/a
Charonia tritonis	3-5.00	10.00	25-40.00
Conus sp.	0.10	0.40-2.00	1-2.00
Lambis sp.	0.50	0.50-1.50	1.50-2.50
Fusinus sp.	1.00	n/a	4.00
Ovula ovum	0.30	0.40-0.80	0.80

Source: TRAFFIC survey data.

Giant Triton *Charonia tritonis*
This species inhabits shallow water coral reefs. It has been known to reach a size of 390 mm (Fisher *et al.*, 1990). From a sample of 23 specimens, the size range was found to be between 210 and 430 mm. The highest percentage of specimens occurred between 250 and 400 mm, and the average size was 323 mm. It was learned that the price paid to fishermen is fixed at about USD 3.00 to USD 5.00, while traders set prices for specimens according to size class.

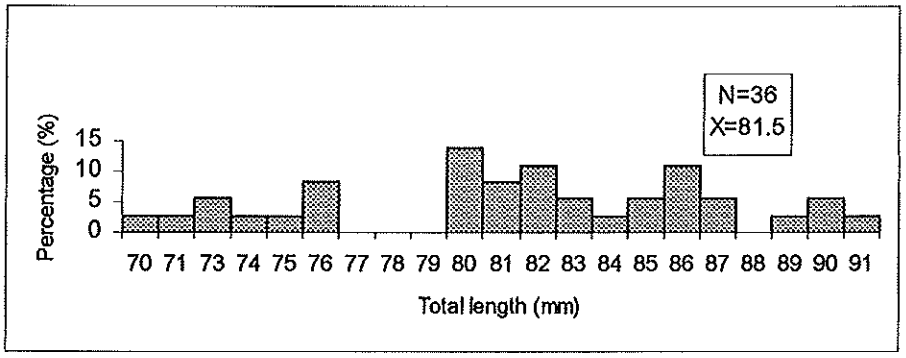
Figure 5
Relationship between total length (mm) and price (USD) of *Charonia tritonis*, Ilha de Moçambique, 1998



Source: TRAFFIC survey data.
Note: N = number of specimens in the sample; X = average length of specimens.

Tiger Cowrie *Cypraea tigris*
Found in the littoral and sub-littoral zones in the sand between rocks and corals, this species is often encountered in pairs or in groups (Fisher *et al.*, 1990). This species can reach up to 100 mm in length. Out of a sample of 36 specimens, the maximum size was 91 mm and the minimum was 70 mm. Specimens were most common between 80 and 87 mm, and the average was 81.2mm. The price for this species is not size-dependent, probably because of the limited variation of the observed sizes.

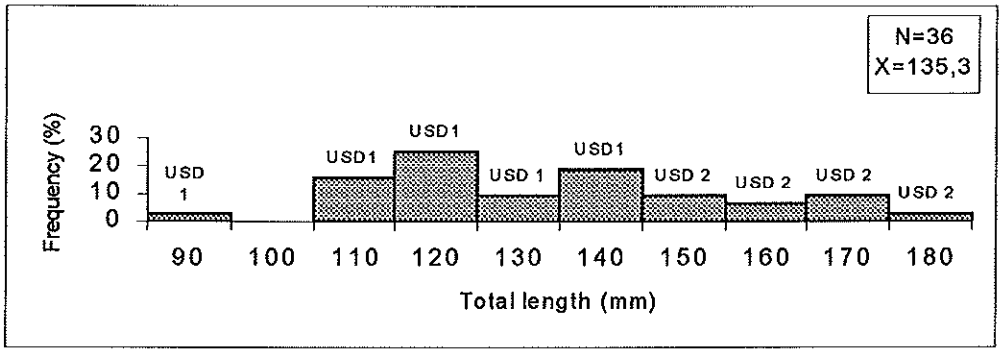
Figure 6
Size sample (mm) of *Cypraea tigris*, Ilha de Mozambique, 1998



Source: TRAFFIC survey data.
Note: N = number of specimens in the sample; X = average length of specimens.

Bullmouth Helmet *Cypraecassis rufa*
Inhabiting sandy bottoms close to coral reefs, this species may grow to 17 cm in length (Fisher *et al.*, 1990). The shell is characterised by its external lip having strong teeth and bending up to the animals' frontal part. According to local fishermen and exporters, price is determined by weight and by the lip character. Male shells have a completely bent lip whereas the female's lip is not completely bent. Males generally command a higher price than female shells; males are sold by weight at about USD 10.00/kg, while females are sold by unit for USD 1.00 to USD 2.00 each. From a sample of 36 female seashells, the minimum size registered was 92 mm, the maximum was 184 mm, and the average size was 135.3 mm.

Figure 7
Size (mm) and price (USD) relationship for female *Cypraecassis rufa*, Ilha de Mozambique, 1998



Source: TRAFFIC survey data.
Note: N = number of specimens in the sample; X = average length of specimens.

The size of the shell specimens sampled in Ilha de Mozambique are regarded as being quite large, and therefore could indicate that the stock is substantial. However, analysis of these figures must be undertaken with some caution, as different environmental and geographical factors can determine the abundance and sizes of the resources. The absence of historical scientific data pertaining to these resources does not allow a more detailed interpretation of the subject.

Exports
It is difficult to quantify the volume of shell exports from Mozambique, due to incomplete data recording, as well as data reporting which is often general rather than species-specific. Exports are often recorded together with corals and non-ornamental shells such as abalone and other bivalves. Nevertheless, there are some exports recorded to the genus

and species level. Certificates for the export of shells are issued by the National Directorate for Forests and Wildlife, and these have been reviewed for the period 1994 to 1997. Permits are issued for shell exports, and CITES export permits accompany exports of Giant Clam *Tridacna* spp., which is included in Appendix II of the Convention.

While no permits were issued for the export of ornamental shells in 1994, a total of 33 certificates were issued in 1995. Permits are issued either by weight in kg, or by unit. In 1996, only one firm was registered for a period of six months, during which time four seashell certificates were issued. In 1997, only one certificate was issued for 200 *Cassis cornuta* shells; this quantity was exported to Spain (DNFFB permit data). Non-CITES shells exported under certificates are presented in Table 26, while Table 27 lists exports of the Appendix II Giant Clam.

Table 26
Certificates issued by the National Directorate of Forests and Wildlife for non-CITES species

1995 exports by UNIT		1995 exports by KG		1996 exports by UNIT		1997 exports by UNIT	
Bursa sp.	1,171						
Cassis cornuta	6,157					*Cassis cornuta*	200
Charonia tritonis	1,119	*Charonia tritonis*	5,000	*Charonia tritonis*	650		
Conus sp.	1,388						
Cypraea sp.	5,246						
Harpa sp.	5,444	*Harpa sp.*	8,778				
Lambis	546						
		Mitras	4,054				
Murex	14,133						
Ovula ovum	190						
		Strombus	120				
Turbo sp.	8						
TOTAL	**35,402**		**17,952**		**650**		**200**

Source: DNFFB data.

Table 27
Exports of Giant Clam *Tridacna* sp. from Mozambique, 1995 and 1996

YEAR	SPECIES	IMPORTER	AMOUNT	TOTAL
1995	*Tridacna squamosa*	Portugal	2,985 kg	
	T. squamosa/maxima	Portugal	2,000 kg	
	Tridacna sp.	Portugal	296 kg	
	Tridacna maxima	Spain	5,000 kg	
	Tridacna maxima	Spain	10,000 kg	
	Tridacna squamosa	Italy	200 units	
	Tridacna squamosa	Italy	10,000 kg	
	Tridacna squamosa	Italy	10,000 kg	
	Tridacna squamosa	USA	10,000 kg	50,281 kg and 200 units
1996	*Tridacna* sp.	Italy	20,000 kg	20,000 kg

Source: DNFFB data.

It is thought that formerly there were three firms in Mozambique that exported seashells, all of which were based in Nacala. According to recent interviews, only one of these companies is still operating. The number of exporters, and the quantity exported have decreased in recent years. Some companies in fact note that trade is now irregular, and that exports only occur on order, usually from buyers based in Portugal or Italy (Department of Commerce, Nacala, pers. comm. to P. Santana Afonso, 1998). One company in Nacala reportedly possesses about 25 mt of *Cypraecassis rufra*, which is in storage due to lack of a market. This company is no longer buying this species, but continues to trade in other species of seashells.

Based on the above figures and information from interviews, it would appear that trade in seashells from Mozambique is decreasing. However, import data for the EU indicate otherwise (Table 28). It should be noted that both import and export data include products other than ornamental shells, so these data should be taken with some caution. At the same time, it is evident that Mozambique's reported exports are well below what is actually being exported.

Furthermore, it is possible that other countries are importing shells and shell products from Mozambique, however, during this survey it was not possible to collect these data.

Table 28
Volume of imports (mt) of seashells and corals imported into Europe

YEAR	IMPORTS
1990	63.6
1991	57.7
1992	0
1993	20.0
1994	116.2
1995	79.4
1996	309.6
1997	57.6

Source: Eurostat data.
Note: Quantities refer to Code 0508, coral and similar materials, shells of molluscs, crustaceans or echinoderms, cuttlebone, powder and waster thereof, unworked or simply prepared but not otherwise worked or cut to shape.

The main countries importing seashells from Mozambique are Portugal, Italy, Spain, and the USA.

There is also reported to be a trade in the opercula of several species, especially *Lambis chiragra*, *Lambis lambis* and *Chicoreus ramosus*. Prices are reportedly about USD 20.00/kg of dried material. Opercula are exported unofficially (illegally) to Tanzania. The utility of this product in Mozambique is unknown.

Illegal Trade
There is evidence of illegal trade in seashells and opercula between Mozambique and Tanzania. Trade links between the two countries became more frequents during the 1980s when Mozambique experienced economic hardship. At that time, Tanzanians would travel south with consumer goods such as food and clothing, and trade these items for marine products (sea cucumbers, shark fin and seashells). The presence of Tanzanians remains in northern Mozambique, and a number of these individuals are involved in the business of transportation, an enterprise that is often associated with the commercialisation of marine resources. At present there are no data to quantify the level of illegal trade in marine products from Mozambique to Tanzania, yet there are numerous anecdotal reports of this activity.

Legislation/Management
Shell collection in Mozambique is regarded as being a subsistence activity, and no permits are required.
Trade is, however, regulated by the Ministry of Commerce. This Ministry issues licenses for sale and export of shells. Mozambique is a Party to CITES (effective 23 June 1981), which is relevant in that Mozambique has recorded exports of Giant Clam *Tridacna* spp. which is included in Appendix II of the Convention. CITES is implemented by the National Directorate of Forests and Wildlife (DNFFB) who issue all CITES permits and certificates.

In Bazaruto National Park, efforts are aimed at prohibiting the collection and trade of four species in particular, *Conus pennaceous*, *Charonia tritonis*, *Cassis cornuta*, *Tridacna squamosa* and *Tridacna maxima* (DNFFB, 1995, pers. comm. to P. Santana Afonso, 1998).

Conservation Implications
Seashells are more abundant in Mozambique than either Tanzania and Kenya and therefore are likely to be subject to increasing exploitation as supplies diminish further north. Indeed, there is already evidence of illegal trade of seashells and opercula into Tanzania. In order to conserve this resource which is undervalued by the Mozambican government, resource surveys and management plans should be undertaken in the near future.

THE HOLOTHURIAN FISHERY

Holothurians, also known as sea cucumbers or sea slugs, comprise one of six classes belonging to the Phylum Echinodermata. The Class Holothuroidea consists of approximately 1,400 species, with about 80 species occurring in the waters of the Western Indian Ocean (Richmond, 1997). All commercial species traded from East Africa belong to two families (Holothuriidae and Stichopodidae) within the order Aspidochirotida. A total of 24 species from six genera were identified in trade during this survey (Table 29).

Table 29
Sea cucumber species traded in East Africa, 1998

SCIENTIFIC NAME	COMMON NAME	KE	TZ	MZ	DEPTH	SUBSTRATE	VALUE (see note)	NO. /KG
Actinopyga echinites	Deep Water Red Fish	Y	Y	Y	Lower eulittoral, common on reef crests	Rock, algae	2	10-30
Actinopyga mauritiana	Surf Red Fish	Y	Y	Y	Lower eulittoral and deeper	Rock, coral	2	10-30
Actinopyga miliaris	Black Fish	Y	Y	Y	Shallow sublittoral		2	10-30
Bohadschia argus	Leopard Tigerfish		Y		Shallow sublittoral	Sand, seagrass, reef	3	10-20
Bohadschia marmorata			Y	Y			3	10-20
Bohadschia subruba		Y						
Holothuria atra	Lollyfish / Black Fish	Y	Y	Y	Shallow sublittoral	Sand	3	5-20
Holothuria cinerascens			Y		Shallow to deep water	Sand, lagoons, rock	3	20-30
Holothuria edulis	Pink Fish	Y	Y		Shallow	Various	3	10-60
Holothuria fuscogilva	White Teat Fish	Y	Y	Y			1	3-5
Holothuria fuscopunctata	Elephant Trunkfish		Y				3	10-60
Holothuria impatiens		Y						
Holothuria leucospilota			Y				3	10-60
Holothuria nobilis	Black Teat Fish	Y	Y	Y		Seagrass, coral	1	3-5
Holothuria parva			Y		Mid eulittoral	Boulders, fine sand and mud	3	10-60
Holothuria scabra	Sand Fish	Y	Y	Y	Lower littoral and deeper	Sand	1	A:6-12 B:30,C:60
Holothuria spinifera		Y	Y				1	9-12
Pearsonothuria graeffei			Y		Shallow	Reefs, coral	3	10-60
Stichopus chloronotus		Y	Y	Y			3	10-60
Stichopus variegatus	Curry Fish		Y	Y	Shallow	Sand, coral	2	10
Thelenota ananas	Prickly Red Fish	Y	Y	Y	Shallow	Reef, rubble	2	6-10
Thelenota anax	Amberfish		Y		Shallow	Reef, and on sand and rubble	3	1-2

Source: Richmond, 1997; TRAFFIC survey data.
Note 1: The column entitled VALUE refers to price variations. No. 1 indicates 1998 selling prices of more than USD6.00/kg (TSH 4,000/kg), no. 2 indicates selling prices of USD3-6.00/kg (TSH 2-4,000/kg), and no. 3 indicates prices of less than USD3.00/kg (TSH 2,000/kg).
Note 2: For *Holothuria scabra* three figures are given for the number of individuals per kg. "A" refers to Grade 1, the highest quality grade, "B" refers to Grade 2, and "C" refers to Grade 3.

Note 3: In Tanzania, a further two species of *Holothuria*, and one species of *Bohadschia* were reported in trade but not identified to species level. In Kenya, one unidentified species of *Bohadschia* was reported in trade.

The holothurian fishery mostly involves the export of the dried product, called beche de mer, trepang or hai-som. Beche de mer is the cured body wall of the sea cucumber and is considered a delicacy in some Asian countries. The Chinese in particular have sought sea cucumbers for over one thousand years in India, Indonesia and the Philippines (Conand and Byrne, 1993). The popularity of sea cucumbers is growing in the West as a dietary supplement.

Sea cucumbers are also harvested for their longitudinal muscles and viscera. In Japan and Korea, holothurians are eaten fresh, boiled or pickled in a mixture of vinegar and soya sauce. Other organs, including ovaries, intestines and respiratory tress, are considered delicacies (Conand, 1989). Historically, *yujo*, or Japanese sex professionals, were supposed to know that "dried rings of beche de mer could be fitted over a penis like a French tickler" (Dalby, 1985).

The annual world holothurian catch is approximately 120,000 mt (wet weight), valued at USD 60 million (Conand, 1998). World holothurian fisheries may be divided geographically and by species. Tropical sea cucumber fisheries involve the export of dried beche de mer originating from numerous species, whilst temperate fisheries primarily involve fresh or frozen products from one or two species (Conand and Byrne, 1993).

In the western central Pacific Ocean, the major beche de mer producers are the Philippines, Indonesia and Malaysia, and harvesting involves a number of species. Indonesia and the Philippines are the largest beche de mer producers in the world. Production in the Indian Ocean can be divided between the Western Indian Ocean (South Africa, Mozambique, Tanzania, Kenya, Yemen, United Arab Emirates and Madagascar) and the Eastern Indian Ocean (India and Sri Lanka). *Holothuria scabra* dominates these fisheries (Conand, 1989).

Beche de mer from East Africa is intermediate in value between the high value products of Japan and the South Pacific, and the lower value products from the Philippines and Indonesia (Conand and Byrne, 1993; Conand, 1998). *Stichopus japonicus* is the species caught in the largest quantities worldwide, followed by *Holothuria scabra* (Conand, 1989). The two main market centres are Hong Kong and Singapore with the latter a major destination for Western Indian Ocean beche de mer (Conand and Byrne, 1993).

Table 30
Annual global catch, including quantities (mt) for Kenya, Tanzania and Mozambique, 1989-1995

YEAR	GLOBAL CATCH	AREA 51 CATCH	KE	TZ	MZ	REGIONAL TOTAL
1989	8,289	991	79	324	--	393
1990	10,401	1,327	86	167	--	253
1991	12,502	1,719	78	426	5	509
1992	10,684	1,467	277	535	--	812
1993	9,776	1,646	14	980	0	994
1994	12,726	3,652	41	1,590	0	1,631
1995	12,317	3,275	55	1,460	6	1,521

Source: Anon., 1997a.
Note: Area 51 comprises the Western Indian Ocean from 30°E to 80°E, and from the coast of Saudi Arabia to India south to 45°S.

Sea cucumbers only live in the marine environment, but can be found at all depths from the poles to the tropics. They occur in a variety of habitats including coral reefs, seagrass beds, algae, rubble, sand and mud tidal flats. Conand (1989) reports that species diversity, density and biomass values increase with the gradient from the open sea to the coast, and from outer slopes to inner reef flats.

Holothurians are generally cylindrical and elongated, with variable dorsal-ventral flattening, colouring and overall size. Sea cucumbers have a very basic body form consisting of an anterior mouth surrounded by a crown of between 10 and 30 retractable tentacles, a posterior anus, and tube-feet. The order Aspidochirotida have ventral tube feet for locomotion and modified, sensory, dorsal tube feet (Richmond, 1997). The skeleton is composed of microscopic

ossicles of varying structure. Body size varies by species but ranges in length from between 10 and 80 cm. Longitudinal and circular muscles within the body wall allow for considerable changes in body shape (Richmond, 1997).

Respiration is achieved by passing water in and out of the cloaca where the respiratory tree is located. Species of *Bohadschia* and *Holothuria* have defensive organs called "cuvierian tubules" which can be everted through the cloaca and anus to entangle and poison predators. Other species contain a poison called holothurin. Holothurians are known to be preyed upon by 19 species of fish including sharks and trigger fish, gastropods including triton and tun shells, loggerhead turtles and starfish (I. Horsfall, *in litt.* to S. Milledge, 1998; Conand, 1989). Some sea cucumbers even eviscerate when disturbed, expelling their internal organs which are later regenerated. *Holothuria scabra* harbours a species of crab as a commensal (Anon, 1985).

Holothurians are deposit or suspension feeders and use their mouth tentacles to trap passing plankton or, depending on the species, to sweep up substrate. Substrate particle size also varies with species, for example *Pearsonothuria graeffei* filters small particles whilst *Holothuria edulis* and *Stichopus hermanii* filter larger-sized particles (Solandt, 1998).

Holothurians have very high fecundity, sometimes reaching several million oocytes and as with most "broadcast" spawners, holothurian recruitment requires adequate adult stock to increase the success rate of fertilisation (Solandt, 1998). However, information on recruitment, growth and mortality are poorly understood. Conand (1989) described the biology of several commercial species of holothuria, including *Actinopyga echinites, A. mauritiana, A. miliaris, Holothuria atra, H. fuscogilva, H. fuscopunctata, H. nobilis, H. scabra,*and *Thelenota ananas.* The annual reproductive cycles are fairly well known for the main commercial species, with the exception of *Actinopyga miliaris* (Conand, 1989). Apart from *Holothuria scabra,* which has two spawning seasons, the others have a single reproductive season of varying length taking place during the warm season, mostly November to January (I. Horsfall, *in litt.* to S. Milledge, 1998). Sea cucumbers appear to be slow growing and vulnerable.

The sea cucumber fishery is important to the artisanal sector; not only is it lucrative, but it only requires basic and inexpensive equipment. The intertidal area and shallow waters are gleaned on foot, with the aid of a lantern if at night. However, most intertidal areas have been fully exploited and skin diving is the most common collection method nowadays to exploit deeper waters, using mask, snorkel and preferably fins. Sea cucumbers are collected by hand and carried in a sack or net. Sea cucumber fishing is most often a directed operation, usually involving teams of divers operating from boats. In the last five years, the use of scuba equipment has allowed divers to further exploit the sea cucumber resources by accessing sea cucumbers at greater depths and allowing longer time submerged.

Beche de mer preparation entails eight stages (Table 31). The most important factors are cleanliness and dryness. Once dried and packed, beche de mer may be kept in storage for several months.

Processed beche de mer is graded according to species, size of the product (length or weight), and the quality of the processing (Anon, 1985; Conand, 1989; Conand and Byrne, 1993). Conand and Byrne (1993) divided commercially important holothurian species into three categories based upon certain characteristics, including their abundance in shallow water, size, the thickness and quality of their body wall, and the main market demand and value. The body wall should neither contain too many spicules nor disintegrate rapidly. Unfavourable characteristics include weak body wall, unpleasant handling due to expelling of cuvierian organs and deep habitat (Conand, 1989).

Some species may be split up into different size grades based on length and weight, including *Holothuria scabra, H. nobilis* and *Stichopus variegatus.* Since fishermen may sell sea cucumbers fresh or processed, the size grades must take into account reductions in weight and length during processing, as much as 10% and 50% respectively (Conand and Byrne, 1993).

Other preferred features found on well-prepared beche de mer include rubbery texture, pleasant odour, moisture content of eight to ten percent, pigmentation and a smooth surface. Conand (1989) reported that beche de mer is afforded a lower grade if the species is not a preferred one, if specimens are too small, are gutted or cut carelessly, contain sand, are over-cooked or inadequately smoked or dried.

Table 31
Preparation of beche de mer

STAGE	PROCEDURE	EXPLANATION
Handling on board	Avoid placing sea cucumbers on bottom of boat unless very clean and even surfaced.	Holothurians shape into cracks distorting their shape. Sand particles become embedded in the body wall.
	Avoid desiccation	To avoid lesions and breakage.
Cleanliness	Clean sea cucumbers thoroughly in salt water.	To remove entrails, sand and slime.
Piercing and gutting	For *H. spinifera and H. scabra* specimens should be pierced once half-way along the body. For *T. ananas and H. nobilis* the specimens should be pierced twice and the intestines removed.	This is often done on a boat since if the animals eviscerate they may stick together.
1st boil	Using half an oil drum (cut lengthways) placed over a hot fire, thoroughly boil salt water.	The water must boil thoroughly to prevent the sea cucumbers from sticking together.
	When water boils (not before), boil sea cucumbers for one to two hours, stirring every five minutes.	Adding after boiling prevents the formation of skin lesions and splitting of the body wall. Stirring prevents sea cucumbers from bending and sticking together.
	Stichopus variegatus should be boiled gently.	Softer body wall cannot withstand rigorous boiling.
Cooling and 2nd boil	For *Holothuria spinifera and H. scabra,* remove and put in cold salt water. Once cooled, place in container and leave until the following morning. Alternatively, place in a hole in the ground and cover.	Bacterial decomposition for this short period will break down the skin making it easier to remove.
	Remove skin and reboil in fresh sea water for 20 minutes. Allow to cool. For *Thelenota ananas and Holothuria nobilis,* remove and cool slowly, (sometimes by leaving in water but removing heat).	Completes cooking and kills bacteria.
	The next morning cut longitudinally along centre and reboil in clean salt water for another two hours.	When ready, consistency should be rubbery and flexible.
	Put a stick in between gap to keep the sides apart.	Prevents the body wall from closing up.
	Avoid contact with fresh water including rain.	Water introduces bacteria and fungi.
Smoking	Place on mesh wire 0.5 m above coals and cook slowly without burning for at least one hour, turning occasionally. Alternatively, a specially designed smoking room is used, measuring approx. 4x2 m. This has a layer of coals 0.3 m off floor with 2 mesh racks above (one at 0.8 m and the other at 1.7 m).	To reduce the moisture content to around 8-10%, preventing fungal growth and rotting. Slow smoking keeps the sea cucumber soft.
Sun drying	Place on mat in the sun for up to seven days.	Use mat to keep sea cucumbers away from sand.
	May be periodically redried in the sun if moisture starts to show through.	Beche de mer will rot if the moisture content increases. Otherwise, well prepared beche de mer may last for 6-12 months.
Storage	Ideally, put in polythene bags.	Prevents absorption of moisture.

Source: TRAFFIC survey data.

THE SEA CUCUMBER FISHERY IN KENYA

Current Fisheries
The holothurian fishery in Kenya is primarily artisanal and is regarded as being one of the most lucrative fisheries in the country. Sea cucumbers are collected by walking in nearshore waters and collecting by hand, but collection also occurs by snorkelling and with scuba gear. Sea cucumber collectors often have boats which facilitate access to deeper waters.

Sea cucumbers are collected primarily from two districts, Kwale District on the south coast, and Lamu District in the north. The main areas of collection are Gazi and Bodo in Kwale, and Bwaju, Mwali (Kizingitini) and Magogoni in Lamu. Small quantities of sea cucumbers are also collected from Malindi, Kilifi and Mombasa Districts. Collection occurs throughout the year although there are peaks during the months of April to September, which corresponds to

the southeast monsoon season. At this time rough seas prevent fishermen from operating offshore, and they revert to inshore fishing activities.

During this survey interviews with approximately 310 fishermen along the Kenya coast revealed that the quantity collected varies considerably by region. The highest number of specimens collected per day was between 15 and 20, in both Kwale and Lamu Districts. The central districts reported lower yields of only about three to four specimens collected per day. Fishermen believe that there has been a decrease in sea cucumber stocks and decrease in specimen size throughout inshore waters as a result of intense collection. Species of *Holothuria* and *Stichopus* were recorded as having declined most in size and abundance. Sea cucumber stocks in deeper water are less affected.

Landings of holothuria in Kenya vary from year to year, with the average catch for the period 1989 to 1995 being 88.7 mt. The highest reported catch was 277 mt in 1992, and the lowest was 14 mt in 1993 (Anon., 1997a).

Trade

During this survey a total of 14 species were recorded in trade in Kenya as shown in Table 28. The four most popular species are *Holothuria scabra, H. nobilis, H. spinifera* and *Thelenota ananas*. Usually Kenyan fishermen prepare beche de mer themselves, and then sell the product to middlemen who in turn sell to exporters in Mombasa. Prices paid to fishermen varied, and ranged from KSH 125/kg for *Actinopyga* spp., up to KSH 600/kg for *Stichopus* spp.

Imports

Fishermen reported that a large proportion of the beche de mer exported from Kenya is actually imported from Tanzania. However, Kenya has not reported any imports of beche de mer.

Exports

All exports of beche de mer from Kenya leave via the port of Mombasa. Table 32 presents official Kenyan export data from two different sources, for the period 1987 to 1997. Complete data from each source were not available for review during this survey.

Table 32
Kenyan beche de mer exports (mt), 1987-1997

SOURCE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Fisheries							23.3	19.5	26.5	11.4	12.7
Customs	13		67		125	116					

Source: Kenya Fisheries Department data; Kenya Customs statistics.

Comparison of Kenyan records of beche de mer shipments with data from importing countries reveals that reported imports are considerably higher than reported exports. Data for the period 1988 to 1997 are presented in Table 33. Large discrepancies are evident between import and export data, with importing countries recording much higher quantities than Kenya. Total exports were reported as 314.7 mt for the 1988 to 1997 period, while imports were recorded at 630.3 mt. The bulk of beche de mer exports from Kenya are destined for Hong Kong and Singapore, with much smaller quantities to Mauritius, United Arab Emirates and Taiwan. Other destinations were not identified during this study. Beche de mer exports from Kenya increased steadily from 1988 to a peak in 1992 at over 200 mt but have since declined to levels similar to the late 1980s of less than 50 mt per annum. Kenyan exporters report that the decline is largely due to the Asian economic crisis, and that they have stocks of beche de mer but are unable to sell due to lack of buyers.

Legislation

Apart from license requirements, there are no regulations in Kenya that are specific to sea cucumbers. Licenses are required to collect or trade in beche de mer, as per *The Fisheries (General) Regulations*, contained in *The Fisheries Act, 1991*. During this survey it was found that few fishermen actually hold licenses, and many believe that this is the responsibility of buyers or middlemen. Hence there is awareness about the requirement, but the rule is not well adhered to.

Table 33
Reported exports and imports of beche de mer (mt) from Kenya to selected countries, 1988-1997

YEAR	Imports reported by country of import, and reported Kenyan exports by country of destination	HK	SG	TW	MU	AE	TOTAL	Minimum exported per year
1988	Imports							
	Exports		37.0				37.0	37.0
1989	Imports		61.0				61.0	
	Exports		6.9				6.9	61. 0
1990	Imports		40.0				40.0	
α	Exports	72.0					72.0	72.0
1991	Imports		59.0				59.0	
β	Exports	108.5	14.7				123.3	123.3
1992	Imports	109.4	102.0	2.1			213.6	
χ	Exports	45.0	29.5			0.7	75.1	213.6
1993	Imports	59.7	19.0				78.7	
	Exports	10.4	5.7		0.1		16.1	78.7
1994	Imports	48.7	36.0				84.7	
	Exports	1.5	10.7				12.2	84.7
1995	Imports	20.5	24.0				44.5	
	Exports							44.5
1996	Imports	7.4	39.0				46.4	
	Exports							46.4
1997	Imports		22.0	0.4			22.4	
	Exports	2.0	7.1				9.1	22.4

Source: Kenya Fisheries Department shipment records; customs statistics from Hong Kong; Singapore and Taiwan.
Note 1: α - Kenya fisheries exports included two consignments containing beche de mer and fish maws, and one consignment containing beche de mer, shark fin and fish maw to Hong Kong.
β - Kenya fisheries exports included two consignments containing beche de mer and fish maws to Hong Kong.
χ - Kenya fisheries exports included one consignments containing beche de mer and shark fin to Singapore
Note 2: HK=Kong Kong; SG=Singapore; MU=Mauritius; AE=United Arab Emirates.
Note 3: These figures should be regarded with some caution as some exports may occur at the end of the year, and are not reported by the importing country until the following year. Hence there may be some double counting.

Conservation Implications
Although the quantity of sea cucumbers collected from Kenyan waters varies considerably between regions, this survey revealed that fishermen believe that sea cucumbers have decreased in number and in size in recent years. There are reports of imports from Tanzania, which could be a result of depleted stocks in Kenya, although such a conclusion would require verification. The harvest of sea cucumber is a rewarding activity financially for artisanal fishermen, hence reports of increasing scarcity are a concern from both the biological and the socio-economic points of view. At present, official export data underestimate the volume of exports by at least 50%, and this presents difficulties for authorities charged with managing the resource. At the same time, Kenya has no legislation specific to sea cucumbers so options for regulatory measures are limited.

THE SEA CUCUMBER FISHERY IN TANZANIA

Current Fisheries
Tanzania's holothurian fishery is largely artisanal with small commercial operations owned by exporters. Skin-diving is the most common collection method although the use of scuba gear to collect sea cucumbers was recorded in all major coastal towns at some time or other in the past. Boats such as canoes are regularly used by teams of divers to explore offshore areas. Underwater collection is carried out mainly by men whilst women and children tend to glean the intertidal flats on foot. Darwall (1996) recorded divers on Songo Songo diving at low tide to a maximum depth of 18 m. Commercial prawn trawlers in Bagamoyo and Kilwa Kivinje account for a small incidental catch of sea cucumbers. These are normally bartered with fishermen in return for goods from the mainland.

As with most countries in the Indo-Pacific region, fishing activity is greatest from mid-February until the end of September (Anon., 1985). Traders throughout Tanzania reported that collection occurs throughout the year when weather permits, although the best time for collecting is between March and May (northeast monsoon), and September to November (southeast monsoon). These months are preferred because of better underwater visibility and calmer seas.

November and March were mentioned as the best months of the year for diving, with January and July the worst months. Local patterns of currents and winds may also affect fishing operations. For example, Mafia Island experiences annual changes in wind patterns with the northeast monsoon winds preventing fishing on the west side during December and March, whilst the east side is protected during the southeast monsoon winds during August to November.

At least 20 different species of sea cucumber are traded in Tanzania, although 50 different local Swahili names were documented. From discussions with 72 traders, daily catches of sea cucumbers varied between five and 50 specimens per fisherman. The average catch rate per person per trip on Songo Songo island was 8.1 sea cucumbers, and on Mafia Island it was and 3.7 per person (Darwall, 1996). Despite the difference in these rates, it has been concluded that sea cucumber fishing pressure around Mafia Island and Songo Songo is similar, and that the catch rate difference can be attributed to the size of the fishing areas (Darwall, 1996).

Holothurian landings statistics from mainland Tanzania and Zanzibar were unobtainable during this survey, however, figures have been submitted to FAO and are presented in Table 30. Tanzanian sea cucumber landings increased from 324 mt in 1989 to 1,460 mt in 1995. Within Tanzania, traders report that most sea cucumbers originate from Mtwara, followed by (in order of decreasing importance) Mafia Island, Kilwa, Songo Songo archipelago, Zanzibar, Tanga, Bagamoyo and Dar es Salaam. Sea cucumbers are usually purchased from fishermen by middlemen who are based at the major coastal towns, namely Mtwara, Lindi, the Kilwas, Somanga, Songo Songo, Mafia, Dar es Salaam, Zanzibar and Tanga.

Trade

The main species of sea cucumber traded in Tanzania can be divided into three value categories as shown in Table 29, and whose composition is similar to that found by Conand and Byrne (1993) for South Pacific species. Several species were recorded as being split into up to six size grades based on length, including *Holothuria scabra, H. nobilis* and *Stichopus variegatus*. In the last five years, traders claimed that they have noticed more division of species into grades.

Normally, beche de mer is traded by weight. Prices in 1997 were quite variable between species and grades. Prices paid to fishermen for one kg varied from USD 0.90 to USD 17.60, while the price paid by exporters to purchase one kg ranged from USD 1.80 to USD 23.70. One exporter in Zanzibar claimed that 75% of his payments were in items such as electrical goods, clothes and blankets. Market prices in 1997 were USD 50.00-65.00/kg for *Holothuria scabra*, USD 30.00/kg for *H. nobilis*, and USD 23.00/kg for *Stichopus variegatus*, although certain Asian buyers in Dar es Salaam have been known to pay as much as USD 250.00/kg.

Prices reached an all time high in the first half of 1997 with *Holothuria spinifera* purchased at up to USD 30.50 to USD 33.60/kg, mainly due to increased competition between buyers for top quality beche de mer. Price declines started in mid-1997 and dropped sharply in early 1998, a direct result of the deteriorating economic climate in East Asia.

Differences between buying and selling prices averaged 80.6% in 1997 but narrowed to just 20.6% in 1998. Once transport and storage costs have been included, traders claimed that profits in 1998 reached as low as TSH 5/kg forcing many to stop business. The sales records of one trader from Mafia Island showed a profit of only USD 4.60 from 400 kg taken to Dar es Salaam in September 1998, equivalent to only USD 0.01/kg, and has since not taken any consignments. Exporters claimed profits of between 30% and 50% in 1997, the highest prices around Chinese New Year, a time when luxury food items such as beche de mer and shark fin are eaten in greater quantities. Their profits had dropped by 15% in 1998.

The levels of trade in different species and grades from Mafia Island were determined by analysing sales receipts between the largest beche de mer trader on the island and a major exporter in Dar es Salaam during May to September 1998. A total of 15 species were traded, divided into 30 different grades. The four species found in the highest quantity were *Actinopyga miliaris* (29.8% total weight), *Bohadschia* sp. (16.1%), *Stichopus variegatus* (11.7%), and *Bohadschia argus* (11.2%). The four highest value species (*Holothuria scabra, H. nobilis, H. spinifera* and *Holothuria* sp.) represented only 4.4% of the total weight and 6.2% total income, although they reputedly dominated

collected from Mafia were top grade species, and most of these were *Holothuria nobilis*. A different scenario is apparent in Mtwara, where the majority of prepared beche de mer comes from Mozambique. The sales records from one major trader were analysed for the twelve month period from August 1997 to July 1998, detailing species, grade, weight and price for sea cucumbers purchased from fishermen and traders arriving at Msimbati, near the Mozambique border. A total of 16 species were in trade, further divided into 24 grades. Species composition differed from Mafia Island, with high value *Holothuria scabra* and *H. noblis* constituting 26.2% total weight and 43.5% total income. Trade was also dominated by *Bohadschia* sp. (19.1% total weight), *Actinopyga mauritiana* (13.4%) and a low value species of *Holothuria* (12.6%).

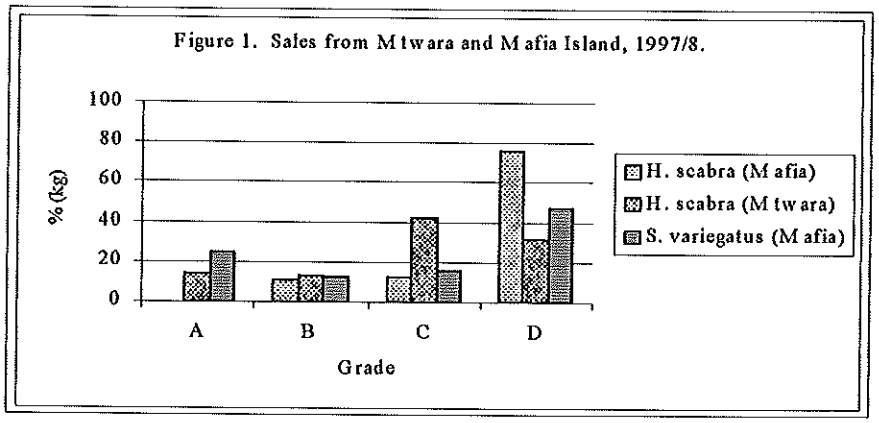
During a survey of 18 fishing trips in Songo Songo during 1995 and 1996, 11 species of sea cucumber were identified (Darwall, 1996). Fishermen reported a further four species in trade. The catch composition (calculated as a percentage of the total number of specimens (118) not of total weight) was 48% *Bohadschia* spp., 11% *Actinopyga mauritiana*, 22% *Holothuria nobilis*, 5% *Actinopyga* sp., 4% *A. echinites*, 4% *Stichopus variegatus*, 3% *Thelenota ananas*, 2% *Bohadschia argus* and 1% unidentified.

During interviews with exporters, fishermen, scientists and other traders, there was unanimous agreement that sea cucumbers have declined in all coastal regions of Tanzania due to overfishing, high demand and high price. Only five years ago, it was always possible to fill orders for one or two species, however, nowadays serious declines preclude this option. The higher value species such as *Holothuria scabra*, *H. nobilis* and *H. spinifera* exhibit the most marked declines; traders report significant declines in the larger size grades in Zanzibar, Mafia, Kilwa and Songo Songo. Traders claimed that at present the most abundant species are the low value *Thelenota ananas*, *Actinopyga echinites*, *Stichopus variegatus*, *Bohadschia* spp. and several other small-sized species. These low value species are now collected along with undersized specimens. In the South Pacific, Conand (1989) also found that the most frequently encountered species were of no or little commercial value.

Rapid assessment surveys carried out on coral reefs in the Tanga region during 1995 to 1996 (40 minute snorkel surveys to a depth of 6 m) revealed that sea cucumbers were more abundant on the outer patch reefs because of reduced accessibility due to both rougher seas and deeper water (Horrill *et al.*, in press). Biological surveys carried out by Frontier Tanzania in Mtwara showed that larger sea cucumbers are found below ten m depth and the most common species is *Holothuria edulis* (Guard, 1998).

It appears that stocks of the most valued sea cucumbers have been overexploited in Tanzania. According to interviews, biological surveys and analysis of trade records, the larger grades are scarcer. Data for *Stichopus variegatus* sales from Mafia Island indicate that a large percentage of small specimens are being caught although adults represent a significant portion of the catch due to selective fishing (Figure 8). This is to be expected for a low value species which has been exposed to relatively low fishing pressure.

Figure 8
Sales of beche de mer from Mtwara and Mafia Island, 1997-1998



Source: TRAFFIC survey data.

In contrast, sales data from Mafia Island for *Holothuria scabra*, a high value species which has been heavily exploited, show an absence of Grade A and only small quantities of Grades B and C. Fishermen would invariably collect the largest specimens possible of this high value species although these results suggest that they are extremely scarce. Data for *Holothuria scabra* sales from Mtwara are close to those of *Stichopus variegatus* and indicate the much higher abundance of large grade *Holothuria scabra* still available in Mozambique waters. This is to be expected because Mtwara has been less heavily exploited than Mafia Island.

This study revealed that preparation techniques in Tanzania were similar to those described in Table 31 although handling and cleanliness on board is generally poor. The quality of beche de mer traded in Tanzania is extremely variable. Apart from the beche de mer prepared by exporters themselves, the best quality beche de mer was observed from Mafia Island and Songo Songo.

The worst quality beche de mer comes from Mtwara where the majority is prepared in Mozambique. Poor preparation may result from insufficient time spent on the process, or from efforts to increase weight with greater water, gut and sand content. While many traders in Mtwara are knowledgable about correct technique, there are many newcomers in the trade, and these individuals often lack the necessary knowledge to prepare beche de mer properly. Since product quality is variable in Tanzania, the current tendency is for buyers to deduct a fraction of the weight from quantities purchased. Analysis of sales receipts from one Mafia Island dealer to an exporter in Dar es Salaam revealed that while 823.1 kg of beche de mer was sold, only 740.4 kg was paid for. This indicates a deduction of approximately ten percent of the total weight.

Imports

Tanzania has not reported any imports of holothurians. Nevertheless there are reports of large quantities of beche de mer arriving in Mtwara from Mozambique; neither Mozambique nor Tanzania has any official record of this cross border trade. The largest exporter on Zanzibar estimated that five years ago, approximately half of Tanzania's beche de mer came from Mozambique. Today, the same exporter surmises that Mozambican beche de mer now constitutes three quarters of what is traded from Tanzania.

Exports

Exporters have largely halted exports as a result of the declining profits. Nonetheless, when it is traded, beche de mer is exported from three ports, Dar es Salaam, Zanzibar and Tanga. The number of official beche de mer exporters on the Tanzania mainland has decreased from 23 in 1993 to eight in 1997. In 1993 six exporters were operating on Zanzibar while in 1997 only two are active. As of October 1998, only three companies were still exporting beche de mer, two from Zanzibar and one from Dar es Salaam. There are reported to be, however, approximately five buyers purchasing top quality beche de mer in Dar es Salaam; it is not known if this material is currently being exported.

According to available export and import statistics, beche de mer originating from Tanzania is exported to at least eight countries, with the majority going to Hong Kong and Singapore, and smaller quantities going to Thailand, Taiwan, Malaysia, USA, UK and Italy. Zanzibar Customs statistics record Hong Kong as the sole destination. In the six years between 1992 and 1997 inclusive, Hong Kong imported 1,881 mt (66.3%) from Tanzania, followed by Singapore with 939 mt (33.1%).

Table 34 illustrates some of the inconsistencies apparent between Tanzania's official figures and those reported by importing countries. Tanzanian export figures comprise the combined totals of exports from Zanzibar and mainland Tanzania; it should be noted that exports from the mainland are higher than those of Zanzibar, and for the period 1990 to 1997, mainland exports were 885.4 mt, while Zanzibar reported exports of 299.8 mt. Overall exports for the period 1988 to 1997 were 2,569.1 mt, while imports were reported as 3,056 mt. Omitted from this table is Thailand, for which Tanzania reported exports of 4 mt in 1993 and 3.2 mt in 1995. Thailand has not reported any imports from Tanzania. Comparison of reported exports with reported imports are disappointing in that there has not been a single year when imports to Taiwan, Thailand or Malaysia were recorded by both Tanzania and the importing country. It should be noted that importing nations do not differentiate between Tanzania mainland and Zanzibar in their customs statistics.

From Table 34 it is apparent that beche de mer exports from Tanzania increased gradually during the 1980s from just under 200 mt per annum to 617 mt in 1992, the highest figure on record. This represents the equivalent of 6,170 mt

live sea cucumbers. Using the average number of specimens per kg listed in Table 29, and assuming the percentage composition is similar to that found in Mtwara, 617 mt of beche de mer represents over 1.7 million individuals. Since 1992, exports have continued to decline with 277 mt reported as exported in 1997. Exports for 1998 are expected to be less than 150 mt. According to Mafia Island Fisheries office, only 3,230 kg of beche de mer were transported from the island in the first nine months of 1998, compared with 15,588 kg in 1997.

Table 34
Official import and export statistics (mt) for Tanzania beche de mer, 1981-1997

YEAR	TANZANIA REPORTED EXPORTS	ASIAN REPORTED IMPORTS	TOTAL IMPORTS REPORTED BY MAIN ASIAN IMPORTERS			
			HK	SG	TW	MY
1981	1.8	n/a				
1982	4.4	n/a				
1983	21.0	n/a				
1984	36.9	n/a				
1985	132.7	n/a				
1986	162.6	n/a				
1988	--	2.0			2.0	0
1989	107.9	176.5	-	173.0	3.5	0
1990	189.2	111.9	0	107.0	4.9	0
1991	193.0	163.0	0	162.0	1.0	0
1992	219.9	617.5	387.9	225.0	4.5	0
1993	398.2	588.6	477.6	111.0	0	0
1994	565.6	554.4	302.7	249.0	0.3	2.3
1995	292.8	412.2	257.2	155.0	0	0
1996	324.6	358.2	232.2	126.0	0	0
1997	277.9	73.7	-	73.0	0.7	-
TOTAL (1988-1997)	2,569.1	3,056.0	1,657.6 (54.2%)	1,381.0 (45.2%)	16.9 (0.5%)	2.3 (0.07%)

Source: Statistics Department, Sub-Commission of Fisheries, Zanzibar; Statistics Department, Fisheries Division, Tanzania mainland; Customs statistics from Singapore, Hong Kong, Taiwan, Thailand and Malaysia.
Note: Reported exports from Tanzania comprise exports from both the mainland and from Zanzibar.

Apart from the official trade record, during this survey traders claimed that an illegal and unrecorded trade in beche de mer exists from Zanzibar, Tanga and Dar es Salaam to Mombasa, Kenya. In addition, Barnett (1997) reported that beche de mer is sometimes exported as fish offal or fish maws. Many beche de mer exporters also export shark fin and to a lesser extent fish maws and fish offal. While Barnett (1997) observed that these exporters largely dealt in shark fin and beche de mer, export consignments were often classified as beche de mer and fish offal respectively, in order to reduce the amount of duty payable. An export duty of 5% of the official minimum price (as declared by the Fisheries Division), is paid on every shipment. Therefore, exporters were able to pay less duty by classifying shark fin (1993 minimum price of USD 13.00 to USD 27.00/kg) as fish offal (1993 minimum price of USD 2.00/kg). Consignments classified as beche de mer, on the other hand, were more likely to be beche de mer since the minimum price (USD 1.50/kg in 1993) was less than that for fish offal. In 1996, official minimum prices were revised, and the price for beche de mer was raised to USD 15.00 to USD 20.00/kg. It is therefore possible that in recent years beche de mer exports have been classified as fish offal to reduce the amount of duty payable.

Legislation
According to *The Fisheries Act, 1970,* and the *Fisheries (General Amendment) Regulations, 1997,* separate licenses are required for traders (fishermen, collectors and dealers) and for exporters of sea cucumbers (Table 35).

The most recent Indicative Export Prices for fishery products were issued in 1996 and are used as a minimum price gauge for calculating the Freight on Board and royalty (5%) for all sea cucumber exports (Table 36).

Table 35
Annual license fees (USD) for collection/fishing/dealing and export of sea cucumbers from Tanzania

Type of License	Local individual/ company with approved shore based fish processing facilities	Local - individual/ company without approved shore based fish processing facilities	Foreigner - individual/ company with approved shore based fish processing facilities	Foreigner - individual/ company without approved shore based fish processing facilities
Collection, fishing, or dealing license	2.50	3.75	400.00	Prohibited
Export licence	17.00	18.70	400.00	

Source: Fisheries (General Amendment) Regulations, 1997.
Note: License fees are quoted by Tanzania in USD.

Table 36
Indicative Export Prices (IEP) for sea cucumbers

Pieces per kg	IEP (USD/kg)
10-20	20.00
20-30	18.00
30-40	15.00

Source: Indicative Export Prices for Fishery Products, dated 27 December 1996, Ministry of Natural Resources and Tourism.

In addition, every district has its own Municipality tax. For example, beche de mer traders in Mafia District pay 5% of the buying price (Anon., 1996).

Conservation Implications
Tanzania has been a source of beche de mer for several decades, with the result being that at present stocks appear to be depleted in several areas. Information from sales records reveals that there is a decline in availability of large size grades, especially from Mafia, Kilwa, Zanzibar and Songo Songo. Only in Mtwara are large specimens still available in abundance, and it seems reasonable to conclude that this is the case because these specimens are imported from Mozambique where stocks are still sufficient. Processing techniques in Mozambique are however sub-standard, and traders in Tanzania have noted the low quality coming from this region, as well as the lower prices received for these specimens.

Declines in sea cucumber populations in parts of Tanzania are evident, and could affect the future status of these species. Removal of large specimens may affect reproduction and recruitment potential. While at present the industry is experiencing a slump due to the Asian economic crisis, when the economic situation stabilizes in that region demand will most likely resume. Instigation of appropriate conservation, management and regulatory measures will therefore be important in ensuring a sustainable harvest.

THE SEA CUCUMBER FISHERY IN MOZAMBIQUE

Current Fisheries
The holothurian fishery in Mozambique is primarily artisanal, and there is both a directed and a by-catch fishery. Two categories of collectors are operating, the first being women and children who collect by foot in intertidal areas when searching for a variety of invertebrates such as clams, mussels and crabs, and the second being men who dive to five to 15 m using snorkels or scuba gear. Divers often use non-motorized vessels to access deeper waters.

Diving with homemade snorkel equipment is practiced to depths of 10 to 15 m in the northern provinces of Cabo Delgado and Nampula. In the south in Inhambane Province divers use ready-made snorkel equipment (Abdula, 1998). Diving is a well-known technique in both Cabo Delgado and Inhambane due to its promotion by PESCOM International in the 1980s, however, in other areas such as Inhaca Island the method is relatively new to fishermen. Diving is also carried out when inshore stocks become depleted, and this has been the case in Bazaruto and Inhaca. Small quantities of sea cucumbers are

sometimes caught as by-catch in trawl and gillnet fisheries. The targeted resource in the gillnet fisheries in Maputo Bay is magumba *Hilsa kelee*.

Holothuria are widely exploited along the Mozambican coast, where suitable habitats occur. However, the main fishing areas are Cabo Delgado and Nampula Provinces in the north and Inhambane and Maputo Provinces in the south (Dionisio and Munguambe, 1993). There is no information about holothurian collection in the central part of the country, e.g. Sofala and Zambezia Provinces. While most sea cucumber fishermen are from Mozambique, in the northern provinces there are a considerable number of illegal collectors from Tanzania (Whittington *et al.*, 1998). During this survey, eleven species of sea cucumber were identified as traded in Mozambique; these are listed in Table 37.

Table 37
Holothurians of commercial value in Mozambique

SPECIES	NORTH OF MZ	INHAMBANE	INHACA ISLAND
Actinopyga echinites	***	***	NC
Actinopuga mauritiana	*	**	NC
Actinopyga miliaris	***	**	NC
Bohadschia marmorata	**	**	NC
Holothuria atra	***	NC	NC
Holothuria fuscogilva	***	**	**
Holothuria nobilis	**	E	NC
Holothuria scabra	E	E	E
Stichopus chloronotus	*	***	NC
Stichopusvariegatus	***	***	NC
Thelenota ananas	*	*	NC

Source: Abdula and Longamane, 1995; Gemusse, 1996; Pacule, 1997; Santana Afonso, 1996; Whittington *et al.*, 1998.
Note: *** = highly commercialised; ** = medium commercialisation; * = less commercialised; E = stock very reduced or overexploited; NC = not commercialised.

Information on holothuria production is highly variable in Mozambique, due to irregular reporting on the part of provincial fisheries authorities, as well as lack of official landing sites. Furthermore, many fishermen are not licensed and hence do not report their catches. Official figures reveal an extremely variable catch, for example, in 1993 the registered catch was reported as 700 mt (Anon., 1995b), but was only 6 mt in 1995 and 54 mt in 1996 (Anon., 1997c).

Data from PESCOM International, the enterprise that held a monopoly on the beche de mer trade during the 1980s, provides a more detailed and perhaps more accurate picture of what holothuria production might be. Figures are presented for the period 1981 to 1989 in Table 38. Production averaged 58.2 mt per year during this period (this average has been calculated omitting 1987 as figures are unavailable for that year). It is unclear why these figures differ so drastically from those reported above by DNP.

Table 38
Beche de mer production (mt) by province, as reported by PESCOM International, 1981-1989

YEAR	INHAMBANE	NAMPULA	CABO DELGADO	TOTAL
1981	55.9	16.6	11.4	83.9
1982	45.0	9.5	27.8	82.3
1983	19.3	17.2	12.4	48.9
1984	34.3	14.5	16.5	65.3
1985	34.8	4.8	7.7	47.3
1986	42.5	8.4	5.7	56.6
1987	N/A	N/A	N/A	N/A
1988	27.2	1.4	1.5	30.1
1989	49.0	1.4	1.1	51.5
Total	308.0	73.8	84.1	465.9

Source: Costa and Montecino, 1990

Processing of sea cucumber in Mozambique is often carried out at organized permanent or mobile fishing camps. Inadequate processing procedures were reported at Bazaruto island, Mozambique, where the fisherman use incorrect processing procedures for the species, *Stichopus chloronotus* and *Holothuria scabra;* these species required different methods of preparation depending on the species (Santana Afonso, 1996).

Trade

Beche de mer is exploited and traded exclusively for export purposes. The dynamics of the trade vary throughout the region. In the north of the country, especially Nampula and Cabo Delgado provinces, beche de mer is traded to Tanzania. According to Costa and Montecino (1990), the prices offered in Tanzania were significantly higher than those offered by PESCOM International; this situation acted as a stimulus to illegal trade. In the north, illegal trade is facilitated by various transport enterprises, as well as insufficient capacity and resources in fisheries and customs agencies to inspect shipments. According to sources in the north, illegal trade occurs by transferring shipments from boat to boat on the open sea. Some traders report an increase in Tanzanians operating in the north, specifically because of poor controls and inspection capacity.

Trade dynamics are further complicated by price differences apparent throughout parts of the country. Table 39 illustrates differing prices for different grades.

Table 39
Variations in holothurian prices (USD/kg) in Mozambique, 1990

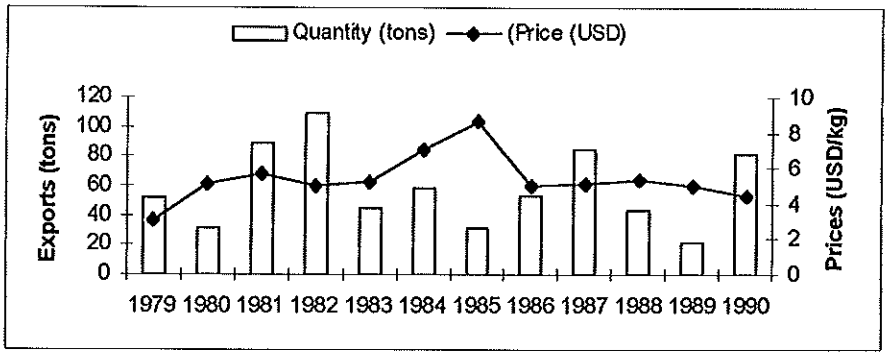
GRADE	PESCOM INTERNATIONAL	PESCOM NATIONAL	BAZARUTO	INHACA/ STATE ENTERPRISE	INHACA-INDIVIDUAL TRADERS
0	4.53	6.20	5-7.00	3.00	8.00
1	3.66	5.00	5-7.00	2.30	8.00
2	2.96	3.80	5-7.00	1.80	7.00
3	2.74	3.30	5-7.00	1.60	6.00
4	1.80	2.60	5-7.00	1.00	5.00
5	1.57	2.20	5-7.00	0.85	*
6	1.14	1.70	5.00	0.60	*

Source: Costa and Montecino, 1990.

Exports

According to data provided by PESCOM International for the period 1979 to 1990, 701 mt of beche de mer were exported to Hong Kong and Singapore, with a total value of USD 3,694,785. Figure 13 shows that the export price increased from USD 3.02/kg in 1979 to USD 8.59/kg in 1985. During the late 1980s the market price was relatively stable at about USD 4.50-5.00/kg.

Figure 13
Beche de mer export quantities (t) and prices (USD/kg) from Mozambique, 1979-1990



Source: PESCOM International data, 1998.

Export statistics recorded by the National Directorate of Fisheries are generally underreported, and are recorded at 5.8 mt in 1992, and 7.3 mt in 1994 (Anon., 1995b). Data obtained from importing countries show that since 1990, Taiwan has been the major importer of beche de mer from Mozambique (Table 40). Exports also go to Singapore, Hong Kong as well as South Africa. Exports to Tanzania are unreported. During the 1990s, import data suggests that exports from Mozambique have fluctuated between 17.7 mt and 52.4 mt but have dropped dramatically to 2.9 mt in 1997.

Table 40
Imports of beche de mer from Mozambique, 1991-1997

Country	1990	1991	1992	1993	1994	1995	1996	1997
South Africa			5.8					
Singapore	5.0	19.0	18.0		3.0	5.0	1.0	
Hong Kong			31.1		9.2	2.4	42.6	
Taiwan	36.6	12.2	3.2	17.7	11.3	7.0	8.8	2.9
TOTAL	**41.6**	**31.2**	**58.1**	**17.7**	**23.5**	**14.4**	**52.4**	**2.9**

Source: Customs statistics from Taiwan, Singapore, South Africa and Taiwan.

Legislation and Management
The Ministry of Trade is the entity responsible for holothurian trade in Mozambique. Fishing licenses are issued by DNP, however, in the case of holothurians, licenses are issued by local Marine Administrations. No specific legislation exists in Mozambique that refers to sea cucumbers

Management measures undertaken in Mozambique for sea cucumbers have largely focussed on implementing closed seasons. For example, in 1981, in Inhaca Island, an experimental closed season was established from 1 January to 31 May. In 1988, PESCOM established a closed season between January and June for associates in Maputo, Inhambane and Cabo Delgado (Costa and Montecino, 1990). It is not known whether these closed seasons were actually observed.

In 1990 in Inhaca, fishing for holothurians was prohibited following drastic resource depletion (Massinga and Hatton, 1997). The fishery was opened in 1993 with a closed season from 1 December to 31 March; at present it does not appear that there is much control over fishing in the area. In the Bazaruto Archipelago, holothurian management commenced in 1992 through a joint WWF/DNFFB project. At that time depletion of *Holothuria scabra* was evident (Dutton and Zolho, 1994). In 1995, at the request of authorities at Bazaruto National Park, the holothurian fishery was officially closed north of Inhambane (Bazaruto archipelago, Inhassoro and Vilanculos), by Inhambane's Fisheries Provincial Services. Despite the closure of the fishery, fishermen continue to exploit the resource due to lack of human and financial means to inspect the area. No management measures or initiatives are known to exist in the north.

Table 41 presents a summary of some of the recommendations that have been proposed in recent years to manage the holothurian resource.

Table 41
Recommendations for holothurian management in Mozambique

Place	Recommendation	Proponents	Year
Inhaca	Closed season from December through March	Costa and Montecino	1990
Inhaca	Minimum size allowed: 20 cm	Costa and Montecino	1990
Inhaca	No licenses to non residents	Costa and Montecino	1990
Inhaca	Implementation of exploitation by rotation	Costa and Montecino	1990
Bazaruto	Closed season: April through June	Dutton and Zolho	1994
Inhaca	Suspension of fishing licenses	Gurjal	1995
Bazaruto	Implementation of a co-management programme	Santana Afonso	1995

In 1995, a "Pilot Sea Cucumber Conservation Project" proposal was submitted for Morrunbene's region in the Inhambane's province. This proposal had as main objectives the establishment of a hatchery and ranch for sea

cucumbers, conservation of existing holothurians, and improvement of renewable and sustainable resources (Odendaal, 1995). This proposal was not developed due to the lack of financial resources.

Conservation Implications

In Mozambique minimal data exists on the sea cucumber fishery, and this is paralleled by a lack of capacity within the country's regulatory authorities to carry out inspection of exports and overall control of the industry. Management measures that are in place are not based on scientific data. While the resource does not appear to be overexploited in Mozambique and stakeholders generally are not worried about its status, the level of harvest could be quite high judging from reports of illegal exports to Tanzania. Proper management regimes based on actual harvest and trade levels would be beneficial to the long-term viability of the industry.

CONCLUSIONS AND RECOMMENDATIONS

Marine resources represent a significant source of revenue for all three countries covered in this survey. These fisheries are primarily artisanal fisheries, with the exception of a portion of the lobster catch in Mozambique. The seashell fishery is valuable for subsistence purposes (for meat) and for supplementing incomes through sale of ornamental and industrial shell. Sales are domestic as well as international. The lobster fishery is similar in that sales to local hotels and markets can be sizable, yet there are significant exports, especially from Mozambique where the industrial harvest of deep water lobsters is well-organized and able to enter the export market. The beche de mer fishery, while geared solely toward the export market, is artisanal thereby yielding revenue to coastal communities as well as to governments in the form of export duties. There is no doubt that all of these marine resources are extremely important to Kenya, Tanzania and Mozambique on a variety of levels.

Given the significance of these resources to local communities and to governments, it is surprising that regulatory and management measures for these species are minimal. In all three countries surveyed, existing measures take the form primarily of license requirements. These are ignored by significant numbers of people involved in harvest and trade, with many artisanal fishermen either unaware of such requirements or unwilling to abide by them. In Kenya, for example, fishermen believe that it is the responsibility of the traders to acquire the necessary permits. For sea cucumbers, there are no laws specific to the taxa in any of the countries surveyed. Lobster legislation is limited to Mozambique where there is a minimum size limit, and to Kenya, where it is prohibited to harvest gravid females; Tanzania has no lobster legislation. Seashell laws are absent in Mozambique, and in Tanzania the only regulation is the requirement for a certificate of ownership. In contrast, Kenya has regulations relating to harvest, sale and export. Hence it is evident that regulatory mechanisms are few in the region. Furthermore, the lack of regulation is exacerbated by insufficient enforcement capacity in pertinent government agencies, as well as the enormity of the task which entails monitoring areas that are vast and often remote or difficult to access (such as the open sea area on the Tanzania-Mozambique border).

Reports of local depletions and declines in sizes of the three groups of taxa studied are frequent, and represent a significant concern from both biological and socio-economic perspectives. Size declines in sea cucumbers have resulted in fishermen searching for new stocks, as in the example of Tanzania importing from Mozambique. Size declines are recorded for numerous seashell species, and these reports are often paralleled by evidence of import from neighbouring countries. Lobster declines are reported in particlar for Kenya, and suggestions have been made for a suitable size limit that would assist in ensuring survival of reproductive females.

At the same time, it is important to state that many of the reports of declines are not based on scientific data. The most glaring omission for all species in this survey is the lack of any recent surveys documenting the status of these resources. For lobsters the situation is somewhat better, with surveys of the spiny lobster resource carried out in Kenya and Tanzania in the 1970s, and the deep water lobster resource off Mozambique the subject of surveys more recently. For seashells, only McClanahan (1989) has undertaken surveys of abundance at selected sites on the Kenya coast, and Newton *et al.* (1993) in Tanzania. No seashell surveys have been carried out in Mozambique. Some sea cucumber suveys have been carried out in Tanzania and Mozambique, but the available information is still insufficient to understand that status of the resource. In order to ascertain threats on the species level, it would seem a matter of priority to undertake resource surveys for these marine species, in order to be able to suggest appropriate harvest limits or quotas, and to set a barometer for gauging population status and any future declines.

Information on production and international trade volumes for all three groups of species is inaccurate and incomplete, and therefore insufficient to formulate sensible conservation, management or regulatory schemes. Given that the harvest is artisanal, many fishermen do not land their catches at official landing sites, and therefore the catch goes unrecorded. As regards international trade, comparison with available import data reveals that there is large-scale under-reporting by exporting nations. The situation also occurs on the importing end, with exports going unreported by the importer. In general, one could say that the available data on all three resources are insufficient and should be improved if they are to reflect reality and be useful conservation and management tools.

Reasons for the poor quality of data available for all taxa concerned in this survey, could be attributed to administrative and/or capacity problems in the fisheries departments. Lack of funds is a frequently-cited problem by departments and is often given as the main reason for inability to inspect export shipments effectivelym visit landing sites, and monitor fishing activity. While lack of funds certainly could be a major obstacle, it may be that other problems are also contributing to inefficiency or other factors. It would be useful to understand the details of why fisheries departments experience certain problems, and therefore concerted efforts could be made to address them.

The artisanal aspect of all three of these fisheries is extremely important. Not only does exploitation form part of the subsistence harvest, but it also serves to generate essential revenue for coastal peoples. As resources decline, measures aimed at management will need to take into consideration this aspect of the fishery. Attention should be directed toward involving local communities in co-management of resources, and to developing regulations that can be well-publicised and implemented in a manner that is understood and appreciated by communities.

Recommendations

The following recommendations should be considered for all three countries in this study, unless otherwise stated. The region has national level differences that distinguish the trades in seashells, sea cucumbers and lobsters, but in general the problems transcend these boundaries and in most cases are similar and demand cohesive solutions and action on a region-wide basis.

- For all species surveyed, there is a lack of up to date biological information on the status of the resource, distribution, abundance and current threats. Resource assessments should be carried out as a matter of priority. The resulting information would be essential to determining sustainable harvest levels, setting harvest limits, developing useful controls and regulations, and gauging future population trends.

- Involvement of local communities should be explored to improve resource management and conservation, as well as data collection. Communities could make a significant contribution to knowledge about harvest levels and resource status, and could be instrumental in implementing necessary regulatory controls. Therefore, it would be useful to develop an appropriate awareness programme among local communities that would consider as a priority topics such as population reduction due to harvest of undersized specimens, harvest of gravid females, and destruction of habitat (i.e. dynamite fishing).

- Develop an appropriate awareness programme among local communities that would consider as a priority topics such as population reduction due to harvest of undersized specimens, harvest of gravid females, and destruction of habitat (i.e. dynamite fishing).

- Review the administrative capacity and operations of fisheries departments in all three countries, in order to understand where problems lie, and how they might be best addressed. Improvement of the effectiveness of fisheries departments is essential and finding solutions to the problem of species declines is closely linked with this issue.

Lobsters

- For Kenya and Tanzania, implement legislation specifying minimum size limits. For Tanzania and Mozambique, implement controls on harvest of gravid females. Improve enforcement of these regulations by inspecting restaurants, hotels, and exports. Ensure that the legislation is well-publicised among resource harvesters, traders and consumers, and enforce controls through fines and/or other penalties that are comparable to the value of the violation.

- Improve collection of international trade data between countries in the region. Improve collection of export data by increasing inspection of outgoing shipments.

- Investigate the possibility of recording exports with more detail; exports are most often recorded with no indication of whether the contents are whole lobsters or tails only.

- Reduce wastage from inefficient harvest by harpoon in Mozambique, by introducing different fishing methods.

- In Kenya and perhaps elsewhere, pursue the option of artificial shelters to increase inshore habitat to increase harvest.

Seashells

- Conduct species-specific resource surveys focussing on the most important commercial species with reports of size declines.

- Collect information about reproductive strategies and life histories of the commercially important shell species. Collect data on, for example, which species have planktonic larvae with wide-ranging dispersal potential, and which produce egg casings thereby being more susceptable to local collection and consequent population depletion.

- Encourage fisheries departments to collect and record in official documentation production and export figures that provide some indication of family of genus. One problem in Kenya (and Mozambique) is that there is no way to ascertain whether shell exports are for industrial purposes, or whether they are comprised mostly of ornamental shell. Focus attention on documenting intra-regional trade volumes.

- Investigate the trade in opercula from Tanzania, to ascertain whether such a high-volume trade is unsustainable in the long term.

- Use improved data collection, knowledge of species requirements and resource surveys, to formulate appropriate legislation, in particular that which relates to individual species and their specific management needs.

Holothurians

- Develop legislation in all three countries addressing harvest of small-sized specimens, by limiting exports to specimens above 75 mm in length.

- Address problems of poor preparation of beche de mer, particularly by approaching the processors in northern Mozambique and providing information on how to prepare specimens properly to earn maximum return and to reduce wastage.

- Consider closed seasons in areas where depletion is prevalent, in order to allow populations to rebound.

- Consider options for addressing problems associated with beche de mer processing such as overexploitation of fuelwood for boiling sea cucumbers.

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