# Bay of Bengal Programme

## Fishery Resources

REVIEW OF THE BECHE DE MER (SEA CUCUMBER) FISHERY IN THE MALDIVES

BOBP/WP/79

FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

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BAY OF BENGAL PROGRAMME
Reef Fish Research & Resources Survey

BOBP/WP/79
MDV/88/007

# Review of the Beche De Mer (Sea Cucumber) Fishery in the Maldives

by
Leslie Joseph
*Programme Officer,*
*BOBP*

**BAY OF BENGAL PROGRAMME**
**Madras, India**
**1992**

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This paper is a review of the beche de mer (sea cucumber) fishery in the Maldives. The review was undertaken in view of the potential of the fishery for further development as well as the vulnerability of the resource to uncontrolled exploitation.

Data and information for the review were gathered in the Maldives during a one month period in May/June 1991. The review was carried out by a Programme Officer of the Bay of Bengal Programme (BOBP). Assistance received by him, from Mr. Hassan Maniku Maizan (Director of Fisheries Research and Development in Male) and Dr. R.C. Andersson, FAO/BOBP Fishery Biologist, in overall planning of the study, from Mr. Hassan Shakeel (Fishery Resources Officer of the Marine Research Section, Male), in logistics and interpretation, from Mr. Abdullah Waiz (of the Marine Research Section, Male), in the collection of information from exporters, from Mr. Ahmed Hafiz (of the Marine Research Section, Male) and from numerous fishermen and exporters, in the provision of information, is gratefully acknowledged.

The review and this paper which reports on it have been sponsored by the United Nations Development Programme and were executed by the Bay of Bengal Programme.

The Bay of Bengal Programme (BOBP) is a multi-agency regional fisheries programme which covers seven countries around the Bay of Bengal – Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka and Thailand. The Programme plays a catalytic and consultative role : it develops, demonstrates and promotes new techniques, technologies or ideas to help improve the conditions of small-scale fisherfolk communities in member-countries. The BOBP is sponsored by the governments of Denmark, Sweden and the United Kingdom, by member-governments in the Bay of Bengal Region, and also by AGFUND (Arab Gulf Fund for United Nations Development Organizations) and UNDP (United Nations Development Programme). The main executing agency is the FAO (Food and Agriculture Organization of the United Nations).



**April 1992**

Published by the Bay of Bengal Programme, 91 St. Mary's Road, Abhiramapuram, Madras 600 018 India, and printed for the BOBP by Nagaraj & Co., Madras 600 041.

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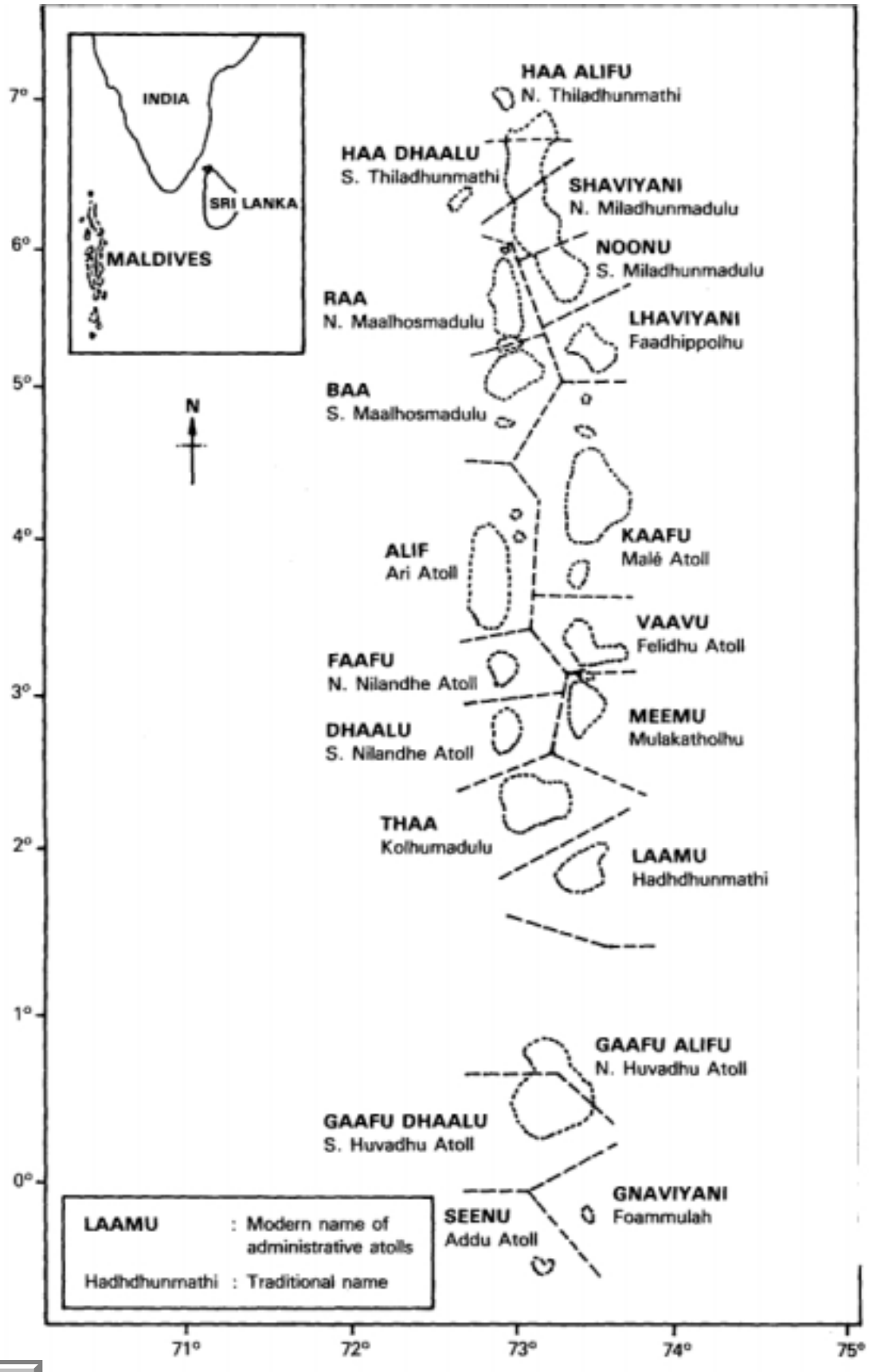



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## 1. *INTRODUCTION*

The Republic of Maldives is an archipelago of over 1200 coral islands, all low-lying accumulations of coral sand and rubble and originating out of 26 atolls. If the unvegetated sand banks are included, the total number of islands is around two thousand. They extend from latitudes 7°6'39" N and O°4'48" S and between longitudes 72°32'30" E and 73°45'54" E in the western Indian Ocean. The atolls stretch in an approximate north-south direction, forming a long narrow chain extending 860 km from north to south. The single chain of atolls widens in the centre, to form a double chain nearly 120 km across at the widest point. For administrative convenience, some larger atolls are subdivided, while some smaller ones are grouped together, resulting in 19 administrative atolls, each governed by an Atoll Chief. The total land area of the country is approximately 300 square kilometres. (Figure 1, facing page).

The population of the Maldives, estimated at just under 215,000 in 1990, is scattered over 202 permanently inhabited islands. Approximately 60 islands have been developed as tourist resorts. The remainder are uninhabited, although many have a few people living on them semi-permanently. Fishing and tourism are the mainstay of the Maldivian economy. Fishing, the main traditional occupation, employs about 40 per cent of the labour force. 22,025 fishermen, operating 1130 motorized *dhonis,* 412 sailing *dhonis* and 34 rowing boats landed a fish catch of 71,247 mt in 1989. The traditional tuna pole-and-line fishery accounted for the bulk *(95* per cent) of the production.

In recent years, however, there have been increasing attempts in the Maldives to exploit hitherto untapped, or lightly tapped, marine resources. Development and promotion of reef fisheries is being actively pursued by the Government. Export of non-traditional marine products, such as shark fins, red coral, live tropical fish etc., have been carried out for some time, mostly by the private sector. The value of exports of all marine products, including fishery products, reached 263 million Ruffia in 1988 and increased to 310.7 million Ruffia in 1989.

Yet another instance of such diversification is the fishery in the Maldives for sea cucumber, for processing and export as beche de mer. Although just a few years old, this fishery has had a significant impact on fishermen as well as marine product exporters. The value of exports of beche de mer in 1988 and 1989 represented 80 per cent and 60 per cent of the total export value of all (non-finfish) non-traditional marine products from the Maldives during these years. But the fishery has largely gone unmonitored. The present review was undertaken in view of its potential for further development and the need for management of a resource highly vulnerable to uncontrolled exploitation.

## 2. *THE REVIEW*

The one-month review was conducted from 26 May to 23 June, 1991. Stormy weather conditions which prevailed in the Maldives from late May to mid-June curtailed some scheduled visits to the atolls to observe the beche de mer fishery. A total of 17 islands in seven atolls were visited from 7th June to 17th June 1991 as follows

| *Date* | *A toll* | *Island* |
|---|---|---|
| 7-8 | Meemu | Thuvaru |
| 8-9 | Dhaalu | Meedhu, Hulhudheli, Badidhoo |
| 9-10 | Faafu | Biledhdhoo, Feeali |
| 11-13 | Baa | Goidhoo, Hithaadhoo, Thulhaadhoo, Kendhoo |
| 13-14 | Raa | Maduvaree, Kadholhudhoo, Maakurathu |
| 14-15 | Shaviyani | Dhashu Komandoo |
| 15-16 | Noonu | Lhohi, Landhoo, Maafaru |



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The review fell within the peak Southwest Monsoon tuna fishery season. The rough sea conditions almost completely disrupted all fishing activities, resulting in very little actual beche de mer fishing being observed. Group discussions with fishermen involved in the beche de mer fishery, however, generated valuable information. The groups ranged from 6 to 9 fishermen. The Island Chiefs, who helped arrange these meetings, also participated in the discussions. The Atoll Chiefs of Meemu and Baa Atolls were also met during the course of the review.

The main beche de mer exporters were met in Male and information on quantities and varieties of beche de mer exported, export prices and markets, prices paid to collector fishermen etc were collected from the records some of them readily made available. Government officials in the Ministry of Fisheries and Agriculture and Ministry of Trade and Industries were also met. Some information on the beche de mer fishery in islands not visited during the review was obtained from fishermen and fisheries field officers from these islands who happened to be in Male during this period.

## 3. *THE BECHE DE MER FISHERY*

### 3.1 *History*

Beche de mer is the commercial name given to the cured sea cucumber, a holothurian *(Phyiu,n Echinodermata).* It is considered a delicacy, very popular in some Southeast Asian countries, and is prepared from the body walls of certain species of large holothurians. Sea cucumber have long been recognized as a food, and a source of income, in Indo-Pacific and South Pacific countries, many of which have beche de mer fisheries dating back over a hundred years.

The fishery for beche de mer *(Huifi Landa* in Dhivehi) in the Maldives is of very recent origin and seems to have commenced in 1985. A trial shipment of 31 kg of Prickly Redfish *(Thelonota ananas)* was made by a marine product exporter to Singapore in late 1985.

A second exporter entered the field in late 1986. The only species collected and processed during 1985 and 1986 was Prickly Redfish. A second species, White Teatfish *(Microthele nobilis)* has been collected and exported from late 1986. The first exporter obtained his supplies from northern atolls, beginning the operation by using two boats, *vadu dhonis,* in Raa Atoll in 1985 and extending it to Haa Alifu Atoll in 1988, operating five boats. The second exporter concentrated on the southern atolls – Gaafu Dhalu, Gaafu Alifu and Laamu Atolls, where local fishermen were given soft loans and other basic needs to enter the fishery. They were also guaranteed that the processed product would be purchased at prevailing market prices. Thus, within two years of inception, the fishery extended to many atolls across the archipelago.

With the exporters coming into contact with more and more foreign buyers, the number of species harvested from Maldivian waters also increased. Three more species were collected, processed and exported in 1987. And since 1988, nine species are being exported.

### 3.2 *Species*

The names of the different species of sea cucumber commercially harvested and exported from the Maldives are given in Table 1.

**Table I**
**Names of commercially harvested holothurians**

| *Scientific name* | *English (Trade) name* | *Maldiwan (Dhivehi) name* |
|---|---|---|
| *Microthele nobilis* | White Teatfish | *Batu* |
| *Microthele axiologa* | Elephant's Trunkfish | *Elephant* |
| *Acinopyga* sp. | Blackfish/Killofish | *Ka/hu K,ru* |
| *Actinopyga mauritiana* | Surf Redfish/Sandfish | *Mush,* |
| *Thelenota ananas* | Prickly Redfish | *Alanaasi (Molhu)* |
| *Thelenou anax* | Turtleshell (Giant Beche de Mer) | *Turtle (Kachchala)* |
| *Halodeima afro* | Lollyfish | *Fulhi (Holhi)* |
| *Stichopus chioronotus* | Greenfish | *Feecu (Kudi Kashi)* |
| *Bohadschia marmorala* | Amberfish | *Hudu Kiru* |



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The common English names by which some Maldivian varieties are known may not refer to the same species elsewhere, *e.g:*

- Surf Redfish (A. *mauritiana)* is also referred to as sandfish, the name which is also given to *Holothuria scabra.*
- *T. anax* is popularly known as Turtleshell. It is also known as Giant Beche de Mer or Amberfish in the South Pacific, whereas Amberfish is the name given for *B. marmorata* in the Maldives. *B. marmorata* is also known as Brown Sandfish.

## 3.3 *Fishing methods, areas and seasons*

The sea cucumber is caught by fishermen in all but one of the islands visited. The exception is Kadholhudhoo, where an organized sea cucumber fishery employs scuba divers. In the other 16 islands, just over 2500 fishermen are involved in this fishery to varying degrees. About 140 to 160 of them (from Thulhaadhoo, Maduvaree, Landhoo and Maafaru), comprising 5-6 per cent of the total population of fishermen in the 16 islands, are involved in year-round sea cucumber fishing on a full-time basis.

It is apparent that the sea cucumber fishery has replaced the reef fishery as the main fishery during the non-tuna season in most of the islands. The peak tuna fishery season is either during the Southwest Monsoon period (May to October) or the Northeast Monsoon period (November to April), depending on the geographic location of the island, and nearly all fishermen are engaged in tuna fishing during these periods. But even during the season, fishermen in II of the 17 islands visited would fish for sea cucumber if tuna fishing was poor. Based on information provided by the fishermen, the following is an estimate of the average number of fishing days/month during different seasons for the sea cucumber fishery

| *Season* | *No. of days/month* |
|---|---|
| (a) During the peak tuna fishing season | 7 |
| (b) During the non-tuna fishing season, by fishermen engaged in mixed fisheries | 12 |
| (c) During the non-tuna fishing season, by full-time sea cucumber fishermen | 20 |

In about half the islands visited, fishing trips are usually to fish off islands within the atoll and are of one day's duration and rarely of more than three days. Earlier, fishermen in Hithaadhoo and Maakurathu had visited other atolls, but had discontinued this practice due to the decline in harvests. Fishermen from nine islands frequently visit other nearby atolls, spending nearly a week (Hulhudheli, Goidhoo and Landhoo), two weeks (Komandoo and Maafaru) or even a month (Feeali) away from their home bases.

When the fishery started, sea cucumber were picked by hand during low tide from the intertidal region and from shallow water lagoons of less than one metre depth. As the resource became less abundant in these areas, snorkling and use of other aids helped to exploit the resources in deeper waters, up to 15-25 m.

A fishing hook fixed to a block of lead and attached to a fishing line is popular in many islands. The diver-fishermen, remaining on the surface or descending just a few metres underwater, depending on the visibility, lower the device to hook the sea cucumber. This is similar to a device reportedly used in the Solomon Islands (James, 1989). A pointed metal spear mounted on a long wooden pole, used in the collection of sea cucumber in some islands, is reported to be effective upto a depth of about 3 metres. The fishermen of some islands *(e.g.* Badidhoo, Landhoo) fish for nocturnal species, such as *Bohadschia marmorata,* using torches.

Scuba diving for sea cucumber, which is now spreading rapidly, developed in response to the depletion of the high valued species, *T. ananas* and *M. nobilis,* in shallow waters.

*Cleaning of beche de mer* (H. atra) *in Feeali, Faafu Atoll.*

*Cleaning of beche de mer in Thulhaadhoo, Baa Atoll*

Scuba diving may have started in 1989. Fishermen of five islands in the northern atolls (Raa and Baa Atolls) observed groups of divers collecting sea cucumber in early and late 1989 during the Northeast Monsoon period. Each group comprised 3-6 divers. This practice soon spread to the southern atolls as well. Fishermen from five islands in the southern atolls of Meemu, Dhaalu and Faafu observed divers collecting sea cucumber in late 1990 and early 1991.

Detailed information on this practice was obtained from a Maldivian businessman operating a fleet of three mechanized boats, *mas dhonis,* to collect sea cucumber using scuba divers. He had 17 divers working for him, collecting sea cucumber from all the northern atolls except Haa Dhaalu. Most of the divers are from Kadholhudhoo island, with a few from other nearby islands. In addition, there were 13 persons involved in processing and other activities. He began this operation in 1988 and claimed to have obtained a permit from the Ministry of Trade and Industries for the purpose. The 17 divers work in two groups, generally working in the same area and fishing for sea cucumber 15-20 days/month for nine months of the year. White Teatfish *(Microthele nobilis)* and Prickly Redfish *(Thelenota ananas)* are selectively harvested. Current catches consist of around 97 per cent of the former and 3 per cent of the latter.

The divers were reported to be collecting the bulk of the catch within a depth range of 5-30 m. Processing was done in nearby islands (preferably uninhabited) where they were operating. The processed product was sold to exporters in Male, whO paid 105 Rf/kg for good quality beche de mer.

The divers were paid a fixed monthly wage of Rf. 2500 each, while the supporting staff were each paid 1500-2000 Rf/month, with food being provided by the businessman. The latter also knew of two other groups, with a total of about eight scuba divers, operating in the southern atolls from late 1990.

One of the Atoll Chiefs mentioned that although there was no ban on scuba diving for sea cucumber, divers were almost always armed with a permit lest they were barred from scuba diving for sea cucumber by the Atoll Chiefs. An Island Chief also referred to an entry made in his records of a group of scuba divers who had produced such a permit, These permits were apparently issued by the Ministry of Trade and Industries without the involvement of the Ministry of Fisheries and Agriculture.

A team of 12 divers was also employed from mid-1988 to mid-1989 by a Male firm to collect sea cucumber from Raa and Baa Atolls. Each diver was paid 1500 Rf/month plus food and lodging for six days' fishing per week.

It is difficult to estimate the number of scuba divers active in the sea cucumber fishery at present. One exporter thought there were about 50 of them.

## 3.4 *Processing*

Processing of sea cucumber is done in the fishermen's own islands or on other islands. During long trips to other islands and atolls, fishermen are accustomed to processing their catch on other islands, frequently uninhabited ones. The crew of each boat processes their catch independently. If a number of boats work together, processing is done by a few shore based persons.

Cleaning of sea cucumber commences on the fishing boat itself, while it is returning to base after a fishing trip. A horizontal cut is made on the upper or lower side of the animal to remove its internal organs, which are usually thrown into the sea or lagoon. The rest of the cleaning is completed on shore (see facing page) with the offal being either thrown into the lagoon or buried ashore, as in Kendhoo, Komandoo, Lhohi and Maafaru islands. Fishermen of Maakurathu, Komandoo and Maafaru islands prefer to do all the cleaning ashore.

*Oil drum used in cooking beche de mer.*

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*Aluminium pot used in cooking beche de mer (also maldive fish).*

The cleaned sea cucumber are then cooked in a container made of half a 44-gallon drum cut lengthwise (see facing page). Aluminium pots used in the preparation of Maldive fish are also used in Hithadhoo, Thulhaadhoo and Kendhoo islands (see facing page). In most of the islands, cooking is done by putting the sea. cucumber into already warmed water.

For large; thick walled species, such as *T. ananas, M. nobilis,* and *1'. anax,* cooking time is generally *45* minutes after the water in the container starts to boil again. Other species are cooked for 15 to 30 minutes. The sea cucumber are generally sorted by specics before cooking, except in a few islands (Meedhu and Biledhdhoo). Larger, thick-walled species are cooked separately from smaller, thin-walled species. In Feeali and Hithaadhoo, they are placed in cold water and then boiled, while both methods are adopted by fishermen in Maduvaree, Kendhoo, and Maafaru islands. When cold water is used, the total cooking time could be about two hours for large, thick-walled species and an hour for others. Fishermen in Kendhoo claimed that cooking in warm water gave a better product with White Teatfish, Amberfish and Killofish. No difference was observed between the two cooking methods as far as the other species were concerned.

White Teatfish and Prickly Redfish collected by the divers operating from Kadholhudhoo are processed in a slightly different way. They too cook the cleaned sea cucumber in hot water for 45-60 minutes. But they also use a second method. In this method, as much viscera as possible are removed without cutting. The product is then boiled for about 30 minutes, washed and buried for 12-18 hours. After retrieval, a ventral cut is made to remove the remaining viscera and then the seacucumber are boiled for another 30 minutes. This method is reported to yield a better product than the more popular cooking method.

In Maduvaree island, Prickly Rcdfish are cooked twice, 30 minutes at a time with a change of water in between. In Thuvaru, too, they are cooked twice. After a first cooking for about 15 minutes, a cut is made mid-ventrally and then the sea cucumber are cooked again for about 30 minutes. The viscera are removed thereafter. The cooking water is either thrown on shore or into the lagoon.

After cooking, the product is smoke-dried to reduce the moisture content. Short sticks are usually placed across the cut to keep the sides apart. This facilitates proper drying of the innerside. Smoking is usually done near the beach, inside kitchens or on platforms generally constructed with coconut leaf stems. When the fishermen of Feeali undertake long trips to other atolls, they resort to smoking the beche de mer in their boats; half an oil drum covered with a wire mesh is used and coconut husks serve as fuel.

The smoked beche de mer is then sun-dried (see pictures on page v and below) until a hard, dry product is obtained. The duration of smoking and the frequency of sun-drying depend on the species, the heat of the smoking fire, the prevailing weather etc.

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*Sun drying of beche de mer on the ground (Hithaadhoo island, Baa Atoll)*

When processing is done in home bases, there is active participation of women in the cooking, smoking and sun-drying of the product.

## *3.5 Marketing and export*

**Beche de mer** produced in the islands are either taken to Maté or sold in the islands. Some of the major exporters have agents in the islands purchasing on their behalf. The exporters usually get the beche de mer into their warehouses within a month of the sea cucumber being caught. The prices paid to the fishermen for beche de mer during different periods from 1987 are given in Table 2.

**Table** 2

**Average prices paid to fishermen for beche de mer (Rf/kg)**

| *Species* | *1987* | *1988 July* | *1990 June* | *1990 Nor.* | *1990 April* |
|---|---|---|---|---|---|
| *M, nobilis* | 23 | 30 | 65 | 65-67 | 77-80 |
| *T. onanas* | 42 | 60 | 85 | 85 | 100 |
| *S. chloronojus* | 28 | 30 | 65 | 65-67 | 77 |
| *A. mauriliana* | 23 | 26 | 35 | 40 | 45-50 |
| *Actinopygasp.* | 9 | 11 | 33 | 33 | 37 |
| *B. mar,norala* | — | — | — | — | 40 |
| *H. atra* — large | — | — | 30 | 33 | 36-37 |
| — small | — | — | 10 | 10 | 10-12 |
| *M. axiologa* | — | — | 12 | 15-19 | 30 |
| *T.anax* | — | — | — | 19 | 30 |

The size range and the number per kg ascertained from stocks held by an exporter are given in Table 3.

**Table 3**

**Size range of some beche de mer varieties**

| *Species* | *Size range* | *No/kg* |
|---|---|---|
| *T. ananas* | 7 - 9' | 6 |
| *81. nobilis* | 6 - 7.5" | 6 |
| *S. chloronotus* | 4 - 5.5" | 38 |
| *A. mauritiana* | 4.5 - 6" | 14 |
| *Aclinopyga* sp. | 5-7.5" | II |
| *B. marmorata* | 6- 7" | 13 |
| *H.atra* | 6-7" | 25 |
| | 4-6" | 93 |
| | <4" | 255 |
| *81. axiologa* | 7 - 9" | 4 |
| *T.anax* | 8-9" | 4 |



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The exporters keep the beche de mer in warehouses in Male, in bulk and unsorted. They are sorted into different varieties and packed in polypropylene bags just two or three days before shipping (see picture below). In earlier years (1987/1988), it was customary for the beche de mer to remain in warehouses for as long as two months, until markets and shipments were arranged. But since 1990, no exporter keeps beche de mer in his warehouse for more than 20 days. Then it is shipped out, usually in containers.

*Sorting and packing of beche de mer for export*

Very often, one exporter will buy from another exporter (at FOB prices) if he has a prepaid order, a deadline to meet and is short of supplies of a particular variety or varieties.

About six marine products exporters are actively involved in the export of beche de mer from the Maldives. Maldivian beche de mer is exported mainly to Singapore and Hong Kong, and, to a much less extent, Taiwan. Some exporters have also set up companies in Singapore to receive beche de mer exports and undertake distribution to other suppliers in both Singapore and Hong Kong. FOB prices paid by Singapore/Hong Kong buyers at different periods since 1988 for Maldivian beche de mer are given in Table 4.

**Table 4**

**Average export** prices **(FOB) for** beche de mer exported (US $/kg)

| *Variety* | *1988* *Aug* | *1989* *May* | *1990* *June* | *1991* *April* |
|---|---|---|---|---|
| *M. nobiis* | 5.40 | — | 8.50 | 9.50- 10.00 |
| *T. ananas* | 9.50 | — | 11.50 | 12.00. 12.70 |
| *S. chloronotus* | 5.75 | 6.50 | 7.80 | 8.70. 9.60 |
| *A. mauritiana* | 3.50 | 4.50 | 5.50 | 6.50- 6.80 |
| *Actinopygasp.* | — | 1.80 | 3.50 | 4.90- 5.75 |
| *B. marmorata* | — | — | 3.50 | 4.50. 4.85 |
| *H. atra* — large | — | — | 3.50 | 4.50 |
| — small | — | — | 2.31 -1.50 | 2.80 |
| *M. axiologa* | — | — | 3.00 | 3.50 |
| *T. anax* | — | — | 2.50 | 3.40. 3.50 |

Marine products exporters in the Maldives have to obtain an export licence for a fixed sum equivalent to the FOB value of items expected to be exported. The items to be exported are listed, but not the quantities. Some items, though listed, may not actually be exported at all. Once the exports reach the FOB value approved in the licence, the exporter should get a new one. All marine products are exported through this licence, except for clam meat and ornamental fish exported under separate licences on the basis of a quota fixed by the Ministry of Fisheries and Agriculture. All licences are valid for six months.

No export duties are levied on the export of fishery products from Maldives. A stamp duty of Rf. 1 for every Rf 1000 in the export licence is charged at the time of issue of the licence. Only the export of ambergris is subject to a levy of 50 per cent export duty, in addition to the stamp duty.

## 3.6 *Income and expenditure*

Expenses on fuel incurred by fishermen using mechanized *dhonis* for collection of sea cucumber are highly variable, depending as they do on the range of their operations. Information on fuel expenditure in several islands is summarized in Table 5.

**Table 5**

**Expenses incurred by mechanized *dhonis* for collection of sea cucumber.**

| *Type of operations* | *Fuel (Rf)* | *Food (Rf)* | *Source of information* |
|---|---|---|---|
| a) Within atoll for trips of less than one day's duration. | 50-100 | — | |
| b) Fishing trips to other atolls. | | | |
| *Duration:* — Day trip | 200-300 | | Badidhoo/Biledhdhoo |
| 5-7 days | 300/trip | 15-20 per fishermen | Goidhoo/Landhoo |
| 10-12 days | 700/trip | per day | Kornandoo |
| 15 days | 1100/trip | | Maafaru |

In a few islands, the distribution of income from sea cucumber fishing takes the form of sharing the catch itself, before or after processing. The share system differs between sailing and mechanized ***dhonis.*** In most islands, however, the practice is to distribute the proceeds from the sale of the catch, after the boat owner recovers his operational expenses on fuel and food.

The share system varies between islands and also between sailing and mechanized *dhonis.* In certain islands (Huludheli, Kendhoo, Maduvaree, Landhoo and Maafaru), the supplier of basic equipment for sea cucumber collection, such as masks, snorkels etc., also gets a share of the income equal to that of a crew member. This share is paid to the boat-owner if the items are supplied by him. If the fishermen use their own equipment, however, this share is not paid. The distribution of income in various islands is summarized in Table 6.

**Table 6**

**Distribution of income from sea cucumber fishing**

| | | *SAiLING* DHONI | | *MECHANIZED* DHONI | | |
|---|---|---|---|---|---|---|
| | | *Boat* | *Crew* | *Boat* | *Crew* | *Island* |
| I. Product shared before processing | | 50% | 50% | 2 shares | 1 share/crew member | Hithaadhoo |
| 2. Product shared after processing | | 50% | 50¾ | 2 shares | 1 share/crew member | Meedhu |
| 3. Net profit shared after sale of product | (a) | | | 50% | 50% | Badidhoo,Biledhdhoo, Kendhoo,Maaknrathu, Landhoo, Maafaru |
| | (b) | | | 50% | 1½ shares to collectors and 1 share to processor | Feeali |
| | (c) | | | ¾ | ¾ | Goidhoo |
| | (d) | | | 2 shares | 1 share/crew member | Hulhudheli, Hithaadhoo, Thulhaadhoo, Komandoo |
| | (e) | | | 3 shares | 1 share/crew member | Maduvaree |
| | (1) | 50% | SOu/s | | | Badidhoo, Biledhdhoo, Feeali |
| | (g) | 1 share | 1 share/crew member | | | Hulhudheli, Hithaadhoo, Thulhaadhoo, Landhoo Maafaru |
| | (h) | 2 shares | 1 share/crew member | | | Kendhoo, Maduvaree, Maakurathu, Komandoo |



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The monthly income of a fisherman from sea cucumber fishing varies from Rf. 500 to Rf. 3000 and is directly dependent on the fishing effort and available resources. In some islands, such as those grouped in (a) and (b), in Table 7, there has been a definite decline from the levels of income that prevailed in previous years. The income levels in different islands are shown in Table 7.

**Table 7**

**Leve's of income from sea cucumber fishing**

| island | Present average monthly income of a fisherman in peak season (Rf) | Previous monthly income (Rf) |
|---|---|---|
| (a) *Rf. 1000* | | |
| Hulhudheli | 800 | 1500-1800 *(1987/1990)* |
| Badidhoo | 400-500 | |
| Goidhoo | > 800 | |
| Kendhoo | 500-600 | |
| (b) *Rf 1000-2000* | | |
| Thuvaru | 1200 | 3000 *(1989)* |
| Meedhu | 1000 | |
| Lhohi | 1500 | |
| (c) *Rf 2000-3000* | | |
| Feeali | 2000 | |
| Hithaadhoo | 2000 | |
| Maduvaree | 2000 | |
| Maakurathu | 2000 | |
| Komandoo | 2000 | |
| Thulhaadhoo | 2500-3000 | |
| Landhoo | 2500-3000 | |
| Maafaru | 2500-3000 | |

These incomes compare with the following monthly incomes earned by fishermen in some islands from tuna fishing: Rf.800 in Goidhoo, Rf 500-600 in Kendhoo, Rf 400-500 in Meedhu, Rf 700- 800 in Feeali and Hithaadhoo, Rf 2000 in Maakurathu and Madhuvaree, Rf 1500 in Komandoo, Rf 3000 in Thulhaadhoo, Rf 500/600 to Rf 2000 in Landhoo and Maafaru.

## 3.7 *Production trends*

All the beche de mer produced in the Maldives, except for very small quantities consumed in some Male restaurants and in some resorts, are exported. The quantities and FOB values of exports during 1985-1990 are shown in Table 8.

**Table 8**

Exports **of beche de mer (1985** - 1990)

| | Qy (m.tons) | Value (Rf) | US P |
|---|---|---|---|
| 1985 | 0.031 | 200 | 28 |
| 1986 | 2.557 | 182,613 | 25,540 |
| 1987 | 33.886 | 3,115,632 | 337,921 |
| 1988 | 553,114 | 39,477,757 | 4,496,327 |
| 1989 | 410,286 | 15,775,881 | 2,240,892 |
| 1990 | 745,925 | 31,584,050 | 3,307,230 |

* (US $ = Md. Rf 7.09 in 1985, 7.15 in 1986, 9.22 in 1987, 8.78 in 1988, 7.04 in 1989 and *9.55* in 1990

(SOURCE : Ministry of Fisheries and Agriculture, Male)



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Significant increases in production have taken place in 1987-88 and, after a drop in 1989, again in 1990.

The monthly exports are shown in Figure 2 (facing page), separately for the years 1988 to 1990 together with the mean of the three years obtained by pooling the monthly data, to observe seasonal variations in production. The export procedure ensures that the time lag between harvesting and export does not exceed one month.

The data shows a seasonality in the fishery. During the first full year of harvesting, *i.e.* in 1987, more beche de mer was produced during the tail-end of the Southwest Monsoon and the beginning of the Northeast Monsoon period. Although in 1988 production appears to have been higher during the Southwest Monsoon months, the seasonality pattern seen in 1987 is repeated in 1989. Monthly fluctuations in production are characteristic of 1990. The mean for the three years shows peak production during March to May, July-August and October-November.

A species-wise estimate of the exports from 1986 to 1990 is given in Table 9. Export data provided by some of the exporters were used to derive the percentage species composition which, in turn, was used to estimate the quantities of different species produced/exported in the table. Only one major exporter operated until 1987 and his data were used for 1986 and 1987. For 1988, 1989 and 1990, species composition data were available for *45* per cent, 58 per cent and 56 per cent respectively, of the total exports, by pooling export data from at least three exporters for each year.

**Table 9**

**Species composition of beche de mer exports 1986-1990 (mt)**

| | 1986 | | 1987 | | 1988 | | 1989 | | /990 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Species | Qty | % | *Qry* | ¾ | Qty | ¾ | *Qty* | ¾ | *Qty* | ¾ |
| T. *ananas* | 2.28 | 89.3 | 12.44 | 36.7 | 61.40 | II.! | 17.23 | 4.2 | 18.65 | 3.5 |
| *M. nobilis* | 0.28 | 10.7 | 10.74 | 3I.7 | 67.48 | 12.2 | 54.16 | 13.2 | 99.21 | I3.3 |
| *S. chioronotus* | — | — | 4.51 | 13.3 | 60.29 | 10.9 | 46.36 | 11.3 | 107.41 | 14.4 |
| *A. mauritiana* | — | — | 5.00 | 15.0 | 155.42 | 28.1 | 37.34 | 9.1 | 49.23 | 6.6 |
| *B. marmorata* | — | — | 1.12 | 3.3 | 71.90 | 13.0 | 53.75 | 13.1 | 65.64 | 8.8 |
| *Actinopyga* sp. | — | — | — | — | 69.60 | 12.6 | 133.75 | 32.6 | 123.82 | 16.6 |
| *H. atra* | — | — | — | — | 44.80 | 8.1 | 38.I6 | 9.3 | 213.34 | 28.6 |
| *M. axiologa* | — | — | — | — | 17.79 | 3.2 | 17.23 | 4.2 | 32.82 | 4.4 |
| *T. anax* | — | — | — | — | 4.42 | 0.8 | 12.31 | 3.0 | 28.35 | 3.8 |
| TOTAL | 2.56 | | 33.81 | | 553.10 | | 410.29 | | 738.47 | I00.0 |



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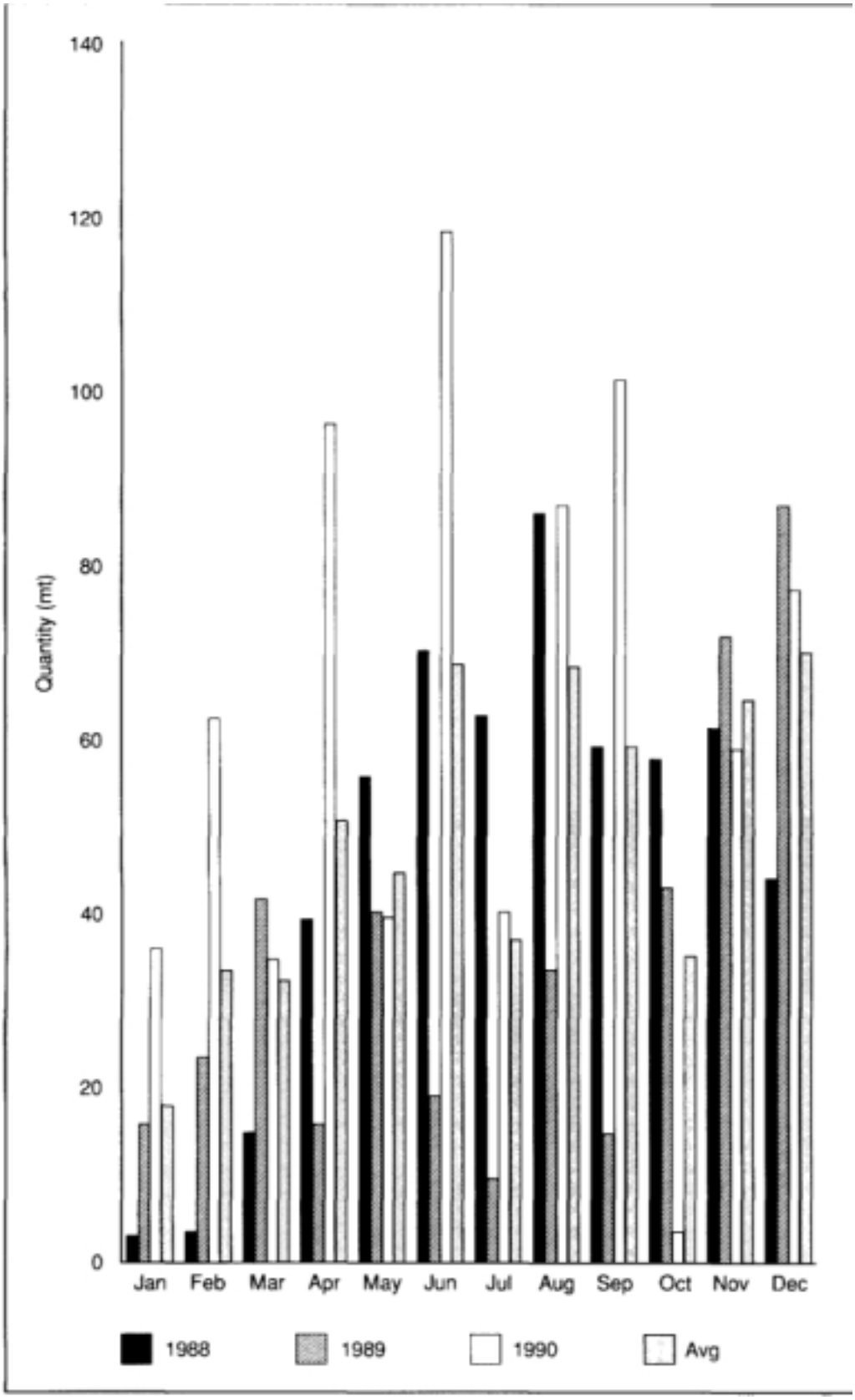
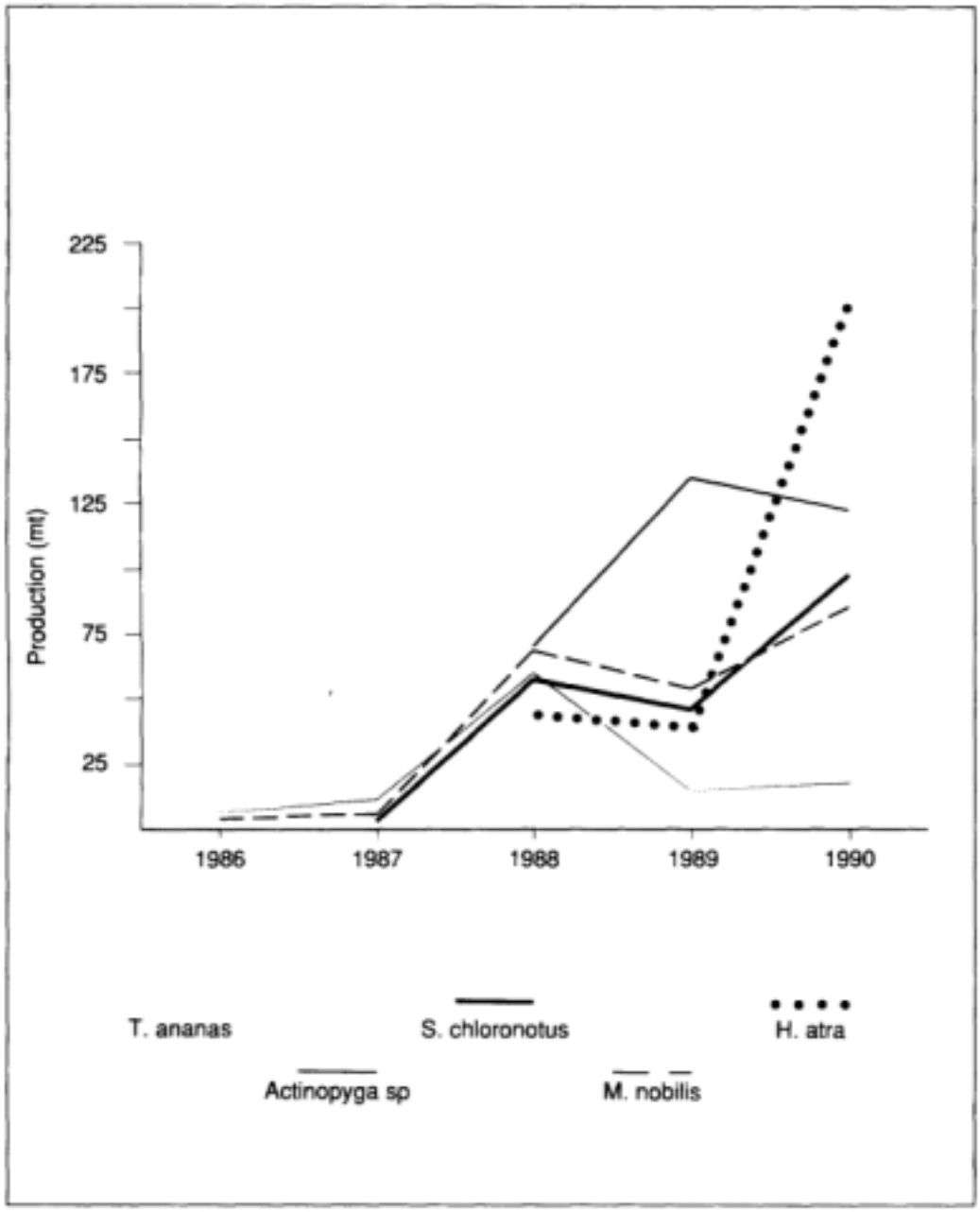
Fig. 2. Monthly exports of beche de mer, 1988 - 1990



Annual variations in the production of major species of beche de mer are shown in Figure 3. Catches of high valued *T.ananas* reached a maximum of 61.4 mt in 1988 and declined to 18.6 mt by 1990, representing only 3.5 per cent of the total catch in 1990. The other valuable species, *M.nobilis*, shows a decline in 1989, but the production has increased again in 1990 to nearly 100 mt. The same trend is shown in the production of S. *chioronotus.* Catches of *A. mauritiana* had reached a peak of *155.4* mt in 1988 (28 per cent of the total catch) and have, since then, declined to less than 50 mt, representing only 6.6 per cent of total catch in 1990. Annual catches of *B. marmorata* were within the 50-70 mt range during 1988 to 1990. *Actinopyga* sp. recorded the highest catches in 1989 (32.6 per cent) and the level of production was maintained in 1990. Catches of low valued *H. atra* have increased nearly five-fold from 1988 to 1990, from 44.8 mt in 1988 to 213.3 mt in 1990. It made up 28.6 per cent of the total beche de mer catch in 1990.

**Fig. 3. Annual variation in the production of major beche de mer varieties**



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## *4. THE BECHE DE MER RESOURCES*

Sea cucumber are strictly marine animals and inhabit all seas and all depths, from the intertidal zone to the deepest abysses. They show a surprising degree of adoptive radiation — some are benthic,some pelagic and some burrowing. They are primarily of benthonic habit and, although in shallow waters they may occur in rocky crevices or under rocks, the majority are found lying more or less buried or concealed on sandy or murky bottoms. They usually feed on sediments. A few are filter feeders.

The Indo-West Pacific area appears to harbour the richest holothurian fauna. According to Hyman (1955), there are about 500 species the world over that have been described. James (1989) puts it around 650.

Nearly 200 species are known from seas around India, with about 75 being found in shallow waters within twenty metres depth (James, 1989). Only 13 of these species are reported to be commercially important, a situation similar to that in Sri Lanka where a total of 70 species of holothurians have been recorded (Joseph and Moyiadeen, 1990). The Great Barrier Reef area is reported to contain about 100 of the approximately 150 species known from northern Australia (Clarke and Rowe, 1975, in Hammond *et al* 1985). Guille *et al* (1986) have described 55 shallow water holothurioid species from New Caledenia. The total number of holothurioids recorded from Madagascar is 122 (Cherbonnier, 1987).

The shallow water lagoons enclosed by the many reefs and islands should support large and varied holothurian populations in the Maldives. The Maldivian atolls rise very steeply from depths of 2500-4000 m, the reef dropping away to over 1000 m in less than 1 km in many places. By contrast, the water inside the atolls is relatively shallow. The larger atolls generally tend to have deeper central lagoons. The atolls in the south Maldives also appear to have deeper lagoons compared to those in the north. In the central Maldives, the approximate depths of the three largest atolls are: North Male Atoll 58 m, South Male Atoll 51 m and Rasdhu Atoll 36m. In contrast, the southernmost atoll in the Maldives, Addu Atoll, which is intermediate in size between South Male and Rasdhu Atolls, has a maximum lagoon depth of 66 m. The average depth of the Huvadhu Atoll lagoon in the south is 72 m.

The coral reef ecosystem in the Maldives is probably similar in its many atolls. But differences in the size and depth of the lagoons and the extent of different habitat conditions (sandy bottoms, sea grass beds, rocky areas etc) may bring about variations in the level of abundance of holothurian resources, both in qualitative and quantitative terms.

Very little is known about the holothurian resources in the Maldives, with no formal studies having been made. Preliminary investigations were carried out during Oct-Dec. 1988 by some Chinese biologists who were part of the Chinese team working on the UNDP/ ESCAP-sponsored Maldives/China pilot study on the application of remote sensing techniques to shallow water marine studies in the Male atolls. Manuscript reports available at the Marine Research Centre in the Maldives reveal that eight species have been identified from Baa, Haa Alifu and Haa Dhaalu Atolls during these investigations, namely *Stichopus chioronotus, Actinopyga lecanora, Actinopyga mauritiana, Halodeima atra, H. leucospilota, Microthele nobilis, Bohadschia marmorata* and *Synapta maculate.* The report also describes the different habitats of these species and lists the most abundant species encountered as *H. atra, H.leucospilota* and *A. lecanora.*



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In a study of the holothurioid assemblages on coral reefs across the central section of the Great Barrier Reef, Hammond *et a!* (1985) identified 23 species, with the most abundant being *H. atra* (41 per cent) and *S. chloronotus (35* per cent). The predominance of the two species, *H. atra* and *S. chioronotus,* occurring mainly on the reef flats, is a general characteristic of Indo-West Pacific reefs (Bakus, 1973 — cited by Hammond *et al* 1985).

The present review has also indicated large concentrations of *A. lecanora* in the southern atolls, while the relative abundance of *H. leucospilota* (immature ones in tidal water, mature ones in deeper water) was greater in the northern atolls. Other species identified in the Maldives include *H. edu/is* and *S. variegatus* (Charles Anderson, pers. comm.), *Bohadschid argus* and *Bohadschia graeffei* (Nashid Rafeeu — pers. comm.). The commercially harvested holothurians at present include about four or five additional species.

A brief description of the commercially harvested species and their habitats, and comments on the status of the resource, are given in the Annexure.

On the basis of information provided by fishermen, the relative abundance of the commercially harvested holothurians was ascertained at four levels of abundance — very common, common, rare and very rare — and this is shown in Table 10. *H. atra, S. chioronotus* and *Actinopyga* sp. were the three most abundant, while the least abundant were *T. ananas,* followed by *M. nobi/is* and *A. mauritiana.*

**Table 10**

**Relative abundance of commercially harvested holothurians**

| | MEEDHU | HULHUDHELI | BAIDUDHOO | NILEDHOO | FEEALI | GOIDHOO | HITHADHOO | THULHAADHOO | KENDHOO | MADUVAREE | MAAKURATHU | KOMANDOO | LHOHI | LANDHOO | MAAFARU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T. ananas | | ** | * | ** | * | | ** | ** | ** | * | | ** | | ** | ** |
| M.nobilis | + | * | * | | * | | * | * | ** | ** | * | * | ** | | |
| A.mauritiana | + | * | ** | + | * | * | * | + | + | * | + | + | * | + | + |
| S.chloronotus | + + | + * | + | + | ++ | + | + | + + | + | + * | + + | * | + | .. | + |
| Actinopygasp. | + | * | + | ++ | + | + | | + | + | + | + | + | + | + | + |
| B.marmorata | + | * | + | + | + | + | * | * | * | + | + | + | + | + | |
| H.atra | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| M.axiologa | + + | + | + | + | + + | + | * | * | ' | * | ' | + | + | + | |
| T.anax | + | + | + | ++ | + | + | ± | * | * | + | * | + | + | + | * |

+ + Very Common + Common * Rare Very Rare



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## 5. *PROBLEMS, ISSUES AND CONCERNS OF THE FISHERY*

### *5.1* ***Decreasing*** *catches of high value species*

The beche de mer fishery in the Maldives has developed at a very rapid rate, from 2 mt to 745 mt, within the very short period 1986-1990. The yearly catches continue to increase rapidly, but the income generated by the fishery has been showing a decrease in recent years. This is the result of decreasing catches of high-valued species and increased catches of low-value species.

The heavy dependence on low-value species has resulted in a substantial drop in the average price per kg paid for Maldivian beche de mer in export markets, as may be seen from the following

| | *MD.Rf* | *US$* |
|---|---|---|
| 1986 - | 71.42 | 9.99 |
| 1987 - | 91.95 | 9.97 |
| 1988 - | 71.37 | 8.12 |
| 1989 - | 38.39 | 5.45 |
| 1990 - | 42.34 | 4.43 |

High value species like *T. ananas* and *M. nobilis,* which were exclusively harvested at the beginning, are still being selectively harvested by scuba divers. Although increased scuba diving has helped to maintain, or even increase, the annual catches of *M. nobi/is,* catches of *T. ananas* remain very low, being less than 5 per cent of the total catch during the last two years. These low catches, even with scuba diving, point to a very low level of abundance of this species. It is likely that *M. nob//is* will follow *T ananas* in the not too distant future. If the spawning populations of these species, which generally find greater protection in deep waters, are drastically depleted, recovery may take a very long time.

### *5.2 The nocturnal species*

Fishermen in some islands expressed concern about the selective harvesting of nocturnal species such as *B. marmorata* and certain *Actinopyga* sp. using torches. As in the case of scuba diving for *M. nob//is,* the increased catches of *B. mamorata* may be due to the selective harvesting and not due to a real increase in abundance. This species is already rare in some islands. The possibility of depletion through intensified night fishing cannot be ruled out, particularly when other high value species are in short supply.

### *5.3 Harvesting juveniles*

Very low-value species such as *H. atra* are fast becoming the "bread and butter" line of the fishery. Being the most abundant species, and also abundant in shallow waters, it is being harvested in increasingly large numbers. When the fishery has to rely on low value species such as *H. atra* for its survival, indiscriminate harvesting of very small sizes does not augur well for the future of the industry. Reference has already been made to the presence of a large proportion of juvenile *H. atra* in the catches, which also represents under-utilization of the resource.

### *5.4 Poor processing*

Techniques for cleaning and processing sea cucumber have not been demonstrated to Maldivian fishermen. Some of the pioneer exporters who received instructions from their foreign buyers at the commencement of the fishery passed them on to the fishermen. One exporter had leaflets printed in Dhivehi, describing the processing techniques, for distribution amongst fishermen. Some fishermen recalled having listened to a couple of radio programmes on sea cucumber, in one of which the processing technique was explained.

The quality of the beche de mer produced in some islands was very poor (see pictures facing page). Processing of sea cucumber requires only simple equipment and the procedures are also very simple, but need to be carefully followed if a good quality product is to be obtained. These are well and clearly set out in, for instance, Handbook No. 18, *Beche de Mer of the Tropical Pacific*, South Pacific Commission, 1979. According to these instructions, some species, such as White Teatfish, are first boiled without cutting.

It is also very important not to cut the beche de mer right across the mid-dorsal line, as it will prevent the carcass from being closed properly, resulting in an inferior product. When cooking, it is also important to introduce the animals into boiling sea water. James (1989) has listed the advantages of this practice over that of cooking the sea cucumber in cold water.

It is evident that the processing techniques followed by the large majority of Maldivian fishermen do not result in a quality product. Foreign buyers have complained about the poor quality of beche de mer from the Maldives, particularly citing the grounds that they are not well cooked and well dried. Some exporters estimated that 10-20 per cent of the beche de mer brought to Male by fishermen were of poor quality. Another exporter, however, stated that the proportion of poor quality beche de mer, which was 50 per cent of the total before 1990, has now been reduced to about 10 per cent.

Export of poor quality beche de mer represents uneconomic utilization of the resource. One exporter expressed the view that revenue from export of beche de mer could be increased by about 30 per cent if the quality could be improved. A consignment of 2000 kg of Prickly Redfish *(T. ananas)* exported to Japan in 1988 is a case in point. Its FOB value was US $ 16.15 per kg. Due to poor quality, over 1600 kg had to be diverted to Singapore and fetched only US $ 8.00 per kg in Singapore.

## *5.5 Migration of fishermen*

There is a considerable amount of migration of fishermen to other atolls in search of beche de mer. There have also been instances where migrant fishermen have been turned back by Atoll Chiefs. These migrations may increase with more and more fishermen desiring to benefit from this resource. Fishermen in most islands tend towards the view that this type of sedentary resource should be left exclusively for the use of the people of an island/atoll.

## *5.6 Interaction of the fishery*

The rapid development of the sea cucumber fishery within such a short period of time in the Maldives may probably have interacted with other fisheries since the same fishermen and craft are involved in all fisheries. The types of interactions and extent, while difficult to ascertain during such a short study, may also vary between atolls/islands due to differences in resources situations, levels of exploitation and economic benefits.

## *5.7 The tuna fishery*

One area of concern that surfaced during the review is the effect of the sea cucumber fishery on the tuna fishery. The average monthly income from the sea cucumber fishery exceeded that from the tuna fishery in some islands (Meedhu, Hithaadhoo, Landhoo and Maafaru). However, fishermen in these islands would prefer to concentrate on tuna fishing during the season.

Fishing for sea cucumber involves more hard work than tuna fishing and is more suitable for younger fishermen able to dive underwater. Most tuna fishermen would, therefore, like to consider it a secondary activity. The fishermen in some islands, like Feeali, however, would wish to carry out year-round sea cucumber fishing if sea conditions were favourable.

The extent to which these opposing trends are prevalent throughout the country, and whether the sea cucumber fishery could affect the fishing effort and catch in the tuna fishery, is not clear.

*Badly processed beche de mer, Hulhudheli island, Dhaalu Atoll*

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*Badly processed beche de mer, Badidhoo island, Dhaalu Atoll*

## *5.8 Toxic properties*

In the past, fishermen have observed unusually heavy mortality of live bait in tuna boats which have been previously used for sea cucumber fishing. They have now more or less got over this problem by cleaning the boats thoroughly before going out tuna fishing and by keeping sea cucumber in containers, or on canvas laid on the deck, to minimize the poisonous effect on bait fish.

Fishermen in Hithaadhoo had seen dead fish around piles of sea cucumber kept at the edge of the lagoon, while fishermen in Badidhoo and Biledhdhoo felt that the dead scad and sardine observed in the lagoons were the result of throwing of sea cucumber viscera into the lagoons during processing. Fishermen in Goidhoo and Kendhoo, however, were either unaware of such an effect or felt that sea cucumber were not harmful to fish. *H. atra, T. ananas* and S. *chioronotus* are the species supposed to possess poisonous effects on fish. Fishermen in Maafaru and Komandoo claimed that water in which these species had been cooked was, when thrown into the lagoon, also, harmful to fish.

The sea cucumber appears, on the whole, to be a helpless and defenceless animal, yet there are a number of reports of its toxicity. In fact, a toxin called "holothurin", deadly to fish, is present in many species.

As reported in Hyman *(1955),* cuvierian tubules of *Holothuria argus* produce blisters and inflammation if they touch the skin. Water squirted from the cloaca of this animal causes dangerous inflammation, especially of the eyes. Although some authors deny any toxicity to many sea cucumber or their cuvierian tubules, including those of ***H.*** *argus,* there is definite proof of the toxicity of holothurians to other animals. Natives of Guam cut a common black cucumber in two and squeeze the contents into rock pools to stupefy fish; the fish come to the surface behaving in a weakened fashion. In recent years, sea cucumber have been widely used in the Indo-Pacific region to poison fish and help to capture them. The species employed seem to be *Holothuria atra,* which do not have cuvierian tubules. For example, people of Majuro atoll in the Marshall Islands use powdered, or mashed, black sea cucumber to poison fish and help in their capture. Maldivian fishermen had also resorted to this practice in the past.

The toxic properties of *Actinopyga agassizi,* a common holothurioid of the West Indies, has also been under investigation. This animal is toxic to fish and other animals, which will die in a short time if placed in aquaria that had been occupied by this species. These holothurioids, however, possess cuvierian tubules, but these do not emit into sea water. The tubules as well as other parts of the sea cucumber, especially the body walls, contain the toxic substance. No toxic action is known for the "cotton- spinning" type of cuvierian tubules that act simply by entangling intruders.

## *5.9 Ecological balance*

It is not certain what effects the removal of large quantities of sea cucumber have on the ecological balance in the lagoons. Although fishermen in some islands claim to have positively correlated fish kills with sea cucumber, they have not observed any reduction in the bait resources in the lagoons as a result of the sea cucumber fishery or of post-harvest practices.

# 6. ***RECOMMENDA TIONS***

The beche de mer fishery in the Maldives, despite its very short history, displays all the signs characteristic of an overexploited fishery. The fact that the trend observed in the islands visited are borne out by the trends derived from an analysis of the export data, shows that they are applicable to the entire archipelago. In the absence of a monitoring mechanism, these signs have not been recognized during a very rapid growth phase. Current levels of exploitation may also hinder future sustainable exploitation of this resource. In order to ensure a long-term sustainable exploitation of the resource, it is imperative to introduce regulatory mechanisms without delay.

The following recommendations are made, in the light of available information, for consideration by the concerned authorities.

(a) The collection and export of ***T.*** *ananas* (Prickly Redfish) should be suspended for 4-5 years to permit the recovery of the resource.

(b) The collection of beche de mer using scuba divitig should be banned. This will take the pressure off the spawning stocks of the valuable species *T. ananas* and *M. noN/is* (White Teatfish) inhabiting deeper waters.

(These two measures, when implemented together, may lead to eventual rehabilitation of *T. ananas* resources.)

(c) Collection and export of small-sized *H. atra* should be stopped by imposing a minimum size limit – say above 6" processed.

(d) Night fishing for nocturnal species such as ***B.*** *rnarrnorata* should be discouraged as a first step and then followed by a ban if increased fishing is accompanied by low catches.

(e) A data collection and monitoring mechanisni should be established for the fishery. It should be possible to collect some basic data on the fishery without too much effort. For instance, the Island Chiefs, or the government officials responsible for fisheries matters in the islands, could periodically gather data on the number of fishermen and craft involved in the beche de mer fishery. If a system is introduced requiring exporters to keep records of quantities and varieties of beche de mer obtained from different islands, these data, together with the fishing effort data from the islands, would serve to establish prevailing trends in the fishery in the different islands/atolls so that the requisite management strategies could be developed. Since the resource is very vulnerable to exploitation and highly sensitive to over-exploitation, the need for a monitoring mechanism cannot be over emphasized.

(f) Regulations should be introduced giving exclusive rights to the use of sedentary resources, such as beche de mer within an atoll, to fishermen of that atoll only. Since the beche de mer fishery is now carried out in almost all atolls, it is unlikely that the resources would remain underutilized in any atoll as a result of such a regulation. On the contrary, it is likely to lead to greater responsibility in exploitation and a better organized fishery. Monitoring and data collection would also become more efficient and reliable.

(g) Fisherfolk should be instructed in the correct and hygienic methods of processing to achieve maximum economic returns from the processed product. Different species are processed in different ways. Demonstrations, leaflets and the radio can be used in such extension activities.

(h) The establishment of sea ranching programmes for sea cucumber, with the active participation of fishermen, should be considered. Participation by resort owners could also be included. A sea ranching programme would be a very viable proposition, particularly in the context of a devolution of use rights as recommended in (f) above.

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**ANNEXURE**

**Commercially Harvested Species of Holothurians**

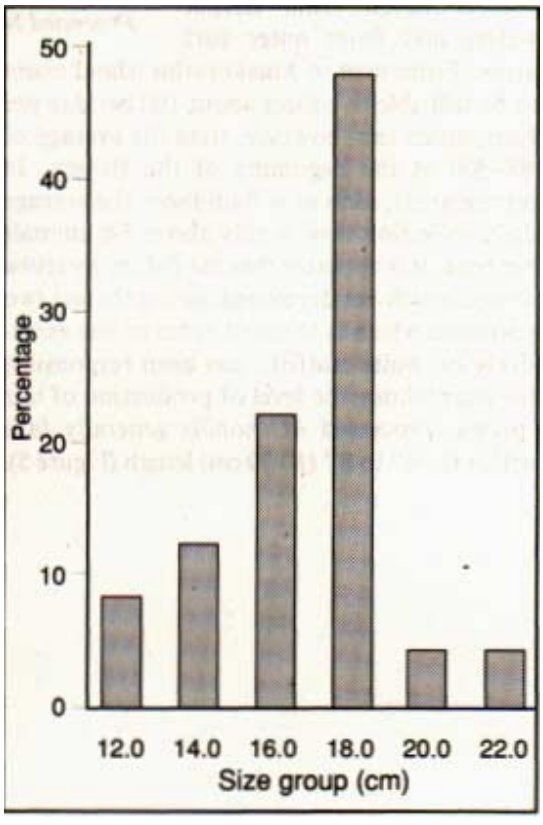
## *Thelenota Ananas* – Prickly Redfish

*Processed* T. ananas *(Prickly Redfish)*

One of the most valuable species of beche de mer, it grows up to 700 mm in length and 3-6 kg live weight. It is characterized by the presence of numerous large pointed teats in groups of two or three all over its body wall. It is found at depths of 2-30 m on clean sandy bottoms of the reef, enclosed lagoons and besides coral heads.

*T. ananas* was the target species at the beginning of the beche de mer fishery in the Maldives, resulting in depletion of the resource from shallow water areas within a few years. It is now very rare in most of the islands and only a few are reported to be available, and those too are only in deep waters (20-25 m) depths and outside the reefs. Komandoo island fishermen, for instance, who collected about 700 animals per boat per day at the beginning of the fishery, are now getting only 10-15 per day, and those from the deeper waters. The processed product is mostly within 5" to 9" (12.5-22.5 cm) in length (Figure 4).

**Fig. 4. Percentage length frequency of processed *T. ananas* (Prickly Redfish)**



## *Microthele nobilis* – White Teatfish

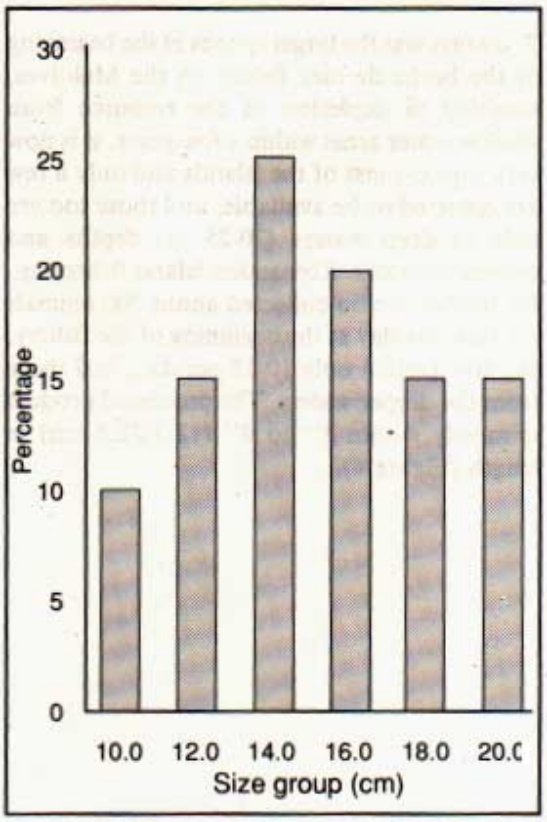
Although *M. nobiis* is reported to be the mostly valuable species of beche de mer in the export market, the Maldivian product fetches lower prices than T *ananas*. The presence of six contractile teat-like projections is the most distinguishing feature of this animal which grows to 400 m in length and 2-3 kg live weight. It is flattened oval in shape and is found in two colours. The white teatfish is the more valuable of the two forms and occurs in waters 3 to 30 m deep, in coral sand in reef passages and in sea grass beds. The black form is found on clean sandy bottoms in shallow water of 3 m depth.

M. nobilis *(White Teatfish) — live (Feeali, Dhaalu Atoll)*

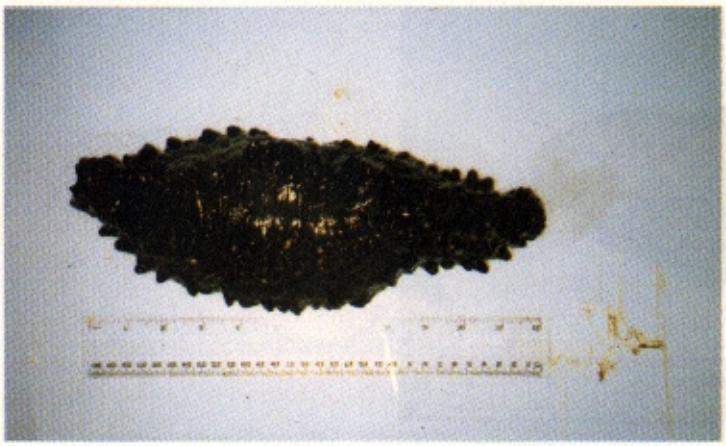
*Processed* M. nobilis *(White Teatfish)*

Along with *T. ananas*, this species was also selectively harvested from the begimng of the beche de mer fishery in the Maldives. It is now very rare in some of the islands and is at present taken from deeper waters and from outer surf areas. Fishermen in Maakurathu island claim to be still able to collect about 100 per day per boat, much less, however, than the average of 400-500 at the beginning of the fishery. In certain areas, such as in Badidhoo, the average daily collection now is only about *5-6* animals per boat. It is apparent that the fishery by scuba divers, which has developed during the last two years and which is targeted more or less exclusively on white teatfish, has been responsible for maintaining the level of production of this species. Processed *M. nobilis* generally falls within the 4" to 8" (10-20 cm) length (Figure 5).

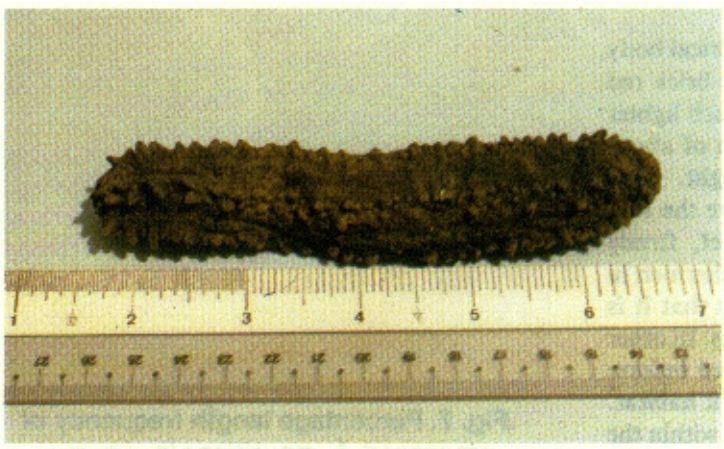
**Fig. 5. Percentage length frequency of processed *M. nobilis* (White Teattish)**



## *Stichopus chioronotus* – Greenfish



*S.* chloronotus *(Greenfish) – live (Feeali, Dhaalu Atoll).*

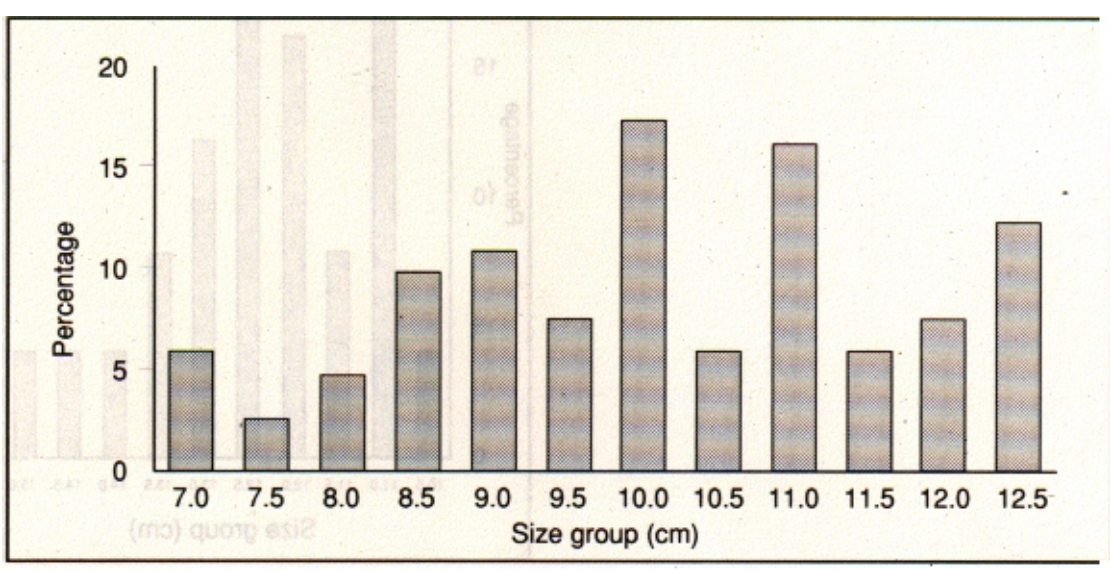


*Processed S.* chloronotus *(Greenfish)*

S. *chioronotus* is v&y dark green (almost black) in colour, growing up to 400 mm. The body is quadrangular in cross-section with numerous prominent teats at each corner of the quadrangle. It is found freely in the shallow waters of the lagoons and in the reef flats with broken coral rubble, in depths up to 2 m. Large specimens have been taken from depths tf 9-10 m. It is quite abundant in most islands, but was reported to be rare in Badidhoo and Kendhoo, where beche de mer resources in general are heavily exploited.

This species is often listed as of little or no commercial value because it degenerates slowly when taken out of the water and tends to break up when boiled. Maldivian fishermen keep greenfish in water right up to processing. It fetches the third highest price (next to *T. ananas and M. noblifs) of all* varieties exported from the Maldives. The size frequency of the processed S. *chioronotus* ranges from 2½" to *5" (6.5-12.5* cms) (Figure 6).

**Fig. 6. Percentage length frequency of processed S. *chioronotus*** (Greenfisti)

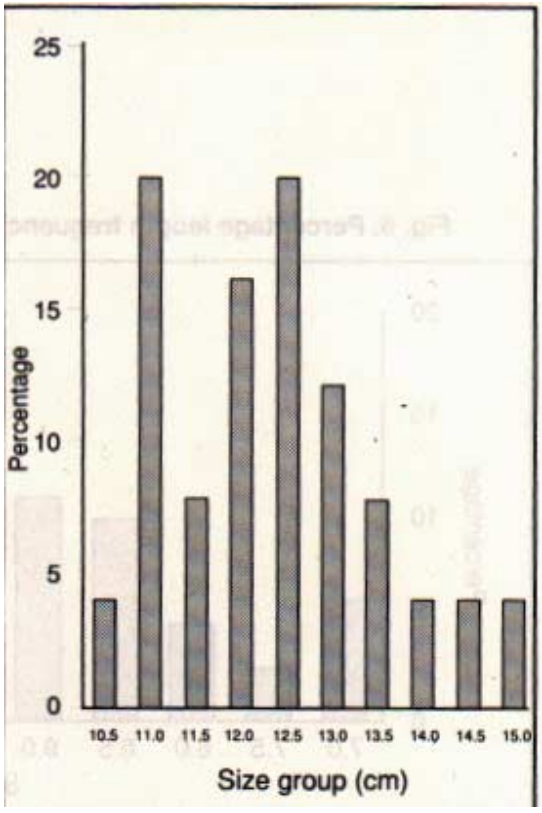


## *Actinopyga mauritiana* – Surf Redfish

*Processed* A. mauritiana *(Surf Redf&sh)*

*A. mauritiana* has an almost cylindrical body with a flattened underside and the brick red colour above contrasts with the much lighter colour below. It grows to a length of about 300 mm and 0.5-1 kg live weight. It is commonly found in the area where the surf breaks on the outside of the reef, firmly attached to the substrata. Some fishermen in islands where it is now rare claim that it is easily taken as it is very conspicuous. In other islands (Landhoo), it was not fished before, as the fishermen were unaware of it habitat. The processed product mostly falls within the *4"* to 6" (10-15 cm) size range. (Figure 7).

**Ag. 7. Percentage length frequency of processed *A. mauritiana*** (Surf Redfish)



## *Actinopyga* sp. – Blackfish (Killofish)

*Processed* Actinopyga *sp. (Killofish)*

A number of species belonging to the genus *Actinopyga* are harvested, processed and sold as Blackfish or Killofish. This genus includes several large species of considerable commercial value. Many of them are very similar in colour and appearance and cannot be identified without detailed microscopical study of body parts. *A. mu/ar/s* (Blackfish), *A. lecanora* (stonefish) and *A. echinites* may all, along with a few other species, be grouped under Blackfish. *A. millaris* is black or dark brown in colour and cylindrical, growing up to 300 mm and *0.5* - 2 kg live weight. It is found in shallow waters of more than 2 m, in clear water on reef flats and on algal beds. *A. lecanora* is dark brown in colour and grows to a length of 400mm and is found at 2-10 m depth, often on the underside of stones and on coral sand with sea weeds. *A. echinites* grows up to a length of 300 mm, *0.5-1* kg weight and generally inhabits deeper waters upto 300 m, on sandy bottoms and among live corals. Some of the nocturnal species are collected at night using torches.

## *Bohadschia marmorata* – Amberfish

B. marmorata *(Amberfish) – live (Feeali, Dhaalu Atoll)*

*Processed* B. marmorata *(Amberfish)*

*B. marmorata* is short and thick, with uniformly distributed dark brown spots on its light yellow to light brown body. It grows upto 400 mm in length and extends sticky cuvierien threads when disturbed. It is commonly found on coarse coral sand, grassy bottoms and sometimes underneath coral rocks.

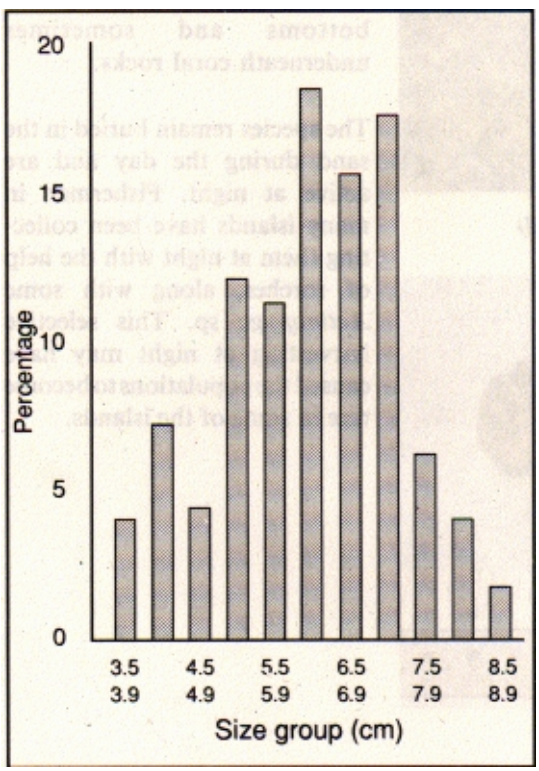
The species remain buried in the sand during the day and are active at night. Fishermen in many islands have been collecting them at night with the help of torches, along with some *Actinopyga* sp. This selective harvesting at night may have caused the populations to become rare in some of the islands.

## *Halodeima atra* – Lollyfish

*H. atra (Lollyfish) live (Feeali, Dhaalu Atoll)*

*Processed* H. atra *(Lollyfish)*

*FIg. 8. Percentage length frequency of processed H. atra (Lollyfish) from Hithaadhoo Island*




*H. atra* is the species most abundant in the Maldives. It is also widely considered to be the most abundant holothurioid species in the IndoTPacific region. It is black in colour, cylindrical, with a smooth body surface and grows up to 600 mm. The red fluid "holothurin" given off, when the body surface is rubbed, is toxic. The smaller sizes of the animal occur in large numbers in ankle-deep water in sandy reef flats. Inside the reef it reaches 300 mm length and is found upto a depth of 6m. Larger animals of 600 mm in length usually occur in the deeper waters outside the reef.

*H. atra* fetches very low prices and the level of exploitation of this species in different islands is a clear reflection of the state of the beche de mer fishery there. Hithaadhoo fishermen now mainly fish this species, with nearly 90 per cent of the catch comprising small ones of less than 4" (10 cm), processed (Figure 8).

Fishermen in Kendhoo started collecting *H. atm* only in 1991 as other species became scarce and nearly 90 per cent of their catches comprised small ones. In Lhohi and Maafaru too, fishing for *H. atra* commenced only during the 1990 Northeast Monsoon season. While two-thirds of the catch comprises small ones of less than 4" in the former, the same proportion of the catch comprises large ones in the latter, with fishermen there avoiding taking small ones as far as possible due to low prices offered for them. Fishermen in Landhoo and Komandoo only fish for the larger ones. Maakurathu fishermen avoid taking them altogether, as prices paid are low and also, possibly, because other beche de mer resources are still in a healthy state.

## *Microthele axiologa* – Elephant Trunkfish

*Processed* M. axiologa *(Elephant Trunkfish)*

*M. axiologa* is a large species, growing up to 600 mm in length and 2-4 kg live weight. It is almost cylindrical in shape and has prominent wrinkles on the upper surface and a slightly flattened underside. The colour is dark orange or brown above, with pale grey sides and underside. It is found in deeper waters (10-40 m) on sandy bottoms. This species has been positively identified by fishermen in all the islands visited, but it is not collected and processed in some of them.

## *Thelenota anax* – Turtleshell

*Processed* T. ann *(Turtleshell)*

*T. anax* grows to a length of 800 mm, is square in cross-section and has many tubercles on its body. It is found in fine sandy bottoms at depths greater than 10 m. It is taken only in a few islands.

# PUBLICATIONS OF THE BAY OF BENGAL PROGRAMME (BOBP)

The BOBP brings out the following types of publications

Reports (BOBP/REP/...) which describe and analyze completed activities such as seminars, annual meetings of BOBP's Advisory Committee, and subprojects in member-countries for which BOBP inputs have ended.

Working Papers (IJOBP/WP/...) which are progress reports that discuss the findings of ongoing BOBP work.

Manuals and Guides (BOBP/NIAG/,..) which are instructional documents for specific audiences.

Information Documents (BOBP/INF/...) which are bibliographies and descriptive documents on the fisheries of member-countries in the region.

Newsletters *(Bay of Bengal News)* which are issued quarterly and which contain illustrated articles and features in non-technical style on BOBP work and related subjects.

**Other publications** which include books and other miscellaneous reports.

**A** list of publications from 1986 onwards is given below. A complete list of publications is available on request.

*Reports (BOBP/REP/...)*

23. *Summary Report of BOBP Fishing Trials and Densersal Resources Studies in Sri Lanka.* (Madras, March 1986.)
24. Fisherwomen's Activities *in Bangladesh. A Participatory Approach to Development.* P. Natpracha. (Madras, May 1986.)
25. *Attempts to Stimulate Development Activities in Fishing Communities in Adirampattinarn, India. P.* Natpracha, V. L. C. Pietersz. (Madras, May 1986.)
26. *Report of the Tenth Meeting of the Advisory Committee.* Male, Maldives. 17-18 February 1986. (Madras, April 1986.)
27. *Activating Fisherwomen for Development through Trained Link Workers in Tamil Nadu, India.* E. Drewes. (Madras, May 1986.)
28. *Small-scale Aquaculture Develop,nent Project in South Thailand: Results and Impact. E* Drewes. (Madras, May 1986.)
29. *Towards Shared Learning : An Approach to Non-formal Adult Education for Marine Fisherfolk of Tamil Nadu, India.* **L.** S. Saraswathi and P. Natpracha. (Madras, July 1986.)
30. *Summary Report of Fishing Trials with Large-mesh Driftnets in Bangladesh.* (Madras, May 1986.)
31. In-service *Training Programmefor Marine Fisheries* Extension Officers in Orissa, *India.* U, Tietze. (Madras, August 1986.)
32. *Bank Credit for Artisanal Marine Fisherfolk of Orissa, India.* U. Tietze. (Madras, May 1987.)
33. *Non-formalPrimary Educationfor Children of Marine Fisherfolk in Orissa, India.* U. Tietze, Namita Ray. (Madras, December 1987.)
34. *The Coastal Set Bagnet Fishery of Bangladesh — Fishing Trials and Investigations. S.* E. Akerman. (Madras, November 1986.)
35. *Brackishwater Shrimp Culture Demonstration in Bangladesh.* M. Karim. (Madras, December 1986.)
36. *Hilsa Investigations in Bangladesh.* (Colombo, June 1987.)
37. *High-Opening Bottom Trawling in Tamil Nadu, Gujarat and Orissa, India: A Summary of Effort and Impact.* (Madras, February 1987.)
38. *Report of the Eleventh Meeting of the Advisory Committee.* Bangkok, Thailand, March 26-28, 1987. (Madras, June 1987.)
39. *Investigations on the Mackerel and Scad Resources of the Malacca Straits. (Colombo,* December 1987.)
40. *Tuna in the Andarnan Sea.* (Colombo, December 1987.)
41. *Studies of the Tuna Resource in the EEZ5 of Sri Lanka and Maldives.* (Colombo, May 1988.)
42. *Report of the Twelfth Meeting of the Advisory Committee.* Bhubaneswar, India, 12-IS January 1988. (Madras, April 1988.)
43. *Report of the Thirteenth Meeting of the Advisory Committee.* Penang, Malaysia, 26-28 January, 1989. (Madras, March 1989.)
44. *Report of the Fourteenth Meeting of the Advisors' Committee.* Medan, Indonesia, 22-25 January, 1990. (Madras, April 1990.)
45. *Report of the Seminar on Gracilaria Production and Utilization in the Bus' of Bengal Region.* (Madras, November 1990.)
46. *Exploratory Fishing for Large Pelagic Species in the Maldives.* R.C.Anderson and A. Waheed. (Madras, December 1990.)
47. *Exploratory Fishing for Large Pelagic Species in Sri Lanka.* R. Maldeniya and *S* Suraweera. (Madras, April 1991.)
48. *Report of the Fifteenth Meeting of the Advisory Committee. Colombo,* Sri Lanka, 28-30 January, 1991. (Madras, April 1991.)
49. *Introduction of New Small Fishing Craft in Kerala.* C. Gulbrandsen and MR. Andersen. (Madras, January 1992)
50. *Report of the Sixteenth Meeting of the Advisory Committee.* Phuket, Thailand, 20-23 January, 1992. (Madras, April 1992.)



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27, *Reducing the Fuel Costs of Small Fishing Boats. O Gulbrandsen. (Madras, July 1986.)*

38. *Credit for Fisherfolk: The Experience in Adirampattinam, Tamil Nadu, india. R. S. Anharasan and O Fernandei.* (Madras, March 1986.)

42. *Fish Trap Trials in Sri Lanka. (Based on a report by T. Hammerman). (Madras, January 1986.)*

43. *Demonstration of Simple Hatchery Technology for Prawns in Sri Lanka. (Madras, June 1986.)*

44. *Pivoting Engine Installation for Beachianding Boats. A. Oscra, R. Ravikurnar. (Madras, June 1986.)*

45. *Further Development of Beachlanding Craft in India and Sri Lanka. A. Overa, R. Ravikumar, O Gulbrandsen,* G. Gowing. (Madras, July 1986.)

46. *Experimental Shrimp Farming in Ponds in Polekurru, Andhra Pradesh, India. J. A. J Janssen, T. Radhaknshna* Murthy, B. V. Raghavulu, V. Sreekrishna. (Madras, July 1986.)

47. *Growth and Mortality of the Malaysian Cockle (Anadara granosa) under Commercial Culture : Analysis through Length-frequency Data.* Ng Fong Oon. (Madras, July 1986.)

48. *Fishing Trials with High-Opening Bottom Trawis from Chandipur, Orissa, india. G. Pajot and B.. B. Mohapatra.* (Madras, October 1986.)

49. *Pen Culture of Shrimp by Fisherfolk: The BOBP Experience in Killai, Tamil Nadu, India.* F. Drewes, G RaJappan. (Madras, April 1987.)

50. *Experiences with a Manually Operated Net-Braiding Machine in Bangladesh.* B. *C.* Gillgren, A. Kashem. (Madras, November 1986.)

51. *Hauling Devices for Beachianding Craft.* A. Overa, P. A. Hemminghyth. (Madras, August 1986.)

52. *Experimental Culture of Seaweeds (Gracilaria Sp.) in Penang, Malaysia. (Based on a report by M Doty and J Fisher).* (Madras, August 1987.)

53. *Atlas of Deep Water Demersal Fishery Resources in the Bar of Bengal.* 1. Nishida and K. Sivasubramaniam. (Colombo, September 1986.)

54. *Experiences with Fish Aggregating Devices in Sri Lanka.* K.T. Weerasooriya. (Madras, January 1987.)

55. *Study of Income, Indebtednes.c and Savings among Fisherfolk of Orissa, India.* T. Mammo. (Madras, December 1987.)

56. *Fishing Trials with Beachlanding Craft at Uppada, Andhra Pradesh, India.* L Nyherg. (Madras, June 1987.)

57. *Identifying Extension Activities for Fisherwomen in Visakhapatnam District, Andhra Pradesh, India.* D. Tempelman. (Madras, August 1987.)

58. *Shrimp Fisheries in the Bay of Bengal.* M. Van der Knaap. (Madras, August 1989.)

59. *Fishery Statistics in the Bay of Bengal.* T. Nishida. (Colombo, August 1988.)

60. *Pen Culture of Shrimp in Chilaw, Sri Lanka.* D. Reyntjens. (Madras, April 1989.)

61. *Development of Outrigger Canoes in Sri Lanka.* O Gulbrandsen, (Madras, November 1990.)

62. *Silvi-Pisciculture Project in Sunderbans, West Bengal: A Summary Report of BOBP's assistance.* CL. Angell, J. Muir, (Madras, September 1990.)

63. *Shrimp Seed Collectors of Bangladesh.* (Based on a study by UBINIG.) (Madras, October 1990.)

64. *Reef Fish Resources Survey in the Ma/dives.* M. Van der Knaap, Z. Waheed, Ft. Shareef, M. Rasheed (Madras, April 1991.)

65. *Seaweed* (Gracilaria Edulis) *Farming in Vedalai and Chinnapalam, India.* Ineke Kalkman, Isaac Rajendran, Charles L Angell. (Madras, June 1991).

66. *Improving Marketing Conditions for Women Fish Vendors in Besant Nagar, Madras.* K. Menezes. (Madras, April 1991.)

67. *Design and Trial of Ice Boxes for Use on Fishing Boats in Kakinada, India.* 1.J. Clucas. (Madras, April 1991.)

68. *The By-catch from Indian Shrimp Trawlers in the Bay of Bengal: The potential for its improved utilization.* Ann Gordon. (Madras, August 1991).

69. *Agar and Alginate Production from Seaweed in India* J.J.W. Coppen, P. Nambiar, (Madras, June 1991.)

70. *The Kattumaram of Kothapatnam-Pallipalem, Andhra Pradesh, India — A survey of the fisheries and fisherfolk.* Dr. K. Sivasubramaniam. (Madras, December 1991.)

72. *Giant Clams in the Maldives — A stock assessment and study of their potential for culture.* Dr. J R. Barker. (Madras, December 1991.)

73. *Small-scale culture of the flat oyster* (Ostrea folium) *in Pulau Langkawi, Kedah, Malaysia,* Devakie Nair and Bjorn Lindeblad. (Madras, November 1991).

76. *A View from the Beach — Understanding the status and need.s of fisherfolk in the Meemnu, Vaavu and Faafu Atolls of the Republic of Maldives.* The Extension and Projects Section of the Ministry of Fisheries and Agriculture, The Republic of Maldives. (Madras, June 1991).

77. *Developmnent of Canoe Fisheries in Sumatera. Indonesia,* O Gulbrandsen and G Pajot. (Madras, April 1992).

78. *The Fisheries and Fisherfolk of Vias Island, Indonesia. A description of the fisheries and a socio-economnic appraisal of the fisherfolk.* Based on reports by G Pajot and P. Townsley. (Madras, December 1991.)

79. *Review of the Beche De Mer (Sea Cucumber) Fishery in the Maldives* by Feslie Joseph (Madras, April 1992.)

80. *Reef Fish Resources Survey in the Maldive.s — Phase Two* by R *C* Anderson, Z Waheed, M Rasheed and A Arif (Madras, April 1992)

82 *Cleaner Fishery Harbours in the Bay of Bengal* (Madras, April 1992)

### *Manuals and Guides (BOBP/MAG/...)*

1. *Towards Shared Learning : Non-formal Adult Education for Marine Fisherfolk.* Trainers' Manual. (Madras, June 1985.)

2. *Towards Shared Learning: Non-formal Adult Education for Marine Fisherfolk.* Animators' Guide. (Madras, June 1985.)

3. *Fishery Statistics on the Microcomputer: A BASIC Version of Hasselblad's NORMSEP Program.* D. Pauly, N. David, J. Hertel-Wulff. (Colombo, June 1986.)

4. *Separating Mixtures of Normal Distributions : Basic programs for Bhattacharya 's Method and Their Application for Fish Population Analysis.* H. Goonetilleke, K. Sivasubramaniam. (Madras, November 1987.)

5. *Bay of Bengal Fisheries Information System (BOBFINS) : User's Manual.* (Colombo, September 1987.)

10. *Our Fish, Our Wealth.* A guide to fisherfolk on resources management. —in comic book' style (English/Tamil/Telugu) Kamala Chandrakant with K. Sivasubramaniam and Rathin Roy. (Madras, December 1991.)

### *In formation Documents (BOBP/INF/...)*

9. *Food and Nutrition Status of Small-Scale Fisherfolk in India's East Coast States : A Desk Review and Resource Investigation.* V. Bhavani. (Madras, April 1986.)

10. *Bibliography on Gracilaria — Production and Utilization in the Bay of Bengal.* (Madras, August 1990.)

11. *Marine Small-Scale Fisheries of West Bengal : An Introduction.* (Madras, November 1990.)

12. *The Fisherfolk of Puttalam, Chilaw, Galle and Matara — A study of the economic status of the fisherfolk of four fisheries districts in Sri Lanka. (Madras, December 1991.)*

### *Newsletters (Bay of Bengal News)*

Quarterly

### *Other Publications*

*Art isanal Marine Fisherfolk of Orissa : Study of their Technology, Economic Status, Social Organization arid Cognitive Patterns.* U Tietze. (Madras)

*Studies on Mesh Selectivity and Performance: The New Fish-cum-Prawn Trawl at Pesalai, Sri Lanka.* BOBP/MIS/3. M.S.M. Siddeek. (Madras, September 1986.)

*Motorization of Dinghy Boats in Kasafal, Orissa.* BOBP/MIS/4. S. Johansen and O Gulbrandsen. (Madras, November 1986.)

*Helping Fisherfolk to Help Themselves : A Study in People's Participation.* (Madras, 1990.)

*For further information contact*

The Bay of Bengal Programme, Post Bag No. 1054, Madras 600 018, India.

Cable : BAYFISH Telex : 41-8311 BOBP Fax : 044-836102.

Telephone : 836294, 836096, 836188.