

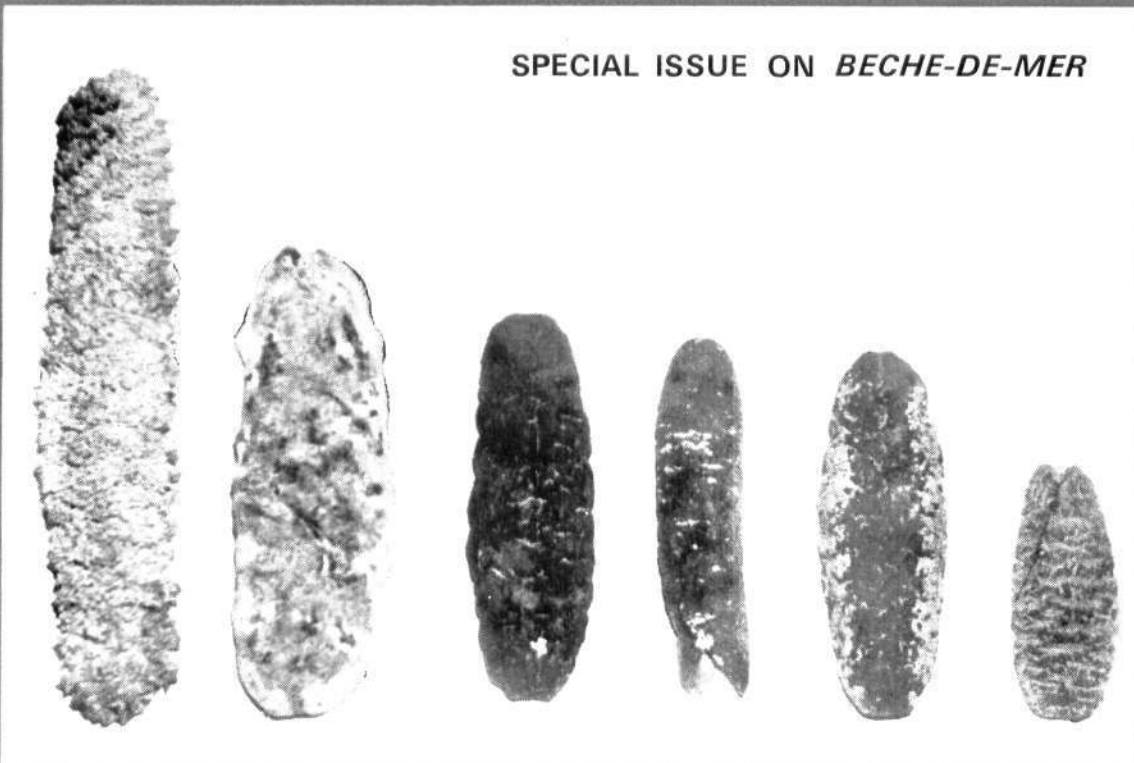


समुद्री मात्स्यिकी सूचना सेवा MARINE FISHERIES INFORMATION SERVICE

No. 92

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SPECIAL ISSUE ON *BECHE-DE-MER*



तकनीकी एवं विस्तार अंकावली TECHNICAL AND
EXTENSION SERIES

कैन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान
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RESEARCH INSTITUTE
COCHIN, INDIA

भारतीय कृषि अनुसंधान परिषद
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

समुद्री मात्स्यिकी सूचना सेवा : समुद्री मात्स्यिकी पर आधारित अनुसंधान परिणामों को आयोजकों, मत्स्य उद्योगों और मत्स्य पालकों के बीच प्रसार करना और तकनीकी का प्रयोगशाला से श्रमशाला तक हस्तांतरित करना प्रस्तुत तकनीकी और विस्तार अंशवली का लक्ष्य है ।

THE MARINE FISHERIES INFORMATION SERVICE : Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers and transfer of technology from laboratory to field.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser.*, No. 92: 1989

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Beche-de-mer — Its resources, fishery and industry
बेश-द-मेर — इसकी संपदायें, मात्स्यिकी और उद्योग

मुख्य आवरण चित्र:

बाँये से दायें — बेश-द-मेर (संसाधित होलोथूरियन) जाति:— थेलेनोटा आनानास, होलोथूरिया नोबिलिस, एक्टिनोपैगा एक्विनेटेस, होलोथूरिया स्काब्रा, एक्टिनोपैगा मौरिट्याना, एक्टिनोपैगा मिलारिस. (फोटोग्राफ: एम. कतिर्वेल)

Front cover photo:

Beche-de-mer (processed holothurian) of species (from left to right): *Thelenota ananas*, *Holothuria nobilis*, *Actinopyga echinites*, *Holothuria scabra*, *Actinopyga mauritiana*, and *Actinopyga miliaris*.

(Photograph: M. Kathirvel).

पृष्ठ आवरण चित्र:

तिरुपालकुडि पुलिन में ढेर किये गये कच्चा होलोथूरिया स्काब्रा (फोटोग्राफ: डी. बी. जेम्स)

Back cover photo:

Fresh *Holothuria scabra* heaped on the beach at Tirupalakudi.

(Photograph: D.B. James).

PREFACE

This special issue of Marine Fisheries Information Service is released to mark the inauguration of the National Workshop on *Beche-de-mer*. The first workshop on *Beche-de-mer* was conducted in Tanzania in 1985. In recent years considerable interest is being evinced in *Beche-de-mer* round the world, particularly in the South Pacific islands because of the high price it fetches. India is at present earning foreign exchange worth about a crore of rupees by exporting *beche-de-mer*. Although valuable resources are found in the Andaman and Nicobar islands and the Lakshadweep, the industry is at present restricted to the mainland of India, along the Gulf of Mannar and Palk Bay. At present *Holothuria (Metriatyla) scabra*, which is not a highly priced species almost exclusively contributes to the industry.

Information on *beche-de-mer* is widely scattered and not readily accessible. The industry is not aware of other valuable species which fetch better prices and their methods of processing. This special issue is brought out to project available information on every

aspect of *beche-de-mer* industry right from their resources, distribution, fishing, handling, methods of processing, sea ranching, stock assessment, conservation, management, marketing, processing, trade, present status of the industry and future prospects. The information will enable the scientists, industry, planners and administrators to take policy decisions to rationally exploit the resources and also develop the industry in an organised manner.

Dr. D.B. James, Scientist of this Institute and Convener to this Workshop has expert knowledge and long experience in this area and made valuable contributions based on his work on the sea cucumbers of Gulf of Mannar and Palk Bay, the Andaman and Nicobar islands and the Lakshadweep. He made every effort to bring together all relevant information on this subject in this issue. I deeply appreciate the interest and efforts put in by him, and hope that this publication will stimulate further work on various aspects of *beche-de-mer* which would ultimately help in boosting exports from the country.

Cochin - 682 031,
21-2-1989.

Dr. P.S.B.R. James,
Director,
C.M.F.R. Institute.

BECHE-DE-MER — ITS RESOURCES, FISHERY AND INDUSTRY

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Introduction

The term *beche-de-mer* is the French rendering of the Portuguese name *bicho-do-mar*, signifying a sea slug. It is also widely known as *Trepang* which is a Malay word. Although the term *beche-de-mer* denotes a sea cucumber, in the trade parlance this word refers to the processed holothurian. As a delicacy it has become part of the life and tradition of the Chinese who eat *beche-de-mer* on festive occasions like the Chinese New Year Day. *Beche-de-mer* procured in dry form is soaked in water, cleaned and cooked in many delicious ways. It is rich in proteins and has low fat content.

India at present exports nearly Rupees one crore worth of *beche-de-mer* mainly to Singapore. The industry is at present restricted to the mainland in the Gulf of Mannar and Palk Bay regions. Recently fishing for holothurians in Andaman and Nicobar islands is banned. The industry which existed once in Lakshadweep is not there now.

The *beche-de-mer* industry is very ancient in India and is essentially a cottage industry. It was introduced to India by the Chinese and they were directly supervising the processing along the Gulf of Mannar and Palk Bay nearly one hundred years back. The Chinese had trade with southern India and Sri Lanka since one thousand years by junks of large size and it is believed that *beche-de-mer* and pearls figured among the Indian products in exchange for porcelain, silks and sweetmeats.

RESOURCES

Commercially important holothurians in the Indian seas

There are over 650 species of holothurians known from various parts of the world. In the seas around India, nearly 200 species of holothurians are known, of which about 75 are from the shallow waters within twenty metres depth. Of these, 13 species are of commercial value. Holothurians which are large in size and with thick body wall are used in processing. Holothurians like *Stichopus variegatus* and *S. chloronotus*

which become gelatinous and disintegrate when kept out of water are processed using special methods.

The following species of holothurians are used for processing. They are *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*, *A. miliaris*, *A. echinites*, *A. lecanora*, *Thelenota ananas*, *Holothuria (Metriatyla) scabra*, *H. (Theelothuria) spinifera*, *H. (Halodeima) atra*, *Bohadschia argus*, *B. marmorata*, *Stichopus variegatus* and *S. chloronotus*. In India at present *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera* are fished in the Gulf of Mannar and Palk Bay for processing. In recent years *Bohadschia marmorata* is also used for processing at Kilakarai and Vedalai in the Gulf of Mannar. There is good scope for using other species like *Holothuria (Halodeima) atra* on the mainland, *Holothuria (Microthele) nobilis*, *Bohadschia argus* and *Stichopus chloronotus* in Lakshadweep and species of *Actinopyga* in Andamans which are abundant in the respective regions.

A field key for identification is given here for the commercially important holothurians, taking into account the important and conspicuous external characters and live colour.

Field key to the identification of commercially important genera of holothurians of Indian waters

1. Anal opening surrounded by five 'teeth' like structures.....*Actinopyga*
 - 1a. No such 'teeth' surrounding the anus2
2. Anal opening surrounded by five groups of papillae*Bohadschia*
 - 2a. Anal opening not surrounded by papillae3
3. Body more or less quadrangular with distinct papillae.....*Stichopus*
 - 3a. Body not quadrangular but tubular, sometimes loaf-shaped.....4
4. Body massive upto 800 mm length, dorsal papillae resembling leaf-like structures.....*Thelenota*
 - 4a. Body moderate in size upto 400 mm; papillae not expanded into leaf-like structures.....*Holothuria*

Genus *Actinopyga*

A very valuable genus for *beche-de-mer* preparation. At present not processed in India.

Field key to the Indian species

1. Colour completely black.....*A. miliaris*
- 1a. Colour brown or brown and white2
2. Colour brown on the dorsal side and white on ventral side; often found near low water mark.....
.....*A. mauritiana*
- 2a. Colour with various shades of brown.....3
3. Colour completely brown, often with sand deposited on the dorsal side of the body...*A. echinites*
- 3a. Brown in colour with lighter colour near the anal region..*A. lacanora*

Actinopyga miliaris

Common name: Black fish.

Remarks: Black in colour, sometimes with a dark brown underside. Yields good quality *beche-de-mer*. Length about 300 mm and live-weight varies from 0.5 to 2 kg.

Habits: Found mainly in water less than 2 m depth on reef flats among live corals and on algal beds.

Distribution in Indian Seas: Lakshadweep, Andamans.

Actinopyga mauritiana

Common name: Surf red fish.

Remarks: Cylindrical with a flat underside; length upto 300 mm and live-weight varies from 0.5 to 1 kg. Colour in live animal brick red above and white below.

Habits: Found only where the surf breaks on the outside of the reef. The tube feet are firmly attached to rocks to prevent the animal being carried away by waves.

Distribution in Indian seas: Lakshadweep, Andamans.

Actinopyga echinites

Common name: Deep-water red fish.

Remarks: Grows to a size of 300 mm and live-weight varies from 0.5 to 1 kg. Body wider in the middle and tapers towards the ends. Dorsal surface wrinkled with fine sand over it. Colour in live specimen uniformly brown.

Habits: Occurs between 3 and 30 m depth on sand bottoms among live corals. Sometimes found in the intertidal region also.

Distribution in Indian seas: Lakshadweep, Andamans.

Actinopyga lecanora

Common name: Stone fish.

Remarks: Grows to 400 mm length. Colour in live animal brown with a lighter ash-grey colour around anus.

Habits: Occurs from 2 to 10 m depth on the underside of large stones; active during nights.

Distribution: Andamans (rare).

Genus *Bohadschia*

Because of the cuvierian tubules, processing is difficult in this genus. It has some commercial value.

Field key to the Indian species

1. Colour black or brown with distinct eye-like spots*B. argus*
- 1a. Eye-like spots absent on the body.....2
2. Colour light brown with black spots...*B. marmorata*

Bohadschia argus

Common name: Leopard fish or Tiger fish

Suggested Tamil name: 'Kannu attai' (Refers to eye-like spots on body).

Remarks: Body cylindrical with very smooth surface. At the slightest disturbance, white sticky threads are thrown out. Grows to 600 mm in length. Live-weight 1 to 2 kg. Colour in live condition brown or black with distinctive eye-like spots all over the body which are encircled with light yellow, white or grey colour. In Lakshadweep the specimens are black in colour.

Habits: Lives freely in the lagoon on coarse sand. A few coral pieces and sand particles are found attached to the body. Occurs from 2-6 m depth.

Distribution in Indian seas: Lakshadweep.

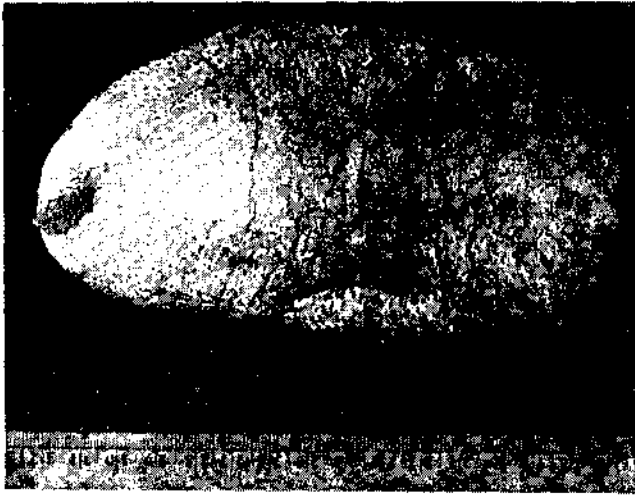


Fig. 1. 'Nool attai' or Chalky fish (*Bohadschia marmorata*).

Bohadschia marmorata (Fig. 1)

Common name: Chalky fish.

Tamil name: 'Nool attai'.

Remarks: Grows to 400 mm length. In live condition yellowish brown with black spots.

Habits: Found in the lagoon often covered with a coating of fine mud.

Distribution in Indian seas: Palk Bay, Gulf of Mannar.

Genus *Stichopus*

Massive, reaching a length of 900 mm. Body disintegrates and becomes gelatinous when taken out of water. Needs special treatment for *beche-de-mer*.

Field key to the Indian species

1. Colour dark green appearing almost black in some shades of light; body quadrangular with four rows of large finger-like processes.....*S. chloronotus*
- 1a. Body massive and loaf-like with irregular brown patches on yellow grey background.....*S. variegatus*

Stichopus chloronotus

Suggested Tamil name: 'Pacha mul attai' (Refers to green spiny nature).

Remarks: Some workers list this species under non-commercial forms while others consider it more

valuable than even *Holothuria scabra*. Occurs in large numbers in the lagoons of Kiltan and Chetlat in the Lakshadweep.

Habits: Found freely in the shallow water of the lagoons and lies out in the open without making any attempt to conceal its body.

Distribution in Indian seas: Lakshadweep, Nicobar.



Fig. 2. 'Mul attai' (*Stichopus variegatus*).

Stichopus variegatus (Fig. 2)

Tamil name: 'Mul attai'.

Remarks: Grows to a large size. Dark yellow in live condition with irregular brown patches and pink tube-feet. Some specimens almost white in colour. Massive forms, occur in deeper waters in Andamans.

Habits: Occurs on algal beds and on clean sand at 3-30 m depth.

Distribution in Indian seas: Andamans.

Genus *Thelenota*

Very massive forms. Formerly one of the most valuable genera for *beche-de-mer* but now there is only limited demand for it.

Field key to the Indian species

1. Numerous large pointed teats in groups of two or three all over the dorsal surface; reddish-orange in colour on the upper side, tube-feet on the lower side bright orange.....*T. ananas*



Fig. 3. 'Thalini attai' or Prickly red fish (*Thelenota ananas*).

Thelenota ananas (Fig. 3)

Common name: Prickly red fish.

Suggested Tamil name: 'Thalini attai'.

Remarks: Grows to 700 mm in length; live-weight 3 to 6 kg. Reddish-orange in live condition with teats darker in colour. Lakshadweep specimens are brown on the dorsal side and bright orange on the ventral side.

Habits: Found at depths of 2-30 m on clean sand bottoms. In the lagoons in the Lakshadweep found feeding exclusively on the calcareous alga *Halimeda* sp.

Distribution in Indian seas: Lakshadweep.

Genus *Holothuria*

Over hundred species are known under this genus.

Field key to the Indian species

1. Body like a loaf with very thick body wall; in the living condition about six pairs of lateral teat-like projections.....*Holothuria (Microthele) nobilis*
- 1a. Body tubular, body wall not very thick; no lateral projections in the living conditions2
2. Body completely black in colour; red coloured fluid comes out when live specimens are handled*Holothuria (Halodeima) atra*
- 2a. Colour not black and no red coloured fluid comes out when live specimens are handled3
3. Yellow markings on the upper side of the body; lower side white with a number of black specks...*Holothuria (Metriatyla) scabra*
- 3a. No yellow markings on the upper side of the body..4
4. Radial plates twice the length of inter-radials and with well developed posterior bifurcations.....*Holothuria (Theelothuria) spinifera*



Fig. 4. 'Rotti attai' or Teat fish (*Holothuria nobilis*).

Holothuria (Microthele) nobilis (Fig. 4)

Common name: Teat fish or Mammy fish.

Suggested Tamil name: 'Rotti attai' (Refers to loaf like shape)

Remarks: This is the most valuable species for *beche-de-mer* preparation. Grows to 400 mm length; live-weight varies from 2-3 kg; body wall very thick (10-15 mm). Occurs in two colours; white one which is more valuable is sometimes referred to as *M. fuscogilva* or *H. fuscogilva*. The black variety is abundant in some of the islands of Lakshadweep.

Habits: White form is most abundant on clean sand and turtle grass. Young white forms live among turtle grass. Black form is found in shallow water of about 3 m on clean sand bottom where there is live coral. Occurs in the lagoons in Lakshadweep with a fine coating of sand.

Distribution in Indian seas: Lakshadweep, Andamans.

Holothuria (Halodeima) atra

Common name: Lolly fish.

Tamil name: 'Karuppu attai'.

Remarks: Probably the most abundant holothurian in the Indo-Pacific region. When body surface is rubbed a red fluid stains the hand. This red fluid is a toxin known as holothurin. This species is highly toxic. Boiling the specimens while processing breaks down the toxin. Not utilised by the industry at present.

Habits: Occurs usually on the dead coral reef flats with sandy or muddy patches. Prefers areas where the calcareous alga *Halimeda* sp. is abundant and it feeds on it. In some areas 1-15 specimens are found in 25 sq.m area. On the reef flat the size range is 200-300 mm and on the outer edge of reef, specimens reach 600 mm in length.

Distribution in Indian seas: Lakshadweep, Andamans, Gulf of Mannar, Palk Bay.



Fig. 5. 'Vella attai' (*Holothuria scabra*).

Holothuria (Metriatyla) scabra (Fig. 5)

Tamil name: 'Vella attai'.

Remarks: The most extensively processed species on the mainland of India and Andamans. The processing is slightly complicated for this species. Currently this species is fetching US \$ 18.00 per kg. Grows to a length of 400 mm and the body is 10 mm in thickness.

Habits: Found in silty sand often near estuaries and frequently on *Cymadocea* beds. Spends part of the day buried in the sand. Occurs from 1-10 m. In some places 2-10 juveniles (50 to 90 mm) were seen distributed in five square metre area.

Distribution in Indian seas: Andamans, Gulf of Mannar, Palk Bay.

Holothuria (Theelothuria) spinifera (Fig. 6)

Tamil name: 'Raja attai'.

Remarks: This species is used for processing along with *Holothuria (Metriatyla) scabra* in the Gulf of Mannar and Palk Bay. Its quality and appearance are first grade and if sold separately would fetch much higher price than Sand fish.

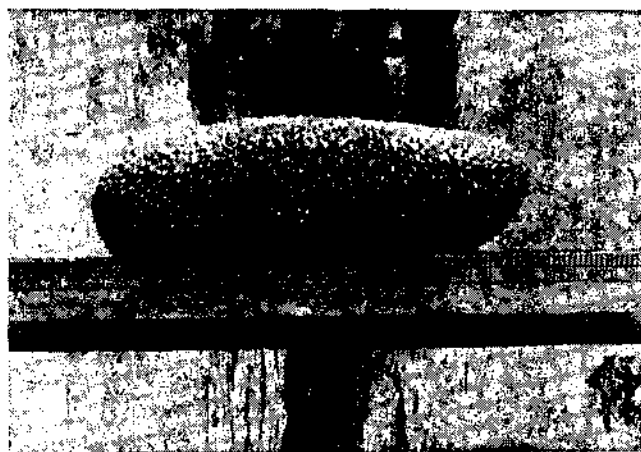


Fig. 6. 'Raja attai' (*Holothuria spinifera*)

Habits: Never encountered in the intertidal region. Found on clean sand and in slightly deeper waters than *Holothuria (Metriatyla) scabra*.

Distribution in Indian seas: Gulf of Mannar, Palk Bay.

Since *Holothuria (Metriatyla) scabra* is the most common and extensively exploited species in India, detailed information on this is given below.

External characters

The body is robust, elongated and cylindrical with blunt ends. The mouth is at the antero-ventral end, surrounded by a ring of twenty pelate tentacles and the anus is at the postero-dorsal end. The dorsal side is convex and the ventral side flat. The total length ranges from 10 to 400 mm and the body weight ranges from 25 to 2,000 g. The skin in large specimens is thick and slimy. On the dorsal side there are many small often inconspicuous papillae, which are thinly scattered. On the ventral side the tube-feet are densely arranged in an irregular manner. Each dark spot on the ventral side represents one pedicel.

In the live condition it is grey to black on the dorsal side and white on the ventral side. Generally smaller specimens are totally black, and larger specimens have a number of irregular yellow or white transverse bands on the dorsal side. Mouth is oval, situated at the centre of the circlet of tentacles.

Habits

Holothuria (Metriatyla) scabra is sluggish in its movements and often lies buried partly or wholly in

muddy or sandy bottoms. They move slowly with the help of 'tube-feet' densely distributed on the ventral side and also through the muscular action of the body wall. They are also found to climb the walls of aquarium tanks.

This species is characteristic of muddy regions. It is confined to shallow waters preferring low saline brackish waters and estuaries. During low tide a number of them can be seen in half buried condition. When they are buried the posterior end is always kept outside. Small forms (50 to 90 mm in length) lie freely on the muddy grounds during low tides.

Feeding

It is omnivorous in habit. The pelate tentacles surrounding the mouth shovel the sand and mud continuously into the mouth. Nutrition is derived from the organic matter in the mud or sand. An analysis of the contents in the digestive tract has revealed the presence of marine algae, copepods, diatoms and molluscan shells. No food preference is noticed. The small intestine always appears to be relatively empty, whereas the large intestine is distended with a load of bottom material. The feeding seems to be a continuous process.

Animal associations

A pea crab *Pinnotheres deccanensis* is found to live inside the cloaca of this species. About 10% of the specimens examined was found to harbour this crab at the enlarged basal part of the respiratory tree. Only female crabs with eggs were found. The crab gets food and shelter inside the holothurian.

Reproduction

The sexes are separate and it is not possible to differentiate the males and females externally. Gonad is single consisting of numerous thin, filamentous tubules united basally into one tuft. It is attached to the left side of the dorsal mesentery and hangs freely in the coelom. The tubules are elongated and branched. From the gonadal base, the gonoduct proceeds in the mesentery and opens to the outside in the mid-dorsal region near the anterior end. In advanced stages of maturity the filaments of the ovary are coloured brown in which the eggs or oocytes are visible as small white spots. The testes consist of long white beaded filaments. The gonoducts consist of ciliated epithelium. During spawning the sperms and ova are released through the

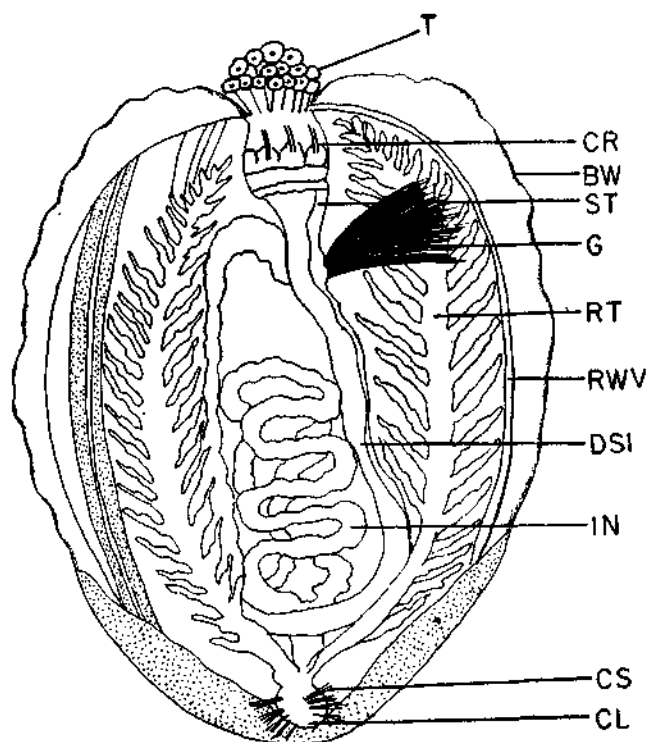


Fig. 7. Internal organisation of *Holothuria scabra*. T-Tentacle, CR - Calcareous ring, BW - Body wall, ST - Stomach, G - Gonad, RT - Respiratory tree, RWV - Radial water vessel, DSI - Descending small intestine, IN - Intestine, CS - Cloacal suspensors, CL - Cloaca.

gonopore by the ciliary action of the gonoduct. Fertilization is external and the embryo passes through different larval stages before settling down to the bottom as juveniles.

The animals show two spawning peaks, one in March-April and the other in September-October. First males spawn and this induces the females to release the eggs.

Culture

The author made some attempts to culture juveniles of the species *Holothuria (Metriatyla) scabra* at Port Blair (Andamans) and rear them in enclosed areas. In February, 1978 a total of 462 juveniles in the size range of 65-160 mm (modal class 81-90 mm) were collected from Sesostris Bay and broadcast in an enclosed area of 1.5 ha near Aberdeen Jetty. The bottom was partly sandy and partly muddy. At the end of July, 1978 they had grown to 190-290 mm.

Sea ranching

At present in Japan only sea ranching programme is taken up for the holothurian *Stichopus japonicus*

(Dr. K. S. Rao: personal communication). It is not economical to rear them till marketable size in the laboratory since the growth rate is found to be slow. Under laboratory conditions mortality is also high. Therefore the seed produced is sea ranched to replenish the stocks. The juveniles when they reach a size of 20–30 mm can be taken to the natural habitat. It is generally found that juveniles are distributed in slightly low saline areas near Pinnakayal, Tuticorin. The low saline waters promote better and faster growth.

FISHERY

Different methods for collecting holothurians

The easiest method to collect holothurians is to pick them by hand during low tide from the intertidal region and from the lagoons where depth of water is less than a metre. Fishermen in Sri Lanka sometimes use a steel-pronged fork mounted on a long handle. At the National Workshop on *Beche-de-mer* held in Tanzania in 1985 it was stated that in depths 2 to 3 m, fishermen use fork ended rod known locally as *Manda* to pick up the holothurians (Fig. 8). 'Hookah' or

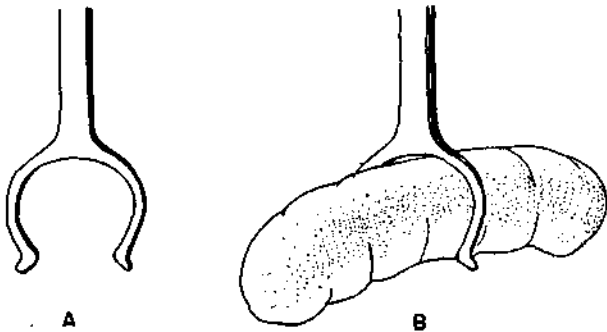


Fig. 8. A device ('Manda') for catching holothurians.

'kapandra' method is prevalent in Philippines to collect holothurians like *Thelenota ananas* and *Holothuria (Microthele) nobilis*. In this method the divers use a breathing hose attached to an air compressor aboard a fishing vessel. Equipped with only wooden goggles, improvised plywood fins and a block of rock or coral for keeping the divers at the bottom for 30 to 60 minutes, they collect all holothurians within their reach.

In India holothurians are usually collected by skin diving in shallow waters of 2 to 10 metres depth.

Divers go out in sailing boats (Fig. 9) in the morning and return in the afternoon. In each boat four to six persons including even small boys go for diving (Fig. 10).



Fig. 9. A sail boat used for holothurian fishing by diving.



Fig. 10. Even boys go for collecting holothurian by diving.

The divers take net bags in which live holothurians are put and brought to the shore (Fig. 11). Since last two years the divers are using aluminium plates (Fig. 12) for the feet as improvised flippers instead of costly rubber flippers.

In Solomon islands (Fig. 13), fishermen have developed a technique for collection of holothurians from deep water using a standard fishing hook fixed to a block of lead of about 7 kg weight attached to a fishing line. One end of the line is held by a man in a boat, while the diver positions himself over the holothurian and releases the weight and the hook over the holothurian. The hook pierces the holothurian which is hauled to the surface by the man in the boat. This method can be used upto a depth of 40 m. At such depths, the diver frequently descends to about six metres in order to see the bottom clearly before releasing the line to spear the holothurians. The efficiency of this method is yet to be tested in India. To successfully use this method the water should have good visibility.



Fig. 11. Net bags used while diving for holothurians.



Fig. 12. Flippers made out of aluminium plates are used now-a-days for diving.

Collection with gear

The holothurians are often caught as bycatch in bottom trawls. With the introduction of trawling in the early sixties in the Gulf of Mannar and Palk Bay a fishery for holothurians also came into existence.

Areas of collection and species

At present holothurians are collected mainly from the southeast coast of India from a narrow strip in the Gulf of Mannar and Palk Bay. Along the Gulf of Mannar Chinnapalem, Vedalai, Mandapam, Periapatnam, Kilakarai and Tuticorin are the important centres. In the Palk Bay Rameswaram, Devipatnam, Tirupalakudi, Karangadu, Mullimonai, Tondi, Pasipatnam, Pudupatnam, Kottaipatnam, Ammapatnam and Kattumavadi are the important centres of which Tirupalakudi

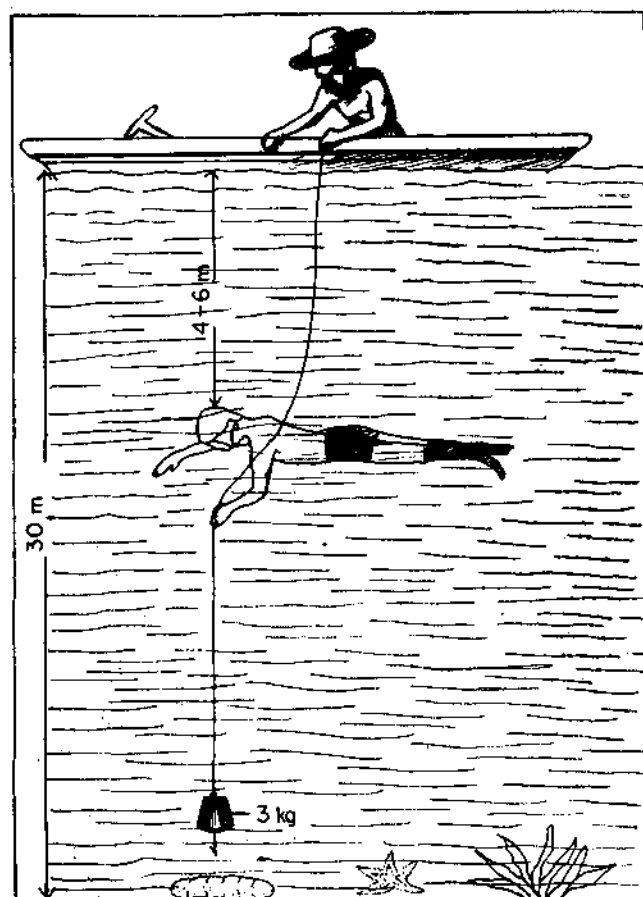


Fig. 13. A method adopted for fishing holothurian in Solomon Island.

is the most important centre. In the Gulf of Mannar and Palk Bay mainly *Holothuria (Metriatyla) scabra* is collected along with *Holothuria (Theelothuria) spinifera* which occurs in slightly deeper waters than *Holothuria (Metriatyla) scabra*. In recent years *Bohadschia marmorata* is also collected and processed at Vedalai and Kilakarai.

During 1975-'78 *Holothuria (Metriatyla) scabra* was caught and processed in the Andamans at Port Blair. Specimens are collected at Mayabundar and Diglipur also. Fishing for holothurians is now banned in Andaman and Nicobar islands. Earlier, collections were made even at Landfall which is the northernmost island of the Andaman Group. In Lakshadweep holothurians were collected earlier at Kiltan and few other islands. Some years back processing took place at Kavaratti and Androth but at present there is no industry. Commercially important holothurians collected from all ten islands of the Lakshadweep are listed in Table 1.

Seasons of collection

Holothurians are fished round the year. In the Palk Bay the fishing is conducted from March to October, the peak season being April and May and in the Gulf of Mannar from October to March, with peak in December and January.

Table 1. Occurrence of commercially important holothurians in Lakshadweep

species	Chetlat	Bitra	Kiltan	Kadamat	Amini	Agatti	Androth	Kavaratti	Kalpeni	Minicoy	Remarks
<i>Actinopyga mauritiana</i>	+	—	+	+	+	+	+	+	+	+	Common
<i>Actinopyga echinites</i>	—	—	—	—	+	—	—	—	—	—	Rare
<i>Actinopyga miliaris</i>	—	—	—	—	—	—	—	—	—	+	Rare
<i>Bohadschia argus</i>	+	—	+	+	+	+	—	+	—	—	Common
<i>Bohadschia marmorata</i>	+	+	+	—	—	—	—	—	+	—	Rare
<i>Holothuria (Halodeima) atra</i>	+	—	+	+	+	+	—	+	—	—	Common
<i>Holothuria (Mertensiothuria) leusospilota</i>	+	—	+	+	+	—	+	+	—	+	Common
<i>Holothuria (Mertensiothuria) pervicax</i>	+	—	—	—	—	—	—	—	—	+	Rare
<i>Holothuria (Microthela) nobilis</i>	+	—	+	+	+	+	—	+	—	—	Common at Amini
<i>Holothuria (Thymiosycia) arenicola</i>	+	—	—	+	+	—	+	—	—	—	Common at Chetlat
<i>Holothuria (Thymiosycia) impatiens</i>	+	—	+	+	+	+	—	—	+	—	Common
<i>Stichopus chloronotus</i>	+	—	+	+	+	+	—	+	+	—	Common
<i>Stichopus variegatus</i>	+	—	+	+	+	—	—	—	—	—	Rare
<i>Thelenota ananas</i>	+	—	—	—	—	—	—	—	—	—	Rare

Overfishing

Holothurians are indiscriminately fished along the Gulf of Mannar and Palk Bay. This has resulted in overfishing in certain pockets. The sizes of the species caught have reduced and the returns for unit of effort have also fallen significantly. For example the average size of *Holothuria (Metriatyla) scabra* fished at Tirupalakudi is only 155 mm, whereas for the same species at Tuticorin it is 215 mm. In some centres like Tirupalakudi, Devipatnam, Karangadu and Mullimonai fishing pressure is more due to the availability of divers and this results in overfishing.

Conservation

It is interesting to note that the conservation and management of holothurians attracted the attention of James Hornell as early as 1920 and he states "The bulk of No. III size (small forms) was obtained in April, May and June of this year; all these are immature individuals under one year old and should be left on the beds to grow to adult size. Unfortunately the Fisheries Act of 1897 does not provide protection of any immature marine animals of value...were these immature *beche-de-mer* left unfished another year, the product would increase threefold in weight and some fold in value".

The author has already pointed out that *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera* are likely to be endangered unless conservation measures are taken. Government of India took a right decision in 1982 to put a ban on the export of *beche-de-mer* below the size of 7.5 cm. The 7.5 cm immature *beche-de-mer* will be 20 cm in length in live condition. It is essential to allow the animals to spawn atleast once in their life time to replenish the stock. In this connection it is pertinent to note that *beche-de-mer* of *Holothuria (Metriatyla) scabra* exported from East Africa, Indonesia and Singapore is 10-18 cm in length. Although *Holothuria (Metriatyla) scabra* breeds round the year, it has two spawning peaks, one in July and the other in October as stated earlier. It is better not to collect and process the material round the year for two reasons. January to May is the ideal season for exploitation. The first reason is that it can be quickly dried in the sun during January to May. Sun dried material is preferred to smoke dried ones in export market. Smoke dried product also incurs additional expenditure by way of fuel. The second reason is that in summer there is no breeding peak. June to December may be declared as closed season.

Management

Over exploitation can easily take place as the animals are defenceless and passive. Therefore to conserve the resource, regulation regarding the size at collection should be imposed. This can be strictly implemented by the Tamil Nadu Fisheries Department as they do in the case of collection of chanks. Since the area of fishing is same for both and the landing centres for holothurians are limited, this can be easily monitored and regulated. Catching material below the size of 20 cm in length may be banned. Even if they are caught and brought to the shore they can be put back into the sea since they live out of water for a long time. There should also be closed seasons, especially during the peak spawning periods of July and October. It is pertinent to note here that the Lakshadweep Administration took the first conservation measures for holothurians when it restricted the collection of *Holothuria (Microthele) nobilis* below the size of 150 mm when processing was practiced during 1968 at Androth and Kavaratti islands.

Apart from size restrictions and closed seasons which have to be strictly implemented as part of management measures, attempts should be made to culture the species to augment production and boost up export. In this the first step is to locate the beds where juveniles are in large numbers. The most important aspect of culture is the development of hatchery system.

Recently a break-through was achieved in CMFRI in inducing *Holothuria (Metriatyla) scabra* to spawn in the laboratory by thermal stimulation, for the first time in India. The fertilized eggs were successfully reared through different stages like Dipleurula, Auricularia, Doliolaria and Pentactula. They were fed on *Isochrysis galbana* and mixed culture of diatoms. On the tenth day, they settled down to the bottom of the tank. In April, 1988 there were more than 32,000 juveniles in the size range of 3-26 mm. They are fed on powder prepared from algae like *Ulva*, *Sargassum* etc. The growth rate appears to be faster when compared to the growth rate in Japanese and Chinese species. Much research needs to be done on the larval and juvenile nutrition, pathology, mortality, physiology, settlement and growth.

BECHE-DE-MER INDUSTRY

History of the beche-de-mer industry in India

The *beche-de-mer* industry is very ancient in India. The Chinese had constant trade with southern India

since more than thousand years. Customs records are available for the export of *beche-de-mer* from 1898 onwards from the Madras Presidency. It appeared to have flourished in Lakshadweep where there is no industry now. Sir W. Robinson who visited the South Canara islands in 1844-'45 reported that during the fishing season, the coastal Moplah merchants were found employed in the preparation of *beche-de-mer*. It had very good demand in the Chinese market at Bombay. The processed material was sent to Mangalore in 'odams' and thence shipped to China. But slowly the industry began to decline and by the time Mr. W.G. Underwood visited the islands in 1881-'82 the trade had almost died out. When the external demand declined, the people neglected this industry and quite naturally it became extinct. The chief reason for the untimely death of the industry might have been the difficulty in transporting the material from a port like Mangalore on the west coast to China directly. Today from Madras it is easily transported to Singapore and Hongkong from where it is re-exported to China.

In earlier years *beche-de-mer* from India and Sri Lanka used to be clubbed together and exported. From 1910 onwards accurate data for *beche-de-mer* processed in India is available as imports from Sri Lanka were stopped. The average export from India during 1898-1910 was 5,534 kg. Since 1910, annual Indian export had fallen to 1,359 kg. This was partly due to First World War and partly due to the reduction in the wholesale rates at Penang. The history of the trade was one of definite fluctuations and the same has been documented by Hornell (*Madras Fish., Bull.*, 11 (4): 119-150, 1917). Hornell entered the *beche-de-mer* industry scene in 1916 when the trade was at an ebb and tried to revive the same on scientific lines. He set up a Government experimental factory for *beche-de-mer* at Tirupalakudi in 1915 and showed how it could be run on profitable lines.

When Hornell visited Kiltan Island in 1908 he saw small quantities of *beche-de-mer* being processed from three species. Judging from the local names he has given, it is assumed that the species belonged to *Holothuria (Microthele) nobilis*, *Bohadschia argus* and *Actinopyga mauritiana* which are abundant even today. He also noted that the methods of curing were different from those practised in the Palk Bay area but resembled those adopted in Australia and Polynesia. Obviously these methods were introduced by the Chinese. The *beche-de-mer* industry which was a success for some time at Androth Island had been abandoned due to epidemic of cholera and this was attributed to the

unhygienic condition in which the curer kept his yard at that time.

In 1967 the Fisheries Department of Lakshadweep sent two persons to Rameswaram to learn the processing of holothurians. They returned and processed different species of holothurians mostly *Holothuria (Microthele) nobilis* in the same method adopted for *Holothuria (Metriatyla) scabra*. Immediately after this one person from Madras came to Androth and processed nearly seven tonnes of *Holothuria (Microthele) nobilis* by paying a royalty of Re. 1.00 per kg to the Administration and five or ten paise for each specimen procured. He processed *beche-de-mer* at Kavaratti also. Fisheries Department restricted the collection of the specimens below 15 cm size. After two years he wanted to return to Lakshadweep but the Administration did not give permission.

At Kiltan there is a place even today known as *Koka pulkkayar* which means a place to boil sea cucumbers. About 60-70 years back one person, who is still living, used to process *Holothuria (Microthele) nobilis* at Chetlat.

Andaman was once famous for *beche-de-mer* and later it was not processed there since the islands chiefly served only as a penal settlement. Sometime back people from Tamil Nadu started processing *Holothuria (Metriatyla) scabra* in Andamans, particularly around Port Blair even though more valuable species like *Actinopyga mauritiana*, *A. echinites* and *A. militaris* were spared due to ignorance of their value and processing methods. At present, fishing for holothurians is banned in Andaman and Nicobar islands.

Locations of the industry outside India

The *beche-de-mer* industry caters to the needs of the Chinese at home and abroad. According to published information the industry exists in Japan, Australia, Palau, Carolin & Mariana Islands, New Guinea, New Caledonia, Samoa, Tahiti, Sandwich islands, Indo-China, Somalia, Kenya, Portuguese, East Africa, Madagascar, Mauritius, Aden, Burma, Cambodia, China, Fiji, Indonesia, North Korea, South Korea, Kenya, Laos, Malaysia, Mozambique, Papua, Philippines, Solomon islands, South Africa, Sri Lanka, Taiwan, Tanganyika, Tanzania, Thailand, North and South Vietnam, U.S.S.R., Tuvalu and Truk (Fig. 14).

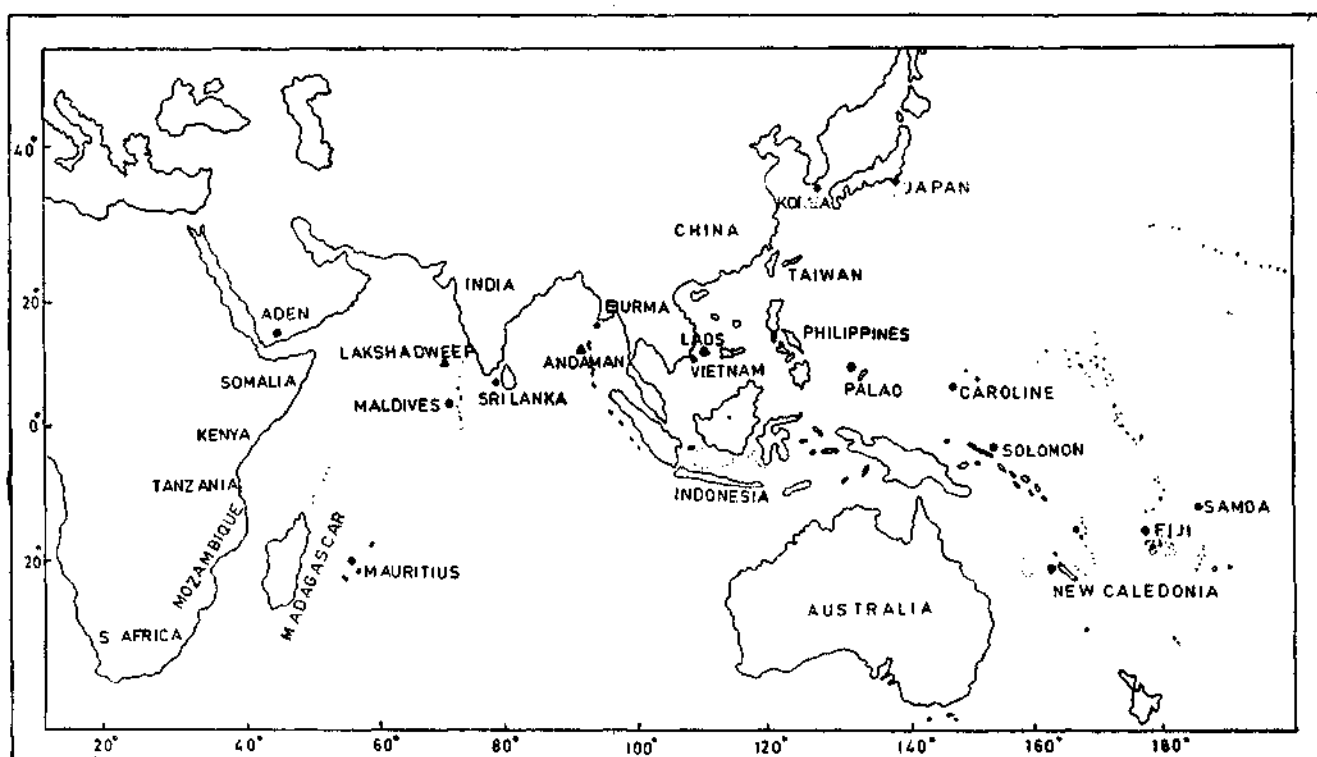


Fig. 14. Map showing the locations of *beche-de-mer* industry. Closed circles indicate places where industry exists now. Closed triangles indicate places where industry existed in the past.

Handling of holothurians

Holothurians being soft bodied animals have to be handled with care after collection since the value of the product depends on the shape. They have the habit of throwing out their internal organs on irritation which is a defensive mechanism and have the powers to regenerate the lost parts in due course. Some of the species have the habit of throwing out sticky threads known as 'cuvierian tubules' when disturbed which is again a defensive mechanism. This is for immobilising small fish and crabs. They should not be exposed to sun after collection since the top surface dries up. Sometimes the animals stick to one another with dried up slime.

As soon as the animals are brought to the boat a slit of 20-30 mm is made near the cloaca. When the animal is pressed near the mouth with thumb, the entrails are quickly thrown out. At Kilakarai where processing is done for *Bohadschia marmorata* the slit on the animal is made in the sea and the entrails are thrown out into the water. After squeezing out the water, the sea cucumbers are placed inside a fish box having smooth interior surface and drain holes. The box should be free from dirt, sand, coral pieces and algal mass as these will get

embedded in the skin spoiling the material. Sand fish can be placed one over the other. They flatten out and remain alive. The teat fish should be arranged in a single layer. If stacked one over the other the skin of the body wall may break and tear marks may remain on processed material down-grading the product. Usually the number of teat fish collected at a time is small and therefore does not necessitate stacking. Prickly fish, because of the large size and weight, should be handled with great care failing which the tubercles get damaged bringing down the value of the product. Use of palm leaf woven baskets should be avoided in transferring the holothurians from the boat to the shore. As already stated the animals shape out into openings between the strips of leaves and are cut or torn during removal from the basket. If the animals have to remain overnight or are kept for extended periods it would be advisable to keep them in sea water in plastic boxes. The sea water inside the boxes should be changed after every 12 hours if the water to animal ratio is 2:1. For green fish and other allied species which disintegrate into gelatinous mass when exposed to air should always be kept in sea water after collection. If the holothurians are kept in fish boxes for long time they become weak and this affects the end product.

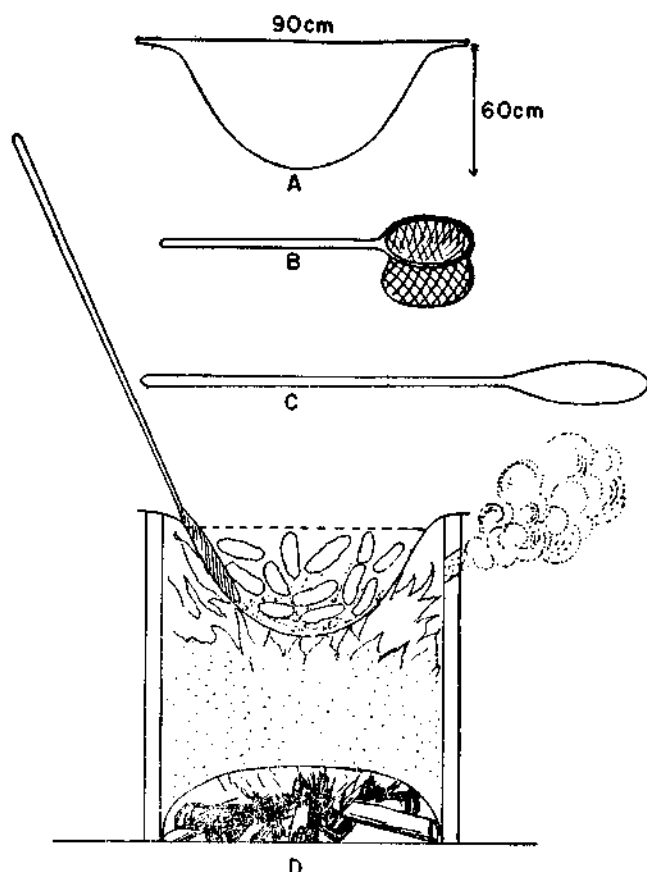


Fig. 15. A - Boiling pan, B - Ring net, C - Spatula for stirring, D - Fireplace.

Cleaning

The holothurians are cleaned in sea water to remove dried slime, sand and other extraneous particles and left-over gut and other entrails. While cleaning it is desirable to squeeze the animals to remove the water that the animal would have consumed during storage.

Degutting

In actual practice, along the Gulf of Mannar and Palk Bay, after the sea cucumbers are brought to the shore they are put as a heap. A slit of 20-30 mm is made near the posterior end of each animal with a sharp knife (Figs. 16, 17 and 18). Immediately the intestines, gonads and respiratory trees run out of the slit.

Boiling

Boiling is a very important step in processing the holothurians since the quality of the final product depends on the shape of the vessel used and the stirring done while boiling. It is the usual practice of the fishermen



Fig. 16. Degutting of holothurians in progress.

to use iron oil drums of 200 l for boiling (Fig. 19). The author has suggested the use of aluminium vessels for boiling (Figs. 15A and 20). In some places along the Palk Bay aluminium vessels are now used for boiling especially when material on hand is less. Copper and brass vessels should not be used for boiling. Hornell (*Madras Fish. Bull.*, 11 (4): 119-150, 1917) reports record of a copper pan being used as a boiler. The holothurians took up so much of copper salts that several deaths resulted from its consumption in China. The boiled body juice is exceedingly corrosive to metals. Hence the boilers must be carefully washed with clean fresh water at the end of each days operation.

The fire place (Fig. 15 D) is simple in construction using locally available materials. The most important point to be considered is concentration of heat for intense heating of the pan. On a beach or in a windy place an open fire tends to impart low heat to the pan. This takes more time and also more fuel. The pan is rested in a circular wall of clay 90-100 cm high supported if necessary by vertical iron rods. The fire mouth

should face windward side and this facilitates concentration of heat on the pan. Holes are kept at the sides to facilitate the escape of smoke. First, two-thirds of



Fig. 17. An improvised method of degutting.



Fig. 18. Women and children are also involved in *beche-de-mer* processing.

the pan is filled with good sea water. Coconut husks are used to start the fire. Coconut shells, mangrove wood and some hard wood give a good combination to produce uninterrupted and intense fire and heat.



Fig. 19. An undesirable practice. Oil drums are often used for boiling holothurians.

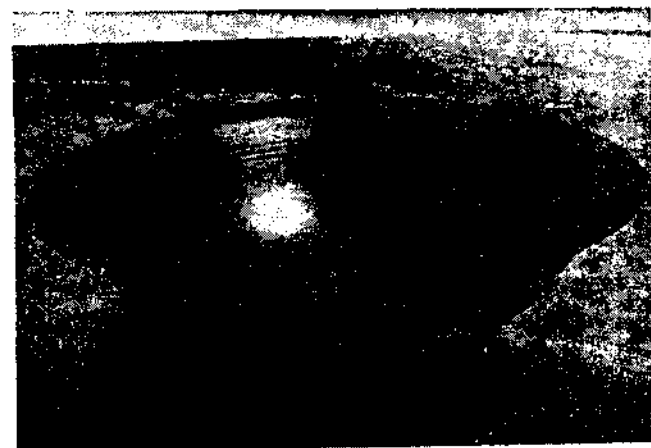


Fig. 20. Aluminium pan used for boiling holothurians.

The flames should constantly be touching the lower surface of the pan during boiling. Slackness or relaxation is detrimental to the quality of the product. If the animals kept in the boiling pan are slowly heated to boil the disadvantages are as follows:

1. The animal usually consumes water, closes the mouth and cloaca while being heated and effectively seals them. Heating boils the water inside and outside the animal. Pressure builds up inside and the body wall breaks unless removed from the boiling pan before that time.

2. After placing inside the pan and until the time of death the sea cucumber could assume any shape. A cylindrical shape is the acceptable shape in the market.
3. Heating slowly irritates the animal to form lesions in the outer body wall followed by breakages.
4. During the heating process the animals touching the bottom of the pan where the heat is intense, could easily be damaged.
5. It will be labour intensive to keep churning the animals inside the pan while heating.

Introducing the animals in boiling water has the following advantages:

1. The animals are killed within a few seconds of introduction.
2. The first reaction of the animal to an adverse situation like intense heat is to contract itself both with its longitudinal and circular muscles. This facilitates the formation of a cylindrical shape which is preferred in the market.
3. If the animal is properly squeezed before introduction into boiling water, the animal has no chance of water intake and the consequential pressure build up which would break the body wall.
4. Labour to churn the holothurians in the pan is required for a short period of boiling only.

To keep the temperature of the boiling water steady the holothurians should be introduced one by one until the height of the water rises to nine-tenth of the height of the pan. A spatula shaped pole is used as the stirrer. For stirring, slide the spatula along the sides of the pan to reach the centre and then lever it on the edge of the pan to lift the holothurians from the bottom. Stirring should continue for forty five minutes at intervals of three minutes during the first twenty minutes and at five minutes intervals for the rest of the period. Usually sand fish takes forty five minutes to boil. It is possible to check whether the holothurians are properly cooked or not by picking up a specimen and dropping it vertically down on hard space. If the piece bounces like a rubber ball, the material is ready for the next stage of processing. If the bouncing is nil or poor the boiling has to be continued for a further period of ten minutes

before checking again. Hornell (1917) mentions about a distinct cooked odour as the end point of boiling. Teat fish usually take 30–45 minutes for boiling and bouncing test cannot be applied for teat fish. A pole with a ring-net at one end is used for removing sea cucumbers from the boiling pan. Remove the material from the pan and allow them to cool on the sand. Add some more clean sea water to the pan to make-up for what had been lost and heat again to boil. Then introduce the next batch. The same water can be used for the next 3–4 batches until it becomes a concentrate of scum, mud and slime.

Processing procedure for teat fish

Different species of sea cucumbers should be processed in different ways. The processing described above applies to sand fish which is the most important on the mainland of India. The prevailing method of processing for *H. nobilis* (Teat fish) is as follows. Each sea cucumber is first slit longitudinally and the viscera is removed. The thick fleshy body wall is washed in sea water and boiled for half an hour. After removal from the boiler the pieces are pinned open by the insertion of short wooden skewers in order to prevent curling. They are then dried in sun on a cajan platform raised 75 cm from the ground. When dried thoroughly they are stored and exported.

The correct method of processing teat fish is given below. The sea cucumbers are first squeezed assuming that the gut entrails have been eviscerated while storing in fish boxes. They are introduced one by one slowly into the boiling water. Relatively fewer numbers of teat fish should be handled at a time to give individual care during boiling. Teat fish tends to float, as it seals water and air inside which builds up pressure with rising temperature. The body wall will break if it is not properly attended. Bloated teat fish are taken and punctured at the mid-dorsal region and put back into the boiling pan for the completion of the cooking process. The sea cucumbers should be stirred frequently using a wooden spatula (Fig. 15 C). The teat fish should be boiled for 30–45 minutes. Since it does not become very rubberlike, the bouncing test for sand fish does not apply for teat fish. The teat fish are removed with a long handled ring-net (Fig. 15 B). They are then cooled by placing on raised platform or wooden plank or on top of logs. Then they are cut open along the mid dorsal line leaving some portion at the anterior and posterior ends. If there are any unremoved visceral portions, they are washed out using lukewarm water. Then the product is again boiled for another 15–20

minutes. The product now shrinks and the body wall becomes hard. They are removed from second boiling with the ring-net and cooled. Wooden splinters of 3-5 cm long are placed between the cut edges of the dorsal wall to expose the interior. They are then dried on drying platforms.

On the mainland of India along the Gulf of Mannar and Palk Bay holothurians like *Holothuria spinifera* and *Bohadschia marmorata* are also processed in the same way along with *Holothuria scabra*. The processing methods of the species of *Actinopyga*, *Thelenota* and *Bohadschia* are not well documented.

Burying

Only in case of sand fish this process is carried out after boiling. Cleaning the sea cucumber after boiling is necessary in the above species. The traditional method involves bacterial decomposition of the outer layer which is scrubbed off by removing the outer mud embedded pigmented layer. Bacterial decomposition is activated by burying in the moist sand. After boiling, the sea cucumbers are cooled and kept moist inside pits in the beach and covered by sand. Bacteria multiply fast and eventually cover the entire surface of the animal. The bacteria start penetrating into the body wall. It is just enough if they penetrate 2 mm or so. Therefore the curing period inside the pits is an important factor. If the animals are kept for a longer time, the body wall



Fig. 21. The boiled holothurians are to be buried in sand over night for removing the outer calcareous coating.

may become too soft for further processing. If the pit is not kept moist at the time of burying bacterial action may be slow and decomposition inadequate. Clean, sandy beaches where little human activity is there are best sites for burying the sea cucumbers. The pit should be 100 cm long, 75 cm wide and 20 cm deep (Fig. 21) and as far as possible with an even floor. The cooled sea cucumbers are arranged densely in single layer and covered with a jute-hessian sac. Water is sprinkled over the sac and the pit is closed with sand and the area is marked.

Cleaning

After 15-18 hours the holothurians are removed from the pit and put into palm-fibre woven basket. The



Fig. 22. Cleaning holothurians by trampling with leg — another unhygienic practice.

specimens by now would have a decomposed outer layer of pasty material which can be easily removed. In usual practice sea cucumbers which are boiled and

buried in pits in the evening are removed next morning. It is then immersed in sea water in baskets, trampled with leg and washed clean (Fig. 22). In this way the decomposed outer chalky layer is washed away along with the soft mud-embedded outer skin and milky white ventral pigmentation. The material is now cylindrical and rubber-like in texture. At this stage it is important to pick out those which still retain white pigment. These require another round of boiling, burying and descumming. The quality of the final product is often affected due to the presence of improperly cleaned sea cucumbers. Sachithanathan *et al.* (*Bull. Fish. Res. Stn., Sri Lanka* 26 (1 & 2): 11-15, 1975) devised a de-scummer for *beche-de-mer* processing. In this processing the sea cucumbers are put in a drum to which a motor is connected to rotate. Inside the drum grooved rubber fingers are fixed and these rub against the sea cucumbers and remove the scum. About 100 sea cucumbers can be cleaned in five minutes using a de-scummer with a chamber of 1 m diameter and 0.45 m in height and the base plate rotating at a speed of 120 revolutions per minute rotated by a three horse power electric motor.

Second boiling

Those which are free from all chalky deposits after thorough cleaning are boiled once again in sea water for another 45 minutes. During the boiling the products are thoroughly stirred. By this second boiling all remnants of bacteria which destroyed the outer layer are killed.

Drying

Drying is one of the most important operations in the processing of sea cucumbers. Sun-drying is the



Fig. 23. Sun-drying of holothurians on sandy beach - yet another undesirable practice.

best when compared to smoking. The products are transferred to drying platforms with wire-mesh trays. They should never be dried on sand (Fig. 23) for sand sticks to the material and brings down the quality of

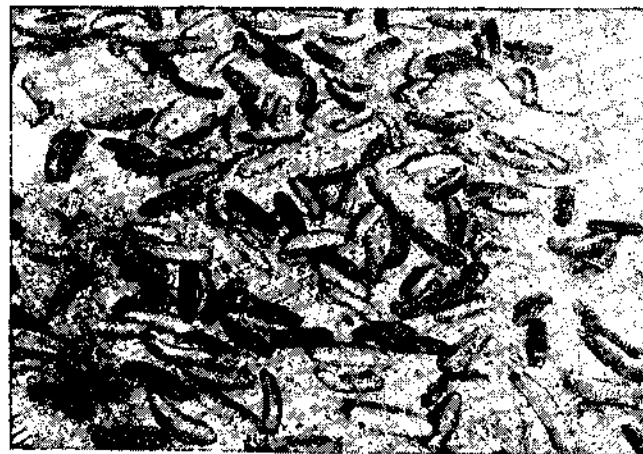


Fig. 24. Palmyrah mats can be used for sun-drying *beche-de-mer*

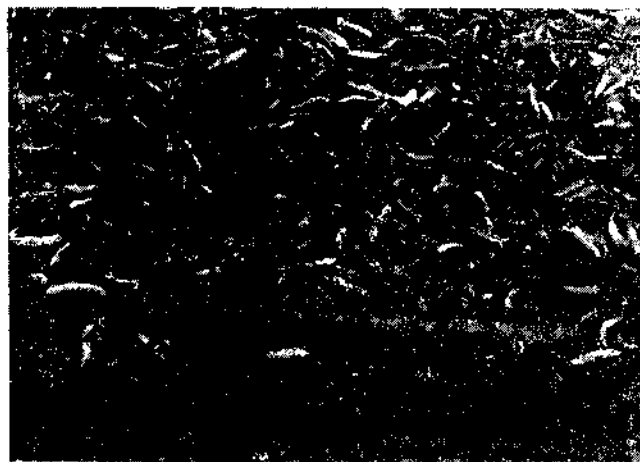


Fig. 25. Close meshed coir nets are also recommended for drying holothurians.

the product. Sea cucumbers are dried until they are hard with only 8-10% moisture content. They can be dried on palmyrah mats (Fig. 24) or coir nets (Fig. 25).

Smoking

Smoking is resorted to during the rainy season and also during cloudy days. The smoke chamber is a sterilizing chamber rather than an artificial dryer. Sachithanathan (*Souvenir, Beche-de-mer factory, Mannar, 1974*) devised a dryer known as Jaffna Dryer for which he made a portable model also. It is made up of drying trays kept in racks inside a drying house.

Hot air and smoke come out from an open-ended, 44 gallon drum in which the fire is made. The drum is placed horizontally under the trays. Mangrove wood or ordinary fire wood is used. The drying trays have wooden frames with wire mesh. In the portable unit three separate sections are assembled as one unit. The lower portion holds the hearth, the middle portion holds the trays and the top portion forms the roof. Asbestos or flat galvanised sheets are used, with wooden frame for support. The trays slide into the middle section and the drum containing the hearth is placed beneath them. Standard copra dryers are also frequently used. Solar dryers provide another alternative.

Quality improvement

At present processing is done under most unhygienic conditions. The export of material to Singapore and Hong Kong involves reprocessing and repacking to suit the demands of the foreign markets. By an Order in 1978 the Government of India brought *beche-de-mer* under quality control and inspection prior to export. While the materials from Japan and Korea are sold at a premium, the product from India is rated low.

Proper handling of the live material after collection is the foremost step to improve the quality of the product. It is desirable to get the animals eviscerated on return journey after collection since the processing site can be kept clean and also the material will be free from all slime, mucus and internal parts sticking to it.

Grading

Since the market value of *beche-de-mer* depends on the species, it is necessary to separate the product according to the species. Within each species length is the most important factor in grading. Longer, sturdier and stouter ones fetch more price than shorter, weak and flexible ones. In some production and marketing centres pieces per kg is used as a grade-determiner. But this is not preferred because, ungutted pieces with full of sand can add to weight. Also the state of drying influences the piece-weight relationship. Following grades are in vogue at the Singapore market for the sand fish.

Grade 1	16 pieces per kg	Grade 2	20 pieces per kg
Grade 3	35 pieces per kg	Grade 4	50 pieces per kg
Grade 5	80 pieces per kg	Grade 6	120 pieces per kg
Grade 7	160 pieces per kg		

Following length grades are used by Singapore buyers for Sri Lankan and Indian products.

Length in cm	Grade
12+	ONDU—SFO
10-12	RENDU—FO
8-10	MUND—O
6-8	NAALU—1
0-6 (broken pieces)	ANCHU—2 (KALAVAN)

Other criteria for grading are size, appearance, odour, colour, moisture content and spoilage. Samples with smooth surface and uniform shape are preferred. In sand fish patches of white pigmentation on the outer surface lower the market value. Smooth surface with no wrinkles are of better appearance than the ones with rugged surfaces. Dark coloured products are preferred over light coloured ones, for the consumers believe that the darker ones are the 'true' sea cucumbers. For this reason, sometimes while boiling, the material is coloured with pigments from Lolly fish and also from the barks of some mangrove plants. The material is hygroscopic and absorbs moisture during rainy season and emits a foul and offensive odour. For best grades odour should be pleasing with no foul smell. The product should be free from bacterial and chemical spoilage. Externally the product should appear dry. The soft internal parts would have already absorbed enough moisture to attract micro-organisms. Fungal growth is an index of moisture content. It is advisable to dry the stored material now and then and keep the moisture level low.

Packing and transportation

Packing materials include copra sacks, jute-hessian sacks and polythene bags. Packing in cartons lined by polythene helps in extending the storage life, besides having several other advantages. It is an usual practice to store them in gunny bags (Fig. 26) and transport as deck cargo. This is not safe since the material may be drenched in rain and spoiled by the spary of sea water. South Yemen exports *beche-de-mer* in cartons lined internally with polythene. If *beche-de-mer* could be sealed inside polythene bags after a good day's drying, the chances of moisture reabsorption is reduced. To prevent tearing of the bag, it can be kept inside an appropriate carton. Storage life of the product can be extended this way.

There appears to be renewed interest in *beche-de-mer* in many tropical countries. However, some factors

discourage the development of the sea cucumber industry. These include limited resource and over exploitation often resulting in the depletion of the stocks, poor prices



Fig. 26. *Beche-de-mer* packed in gunny bags for transportation.

paid to the fishermen and primary processors and unfamiliarity with correct processing methods resulting in low quality and poor demand.

Market trends and marketing

The markets for *beche-de-mer* are concentrated in Asia. Hong Kong and Singapore are the major import and re-export centres. Japan is the only major consumer of fresh products, but supplies are primarily from domestic sources. The functions of the importers/re-exporters are not limited to the physical movement of the product alone. Certain functions to upgrade and add value to the produce are also performed. These functions include grading, cleaning, drying and packing. In 1985, Hong Kong imported 6,209 tonnes and re-exported 5,008 tonnes leaving about 1,200 tonnes for its own consumption. China markets a great deal of *beche-de-mer* and supplies its own demands.

Singapore buys mostly sand fish from South East Asia. Hong Kong gets its supply of sand fish from South West Indian Ocean and teat fish, prickly fish, red fish and black fish from the Tropical Pacific. Most of the re-exports from Singapore go to Malaysia. From Hong Kong it is re-exported to Thailand, USA and other countries. East African littoral states supply the Hong Kong market with sand fish and the Tropical Pacific Islands supply the teat fish, prickly red fish etc.

Prices vary with seasons. In most of the countries in the Indo-Pacific region fishing commences in mid

February and goes on till the end of September. Prices are lower during this period and high during January because of the Chinese New Year which falls in February. Europe buys the most expensive products from Hong Kong. Locally in Hong Kong medium to high value species are consumed. Singapore itself does not produce any *beche-de-mer* but its annual consumption varies from 80 to 100 tonnes. Philippines is the largest supplier to Singapore. Other major suppliers exclusively dependent on Singapore market are India, Sri Lanka and Sabah (East Malaysia). New Caledonia is second after Philippines in its supply of *beche-de-mer* to Singapore. Though Sabah is a major supplier to Singapore its direct trade with West Malaysia is negligible. This

Table 2. Countries producing, consuming, exporting and importing *beche-de-mer*

Country	Produce	Consume	Export	Import
Aden	+	—	+	—
Australia	+	—	+	+
Burma	+	+	+	+
Cambodia	+	+	—	+
China	+	+	+	+
Fiji	+	—	+	—
Hong Kong	—	+	+	+
India	+	—	+	—
Indonesia	+	+	+	+
Japan	+	+	+	+
Kenya	+	—	+	—
Laos	+	+	—	—
Malaysia	+	+	+	+
Madagascar	+	—	+	—
Mozambique	+	—	+	—
New Guinea and Papua	+	+	+	—
New Caledonia	+	—	+	—
North Korea	+	+	+	+
North and South Vietnam	+	+	+	+
Philippines	+	+	+	—
Singapore	—	+	+	+
Solomon Is.	+	—	+	—
South Africa	+	—	+	—
South Korea	+	+	+	+
Sri Lanka	+	—	+	—
Taiwan	+	+	+	+
Tanganyika	+	—	+	—
Tanzania	+	—	+	—
Thailand	+	+	—	+
U.S.S.R.	+	+	+	+

is due to the transport links which are much more cheaper and frequent between Sabah and Singapore.

Major producing and exporting countries are the Philippines, Indonesia, Japan and East Africa with the Pacific islands and Australia as important newcomers. Next to Hong Kong and Singapore the major importers are West Malaysia, P.R. China, Taiwan, Province of China and Thailand. The last four countries depend to a great extent on re-exports from Hong Kong or Singapore. Countries producing, consuming, exporting and importing *beche-de-mer* are given in Table 2. *Beche-de-mer* known under different names in different languages is given in Table 3.

Table 3. *beche-de-mer* known in different languages

Language	Local Name
Burmese	Pan-le-pet-kye, Pin-lehmyaw
Danish	Sopelse, Soagurk
German	Trepang, Seegurke
Greek	Holothuria-agouria, Tis thalassiss
Hong Kong	Hoy sum
Italian	Olothuria
Israeli	Saebugu
Indonesian	Tripang, Teripang
Japanese	Namako
Malaysian	Trepang
Norwegian	Sjopolsen
Dutch	Zeekomkommer
Portuguese	Holothuria
Swedish	Sjorgurka
Thai	Pling khao
Turkish	Deniz hiyari
Yugoslavian	Morski krastavac-trap

Marine Products Export Development Authority, India conducted a market survey in 1986 in Malaysia, Singapore and Hong Kong. According to the report Peninsular Malaysia with six million Chinese population is an important market for *beche-de-mer*. India is having very little share in the market (about 4 tonnes). Singapore is one of the leading *beche-de-mer* importing countries of the world. Her annual imports are well over 500 tonnes. Philippines continues to be the principal supplier and her supply was about 145 tonnes in 1986, followed by Tanzania 66 tonnes, Kenya 65 tonnes, Sabah 64 tonnes, New Caledonia 61 tonnes, India 59 tonnes and Sri Lanka 36 tonnes. There is no direct supply of this item to Hong Kong from India. Indian *beche-de-mer*, however, reaches Hong Kong market

through Singapore. But due to the ban on the export of small sized *beche-de-mer* less than 7.5 cm the supplies from India witnessed a sharp fall in recent years.

The *beche-de-mer* of Japanese origin is being sold at premium in the Hong Kong market. The next best preference is for the Korean product. There is no size restriction on their imports. Even small sized forms have market.

Table 4. Major source of supply of *beche-de-mer* to Hong Kong

Country	Quantity supplied in tonnes	
	1984	1985
Philippines	1,370	2,955
Indonesia	1,060	2,439
Singapore	78	308
Japan	18	21
Korea DRP	31	26
Sri Lanka	0	1
Others	348	9
Total	2,905	6,209

Price structure

The recent rates for all the important species at Hong Kong and Singapore are not available. During the last ten years prices of *beche-de-mer* of sand fish have soared up from a meagre US \$ 2.95 for 17 pc/kg in 1974, to US \$ 16.00 in 1985 in the Singapore market.

Species preferences

The published information available is not in agreement with regard to the species most preferred and the order of importance. However, all publications state that the best grade *beche-de-mer* is prepared from teat fish, either black or white varieties. Next in order of importance are prickly red fish (*Thelenota ananas*), black fish (*Actinopyga miliaris*) and deep water red fish (*Actinopyga echinites*). The white teat fish (*Microthele fuscogilva*) is the most preferred species and also the most expensive one. It is followed by sand fish (*Holothuria scabra*). The various markets have their own preferences. Taiwan Province of China has a preference for *Stichopus japonicus*, *Actinopyga* spp. and *Holothuria scabra*.

Table 5. Singapore: imports of dried sea cucumber (1980-'84) (in tonnes)

Countries	1980		1981		1982		1983		1984	
	MT	Rank	MT	Rank	MT	Rank	MT	Rank	MT	Rank
Hong Kong	15	7	5	9	57	5	50	5	27	9
India	63	4	87	7	96	1	95	2	59	6
Kenya	0	0	15	7	22	8	50	5	65	4
Mozambique	0	0	8	8	48	6	22	9	21	10
New Caledonia	0	0	0	0	0	0	0	0	67	2
Philippines	69	3	95	1	74	3	98	1	145	1
Sabah	164	1	88	2	83	2	77	3	64	5
Sri Lanka	97	2	81	5	67	4	52	4	36	8
Tanzania	33	5	36	6	20	9	43	8	66	3
Other countries (including PR China, Japan, W. Malaysia, PN Guinea)	26	6	31	6	39	7	46	7	40	7
Total	467		446		506		533		590	
Growth index	100		96		108		114		126	

Table 6. Some grades of beche-de-mer in the Hong Kong market

Market name Cantonese	Market name English	Common name and the scientific name	Source	Size (cm)	Purchasing price per pound (in U.S. dollars)	Selling price per pound
Paesae som	White stone	Teat fish <i>Actinopyga nobilis</i>	Makassar Fiji Is. Solomon Is.	18 to 23	1.50	3.00
Wusae som	Black stone	Teat fish <i>Actinopyga nobilis</i>	Makassar New Guinea Fiji Is.	10 to 18	0.60	1.00
Leo som		Pickly red	Korea, Japan U.S.S.R.	4 to 5	1.40	1.75
Bufa som	Plum flower	Prickly red <i>Thekenota ananas</i>	Indonesia	18 to 25	0.25	0.35
Tok som		Sand fish <i>Holothuria scabra</i>	Africa Indonesia Singapore	10 to 18	0.10	0.15

Source: Sachithanathan, Souvenir, *beche-de-mer* Factory, Mannar, 1974.

Demand is limited to a few sizes of these species, mainly the smaller ones. Japan consumes mostly *Stichopus japonicus* raw or boiled and produces enough of this species for its own domestic needs while some are exported. The highly priced species are *Holothuria nobilis*, *Thekenota ananas*, *Stichopus variegatus* and *Actinopyga mauritiana*.

Uses of beche-de-mer

Apart from its value as food *beche-de-mer* is reputed to have aphrodisiac qualities which has undoubtedly enhanced its popularity. It is also credited with curative powers for ailments like high blood pressure and muscular disorders. Cebu fishermen have been known to

use the cuvierian tubules as a crude plaster for minor wounds. Its association with culture is so dominant in some communities, that the brides are given a few bags of *beche-de-mer* as dowry on the wedding day! In some parts of the Pacific, pregnant women walk in shallow waters to pick up certain species of sea cucumbers, clean them in sea water and eat them raw. Holothurian toxin is used in some places for fishing. *Beche-de-mer* has the following nutritional composition: protein 43%, fat 2%, moisture 17%, minerals 21% and insoluble ash 7%. Because of the low fat content it is recommended for persons having the problem of cholesterol. The soup made out of *beche-de-mer* is believed to possess curative properties for whooping cough, bronchial inflammation and other respiratory defects.

Recipe for beche-de-mer preparation

Beche-de-mer is cleaned and cooked in many delicious ways. One recipe is given below. First the *beche-de-mer* is soaked for four hours in cold water and then scrubbed with a brush to remove any chalky deposit still sticking to it. This is again placed in cold water. This process is repeated ten times. The meat becomes swollen and soft and ready for use. The following recipe is used. Place eight pieces of *beche-de-mer* in cold water. Boil them for five minutes and drain the water. Then simmer them for about 20 minutes in about three cups of chicken stock and cut the drained meat into large pieces. Discard the tick. Fry the meat for about two minutes with a little light soy sauce and oil in a frying pan. Now remove the meat to another frying pan. Add some fresh oil, heat it and add two green onions cut to 4 cm length along with six thin slices of ginger, two table spoons of sherry and the pieces of *beche-de-mer*. Fry it well by stirring and add three table spoons of light soy sauce, dashes of pepper and Ajinomoto, $\frac{1}{2}$ teaspoon of sugar, $\frac{1}{2}$ table spoon of dark soy sauce and $\frac{1}{2}$ cup fresh chicken stock. Cook it on high flame for two minutes. Add one table spoon of corn starch dissolved in two table spoons of cold water and $\frac{1}{2}$ table spoon of sesame oil. Now it is ready for serving. This preparation has to be stirred well before serving.

Defective processing

Different species of holothurians have to be processed in different ways. In India the method introduced by the Chinese for *Holothuria (Metriatyla) scabra* is used for other species also. The chief defect in processing is faulty evisceration. After making a slit they are simply put in a heap without squeezing individu-

ally. Now-a-days smaller forms are also processed for want of larger ones. The smaller ones do not eviscerate properly even after making a slit on the body wall. Very often 90% of the body weight of smaller forms will be accounted by sand. The evisceration is so faulty that after boiling, large quantities of intestines and other internal parts remain in the boiling pan.

Another major defect in processing is imperfect removal of chalky dermal coating. This is due to imperfect boiling and also because the bacterial action on the outer skin is not to the required degree. The chalky coating is removed in a most unhygienic manner by putting them in baskets and trampling with feet while water is poured over the product (Fig. 22). This problem can be solved by using a de-scummer. Such devices can be installed in *beche-de-mer* factories where facilities like electricity and water are available. About 100 sea cucumbers can be cleaned in five minutes time by the de-scummer.

Yet another defect in processing is found at the time of drying. The material should never be dried on sand since sand sticks to the surface and forms a coating on the material. The best method to dry them is to put them over palmyrah mats on raised platforms. In some places coir mats are used for drying. If the meshes are large the purpose will not be served.

Trade irregularities

Often *Holothuria (Halodeima) atra* which is abundant and cheap is also processed and mixed with samples of *Holothuria (Metriatyla) scabra* to increase weight. Some black holothurians are also put during boiling to make the product look darker. In Australia mangrove bark decoction is used to dye the material. Another common trade trick is to slit open large animals and insert small ones in the cavity within. Improper evisceration is also a deliberate act to increase the final weight of the product. In some places some hydroxide crystals are added during boiling so that the white chalky material is thoroughly removed. This is a health hazard and the material thus processed can be identified as it is eaten away at several places due to the action of hydroxide.

Problems facing the industry

The industry is in short supply of material for processing. This is largely due to the fact that fishermen concentrate on a narrow strip of sea in the Gulf of Mannar

and Palk Bay and exploit only two species viz., *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera*. No survey has been conducted in the Palk-Bay. Some information is available on the population of *Holothuria (Metriatyla) scabra* off the shores of

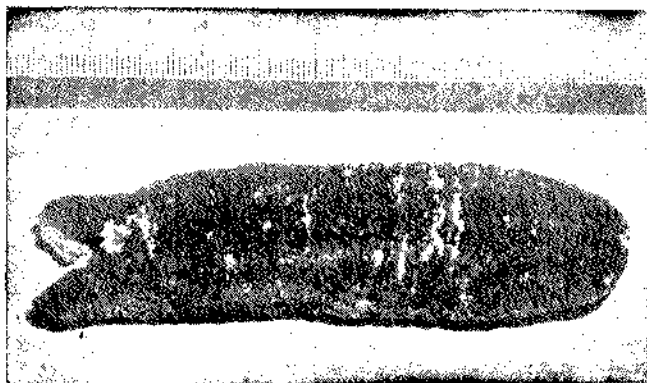


Fig. 27. Beche-de-mer of *Holothuria scabra*.

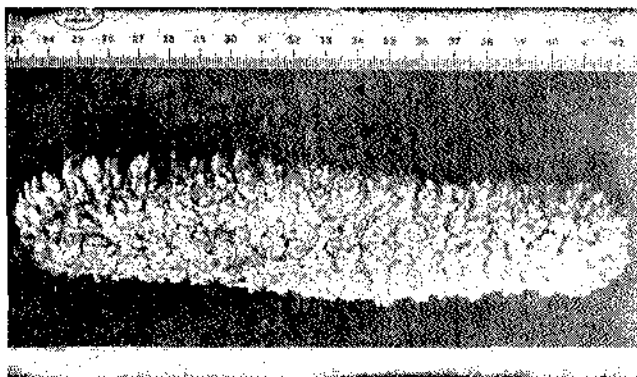


Fig. 28. Beche-de-mer of *Thelenota ananas*.

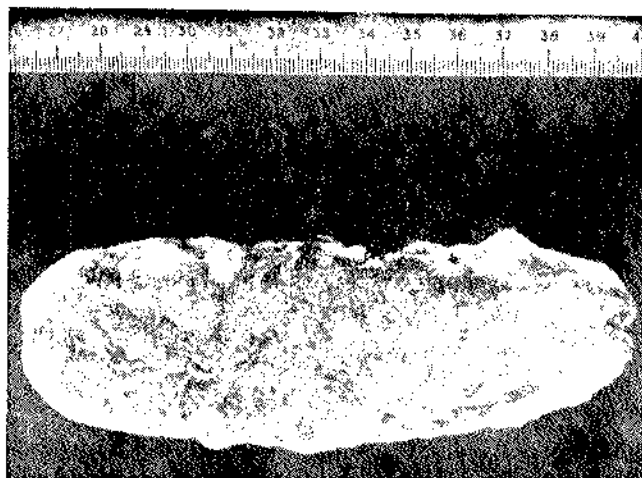


Fig. 29. Beche-de-mer of *Holothuria nobilis*.

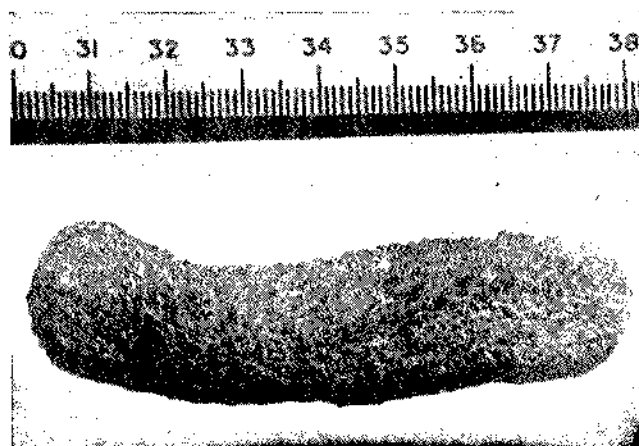


Fig. 30. Beche-de-mer of *Holothuria spinifera*.



Fig. 31. Beche-de-mer of *Actinopyga mauritiana*.

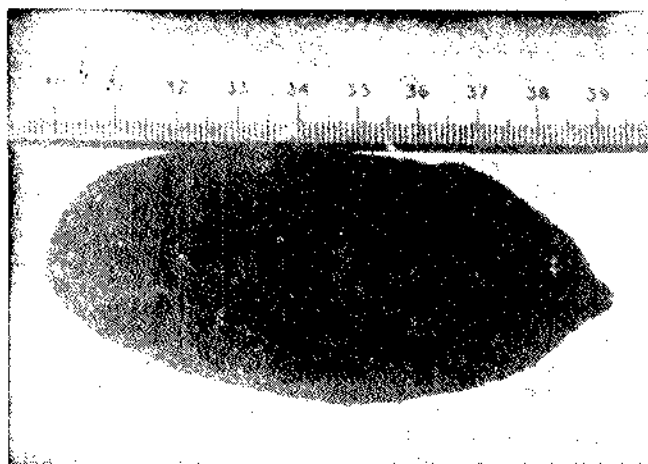


Fig. 32. Beche-de-mer of *Actinopyga miliaris*.



Fig. 33. *Beche-de-mer* of *Actinopyga echinites*.

northwest coast of Sri Lanka. This species is found distributed in depths of 6–20 m. Production is estimated to be about 100–150 tonnes per annum. However, there is no information on the potential yield.

In order to overcome the shortage of material the fishermen may launch out to other places like Andaman and Nicobar islands and the Lakshadweep. In Andaman and Nicobar islands there are more than 500 islands. No survey has been conducted in these islands for sea cucumbers. Good resources must be available in some of the islands which have not been visited so far by the persons involved in the industry. At Andaman and Nicobar islands and the Lakshadweep, holothurians which have much higher value than *Holothuria (Metriatyla) scabra* are available. In Lakshadweep the best quality holothurian *Holothuria (Microthele) nobilis* occurs in good numbers around some of the islands. Another valuable holothurian there is *Actinopyga mauritiana*. In Andamans ten years back *Holothuria (Metriatyla) scabra* was processed chiefly around Port Blair. Other valuable holothurians at Andamans are *Actinopyga mauritiana* and *A. echinites* which occur in good numbers. These are now not processed due to ignorance of their value and also the processing methods.

Another problem faced by the industry is the low price offered in the international market due to the fact that the Indian material earned a bad name since it is processed under less hygienic conditions and also the final product is less attractive.

Recent developments in the industry

In the last 20 years some changes have taken place in the industry. There has been an effort on the part of the industry to process the material in more hygienic manner due to the present day attractive prices offered. Now the material is always dried on coir mats. In many places aluminium vessels are used for boiling the holothurians instead of rusted iron drums. Now these have to be replaced by saucer-shaped pans preferably made out of hindalium. Now regular fire wood is used in the place of dry coconut and palmyrah leaves.

In the past two years divers are using round aluminium plates as 'flippers'. This enables them to cover greater distance underwater with ease. This may also prove to be counter productive at times since the divers may try to pick up with ease all material irrespective of size.

Present status of the industry

The prices offered for *beche-de-mer* in recent years is attractive. In 1986 Hong Kong market offered US \$ 17.00 per kg for large sized *beche-de-mer* (13–15 cm) processed from *Holothuria (Metriatyla) scabra*. They weighed 25–35 pieces per kg. However, the export which was 91 tonnes in 1975 has gradually fallen to 11 tonnes in 1985. This is partly due to the ban imposed by the Government of India in 1982 on the export of material less than 7.5 cm in size. The ban was later relaxed to clear the accumulated material and this accounted for 71 tonnes of export in 1983. In recent years large forms have become rare particularly around Tirupalakudi where intensive fishing is done since time immemorial.

The percentage of small sized *beche-de-mer* increased during the years 1979–'86. *Beche-de-mer* of 7.5–10 cm size which formed only 33% during 1979–'80 increased to 80% during 1985–'86. Details of percentage of different sizes during the years 1979–'86 are given in Table 8. The demand in foreign markets like Hong Kong and Singapore are more and they require about 10–20 tonnes per month and the suppliers in India are unable to meet the heavy demand. Lured by the high price offered and also due to the high demand, they resort to processing small and immature forms thus endangering the stocks of the species. To meet the heavy demand, in Kilakarai they are now processing *Bohadschia marmorata*. If the industry has to be saved, conservative measures have to be taken up immediately and the industry should be diverted to other places like the Andaman and Nicobar and the Lakshadweep islands

where there is at present no processing at all. The industry has been introduced at Tuticorin recently. There is an organised industry where about 50 boats are engaged in diving operations for holothurians and daily Rs. 10,000 to 15,000 worth of holothurians are fished.

At Rameswaram most of the holothurians landed are large. At Tondi only one person is engaged in holothurian processing. In Pudupatnam most of the divers come from Tiruppalakudi, Karangadu and Mullimonai. At Kottaipatnam one person is engaged in this industry for the past 15 years. Here large specimens fetch Rs. 4 for each piece. *Beche-de-mer* above 7.5 cm is sold at Rs. 120 to 130 per kg. Each kg may

contain 22-25 pieces. At Kattumavadi also only one person is engaged in processing holothurians for the past 25 years. There are no local divers in the village but divers from Periapatnam and Kilakarai come there and dive for holothurians during the season. At Mallipatnam also only one person is engaged in holothurian processing for the past 20 years. There are no local divers in the village. Divers from Periapatnam regularly camp there during June and collect holothurians.

Kilakarai is the main centre for the export of *beche-de-mer*. At present there are three merchants and two merchants in Ramnad exporting the material. Each merchant exports 20-25 tonnes of *beche-de-mer* annually.

Table 7. Prices of dried sea cucumber in 1986 (Trepang)

Species	Common name	Sizes (cm)	Pieces/kg	Price/kg (US \$)
<i>Actinopyga lecanora</i> or <i>A. miliaris</i>	Khaki	8.9	15-25	1.90
		7.6-8.9	40-50	1.50
		6.4-7.6	80-100	1.00
		5.1-6.4	120-200	0.65
		2.5-5.1	250-300	0.40
<i>A. echinites</i>	brown beauty	3 up	—	0.65
<i>Holothuria atra</i>	black beauty	10.2	40-50	1.10
		7.6-10.2	80-100	0.70
		5.1-7.6	120-150	0.40
<i>Holothuria fuscogilva</i>	patola	10.2	—	0.38
<i>H. scabra</i>	patos	15.2	—	0.70
	dalamogon (giant)	15.2	—	0.70
<i>Bohadschia argus</i>	leopard	10.2	—	0.55
<i>S. chloronotus</i>	cautro cantos	10.2	—	1.75
<i>S. variegatus</i>	hanginan/gadul	10.2	—	2.10
		7.6-10.2	—	1.80
		6.4-7.6	—	1.40
		5.1-6.4	—	0.50
		8.9	20	3.75
<i>Actinopyga</i> sp.	buli-buli	7.6	30	3.25
		6.4 - 7.6	50	2.50
		5.1-6.4	80-100	1.75
		2.5-5.1	—	0.90
		15.2	—	4.50
<i>Thelenota ananas</i>	tinikan (prickly fish)	12.7-15.2	—	4.00
		10.2-12.7	—	3.50
		10.2	—	0.55
<i>Holothuria pulla</i>	Lawayan-mataba-payat	6.4	—	0.15
<i>Actinopyga echinites</i> (big)	hodhod	10.2	—	4.00
		7.6-10.2	—	3.50

Source: Trinidad-Roa, Mar. Sci. Inst. Cont. 7151: 15-17, 1987.

Small quantities are sent as accompanied baggage by air from Madras. Supplying of material to Sri Lanka is now suspended due to disturbed conditions.

Future prospects for the industry

The *beche-de-mer* industry in India has a bright future if it switches over to other grounds like Lakshadweep and the various islands of Andaman and Nicobar which have the best quality holothurians for *beche-de-mer*. The industry has to diversify to other areas and other species. In order to encourage processing of other species it is necessary to send processed samples to Singapore and Hong Kong and ascertain the present rate. This will encourage the local people to take up processing of other species. The break-through achieved in inducing *Holothuria (Metriatyla) scabra* to spawn in the laboratory for the first time in India by thermal stimulation and later successful rearing of the larvae to juveniles will go a long way to solve the shortage of material faced by the industry. Sea ranching has to be taken up in large scale to replenish the stocks.

Beche-de-mer processing plants

Though *beche-de-mer* fishery is an artisanal one and the industry is essentially a cottage industry, by setting up *beche-de-mer* processing plants the industry can be better organised. The advantage of having a factory is that processing is carried out by selected and trained staff to ensure uniformity, hygiene, greater care for better standard and quicker production. Bad weather conditions will not affect processing, and suppliers of raw material will get continuous employment. It is also easier to install devices like the de-scummer. It

is desirable to have one or two factories under the co-operative sector along the Gulf of Mannar and Palk Bay. In *beche-de-mer* industry three parties are involved, the fishermen who goes for diving, the processor who purchases the material and process it and the exporter. The fishermen get the least amount in the present set up. By setting up *beche-de-mer* factories under the co-operative sector the middle men can be eliminated.

Recommendations

Having made a survey of the *beche de-mer* industry from every angle it is thought desirable to present some general recommendations for improving the industry in India.

1. The industry is at present restricted to a narrow strip in the Gulf of Mannar and Palk Bay on the main land. Detailed surveys for holothurian resources along the mainland of India, Andaman and Nicobar islands and the Lakshadweep should be conducted.
2. Considering the vast number of islands and also the availability of more valuable species of holothurians in Andaman and Nicobar islands the existing ban on exploitation should be lifted and the exploitation should be monitored.
3. In Lakshadweep the most valuable holothurian *Holothuria (Microthele) nobilis* for *beche-de-mer* preparation occurs in good numbers. Therefore the industry has to be urgently extended to the Lakshadweep.

Table 8. Size-wise export (in kg) of *beche-de-mer* from India

Size (cm)	1979-'80	1980-'81	1981-'82	1982-'83	1983-'84	1984-'85	1985-'86
10-15	7,031 (16.9%)	4,755 (14.21%)	2,054 (3.06%)	3,596 (7.48%)	3,051.5 (3.8%)	2,851 (18.52%)	2,123 (19.5%)
7.5-10	13,987 (33.7%)	9,332 (27.89%)	6,986 (10.4%)	19,192.5 (39.93%)	22,643 (28.22%)	12,545 (81.48%)	8,765 (80.5%)
5-7.5	18,301 (44.0%)	15,867 (47.42%)	45,675 (66.59%)	22,370.5 (46.54%)	39,021 (48.64%)	—	—
Below 5	2,182 (5.3%)	3,502 (10.46%)	13,373 (19.95%)	2,906 (6.04%)	15,495 (19.31%)	—	—
Total	41,501	33,457	67,088	48,065.0	80,210.5	15,396	10,888

Source: Data compiled from the invoices registered in the MPEDA Regional Office, Madras.

4. Fishermen should be taught of the correct and hygienic methods of processing. Different species of holothurians should be processed in different ways. A workshop is to be conducted for the persons involved in processing.
5. Fishermen should be taught about the value of conservation and management through lectures and exhibitions.
6. Fishermen should be involved in sea ranching programmes since they can monitor the growth of the holothurians and give feed back information.
7. *Beche-de-mer* processing plants should be opened at important centres under co-operative sector so that the fishermen will get maximum benefit.
8. They should be taught about the value of ecosystem. Destruction to coral reefs and algal beds should be avoided.
9. Printed literature should be made available to fishermen and the industry in local languages telling them what they should do and what they should not.

Export

Export figures are available from 1898 to 1916 and again from 1963 to 1987. The two World Wars have affected the trade to a large extent and during 1914-'15 there was no export. The export value reached one lakh figure in 1968 and 20 lakhs in 1975. In 1984 and

Table 9. *Export figures of beche-de-mer in weight and value during 1978-'87*

Year	Weight of <i>beche-de-mer</i> (kg.)	Value of <i>beche-de-mer</i> (Rs.)
1978	24,537	10,76,560
1979	31,231	15,22,941
1980	34,013	18,72,314
1981	47,841	26,28,757
1982	37,143	17,23,558
1983	71,853	36,96,765
1984	20,715	17,97,948
1985	11,993	11,68,213
1986	32,864	38,03,858
1987	53,755	79,37,977

1985 the exports were low due to the ban on the export of small sized material. Last year *beche-de-mer* worth over Rs. 79 lakhs was exported and it is hoped that this will cross one crore mark soon. The export figures for the 10 year period from 1978 to 1987 are given in Table 9.

ADDRESSES OF BECHE-DE-MER IMPORTERS

Hong Kong

NAM KWONG Co.
P.O. Box: 3042
Hong Kong
Telex: 75371 NKCHK HX.

* TAI HING INTERNATIONAL LIMITED
GPD Box: 5690
308-309 International Building
141 Des Voeux Road
Central Hong Kong.

SEA SOURCE Co.
2nd Floor, General Building
6-14 Centre Street
Saiyingpun
Hong Kong.

WINSON TRADERS (HK) LTD.
501 Wong House
26/30 Des Voeux Road
West Hong Kong
Hong Kong.
Telex: 85005 WTGRP
Telephone: 5-406706, 406484
Cable: WINFIRM.

KIT HENG CHUNG (HK) LTD. COMPANY
1st Floor
155 Des Voeux Road
West Hong Kong
Hong Kong.
Telex: 65520 CCPHX
Telephone: 473560
Cable: BEST BEACH.

EUROSIA HOLDING LTD.
Milwood Mansion, 9/F, Block C
Tsimshasui
Kowloon
Hong Kong.
Telex: 37598 EUHOL HX
Telephone: 3-669309-0
Cable: EUHOLIMIT, HONG-KONG.

SUMMER TRADING COMPANY
808-809 Wing Tuck Comm. Centre
177-183 Wing Lok Street
West Hong Kong
Hong Kong

Telex: 65362 SUTCO HX
Telephone: 5-411689, 456035/6
Cable: EAERY.

ORIENTAL MARINE PRODUCT GROUP
GPO Box: 251
Hong Kong

Telex: 38179 OMPG HX
Telephone: 3-7790021
Cable: GREATWHITE HONG KONG.

FULL SUCCESS TRADING CO.
19-25 Des Voeux Road W
Room 402
Hong Kong

Telex: 38247 FOWIL HX
Telephone: 3-687851, 689808
Cable: FOWSILAR HX.

EASTERN PEARL INTERNATIONAL CO.
Room 1101-2, Seaview Comm. Bldg.
21-24 Connaught Road
West GPO 5409
Hong Kong

Telex: 74279 SHARK HX
Telephone: 5-408184
Cable: PEARLATION.

HEEP TUNG LONG
GPO Box 407
Hong Kong

Telex: 60195 HEEP HX
Telephone: 5-468313, 467005
Cable: TIBURON, HONG KONG.

UNIQUE DISTRIBUTORS LIMITED
GPO Box 293
Hong Kong

Telex: 61397 UNIWA HX
Telephone: 5-278331
Cable: SYSTEMS.

CHI FU COMPANY
14 Possession St.
1st Floor
Hong Kong

Cable: CHIRUCOOAN.

CONCORD INTERNATIONAL LTD.
Pak Lee Mansion 9th Floor
63 King's Road
Hong Kong
Cable: ASAFLA.

HEEP TONG HONG
16c Nam Pak Hong Building
22-28 Bonham Strand West
Hong Kong
Cable: TIBURON.

TAIYONG TRADING CO.
Room 601, 6th Floor
Lee Kiu Building
51 Jordan Road, Kowloon
Hong Kong
Cable: SHARKFINS.

KWONG HING HONG
3 Wilmer Street
1st Floor
Hong Kong
Telex: 61649 PATHK HX
Telephone: 5-478443, 490054.

NAM YUEN HONG
10 Eastern Street
Ground Floor
Hong Kong
Telephone: 5-467404.

Singapore

SARIANO CO.
40 Wilkinson Road
Singapore - 1543
Telex: RS 25283

SEAKING TRADING CO.
45 A Jalan Membina
Singapore - 0316
Telephone: 271 72 30.

ENG THONG CO.
74 South Bridge Road
Singapore - 0105
Telephone: 222 0701

YONG THAI TRADING CO.
65 Telok Ayer Street
Singapore - 0104
Telephone: 222 7192.

CHOON HONG MARINE PRODUCTS
51 North Canal Road
Singapore - 1.

Telephone: 43 4073.

A. M. ABDULLAH SAHIB & Co.
Maxwell Post Office No. 19
Singapore - 9000.

Telex: RS 20847 AMAH

Telephone: 5334553, 5344074

Cable: AMAH.

ASIA SEAFOOD COMPANY
353-A Circuit Road, Block 64
Singapore - 2337.

Telex: RS 24200 TMSR

Telephone: 7 384077

Cable: ASIATONGA, SINGAPORE.

WE SOON MARKETING PTE. LIMITED
Block 1057, Eunos Ave. 3, 0469
Singapore - 1440.

Telex: RS 38103 WICO

Telephone: 7457432, 7473902

Cable: WEISON.

HIAP HENG CHNG (S) PTE. LTD.
5-6 North Canal Road
Singapore - 0104.

Telex: RS 25106 FINEACH

Telephone: 911888

Cable: FINEBEACH.

* AVIMARINE PTE. LTD.
470-A Upper Serangoon Road
Singapore.

Cable: LOKEMARINE.

CHOP CHIP CHAING
20 New Bridge Road
P.O. Box 3225, Singapore - 1.

CHOP YONG HONG
16 North Canal Street
Singapore - 1.

* DANIEL OEI ENTERPRISES
G 80 Katong Shopping Centre
East Coast Road, Singapore - 15.

ENG THONG CO. PTE. LTD.
74 South Bridge Road
Singapore - 1.

HON HUAT ENTERPRISES PTE. LTD.
Telok Ayer Street
Singapore - 1.

NG ENG WHAT
14 New Bridge Road
Singapore - 1.

PHOON HOAT AND CO. PTE. LTD.
G.P.O. Box 2414
171 Bencoolen Street
Singapore - 7.

Taiwan

TRANSWORLD ENTERPRISES CO.
4A, No. 1 Alley 6, Lane 303
Nanking East Road, Section 3
Taipei.

Cable: TWENTER

Malaysia

ENG WAN TRADING CO.
P.O. Box 554
57 Leboh Pantai
10770 Penang
Malaysia.

Telex: MA 40638

Telephone: 04 63811

Cable: PRECIOUS PENANG.

U. S. A.

THE INTERSOURCE COMPANY
1860 Ala Moana Blvd No. 405
Honolulu
Hawaii - 96815.

GEORGE K. TANG
Suite 202
1253 Bush Street
San Francisco
California - 94019.

* Buyers accept prickly red fish.

China & Japan : China and Japan do not at present import *beche-de-mer* since they are able to supply their own needs.

Malaysia : Malaysia imports *beche-de-mer* from Hong Kong and Singapore and does not deal directly with producing countries.



बेश-द-मेर — इसकी संपदायें, मात्स्यकी और उद्योग

डी. बी. जेम्स

सी. एस. एफ. आर. आइ. का टूटिकोरिन अनुसंधान केन्द्र

प्रस्तावना

बेश-द-मेर पोर्चुगोस नाम बेशे-द-मेर का फ्रांसीसी शब्द है जिसका अर्थ है समुद्री स्लग। यद्यपि बेश-द-मेर शब्द एक समुद्री ककड़ी को सूचित करता है तथापि इसका संकेत संसाधित होलोथूरियन से है। यह चीन के लोगों का विशेष भोज्य है। चीन के लोग त्योहारों के अवसर पर विशेषकर नववत्सर पर बेश-द-मेर खाते हैं। इसमें प्रोटीन की सुलभता है और फाट बहुत कम है। इसलिये कोलेस्ट्रॉल रोगियों केलिये यह बहुत अच्छा है।

अब भारत से एक करोड़ रुपये का बेश-द-मेर निर्यात करता है। विशेष रूप से यह सिंगपूर की ओर है। देश में इसका उद्योग पाक की खाड़ी और मान्मार की खाड़ी में होता है। हाल ही में अन्डमान और निकोबार द्वीपों में होलोथूरियन के मत्स्यन पर रोक लगाया है।

बेश-द-मेर भारत का बहुत पुराना कुटीर उद्योग है। भारत में इसका प्रस्तुति चीनियों ने की। आज से एक सौ साल पहले मान्मार और पाक की खाड़ी में इस उद्योग का निरीक्षण चीनियों द्वारा किया जाता था।

भारत के बेश-द-मेर पर सबसे पहले कोलियर (1830) ने लिखा था। जेम्स (1983) ने भारत के बेश-द-मेर पर किये जाने वाले कामों का संक्षिप्त विवरण दिया। डुरैराज और सहवर्तियों (1984) ने बेश-द-मेर के गुणों और संसाधन के समय स्पीज़ीसों में देखनेवाले संकोचन के बारे में अध्ययन किया। हाल में जेम्स (1986) ने बेश-द-मेर के गुण बढ़ाने लायक रीतियों का विवरण दिया।

भाग I : संपदायें

वाणिज्यिक होलोथूरियन

विश्व के विविध भागों में अब तक 650 से अधिक होलोथूरियन स्पीज़ीसों के बारे में पता मिला है। भारत के चारों ओर के समुद्रों में करीब 200 होलोथूरियन स्पीज़ीस हैं और इस में लगभग 75 स्पीज़ीस 20 मी. गहराई के उथला जल में दिखाई पड़ती हैं। इस में 15 स्पीज़ीसों वाणिज्य की दृष्टि से मूल्यवान हैं। संसाधन केलिए बड़े आकार के होलोथूरियन का उपयोग करते हैं। इसके संसाधन केलिए विशेष तरीक़ायें जैसे स्ट्रिकोपस वेरिगैटस और एस. क्लोरोनोटस आदि का उपयोग करते हैं।

सर्वेक्षण साहित्य के अनुसार संसाधन केलिए उपयोग करने वाले स्पीज़ीस नीचे की प्रकार हैं। होलोथूरिया (मैक्रोतेले) नोबिलिस, होलोथूरिया (मैक्रोतेले) फुस्कागिलवा, होलोथूरिया (मैक्रोतेले) ऐक्सोलोगा, ऐक्टिनो-पैगा मॉरिटिआना, ए. मिलारिस, ए. एक्लिनेटस, ए. लेकनोरा, थेलेनोटा एनानास, टी. एनाक्स, होलोथूरिया (मेट्रियाटैला) स्कैत्रा, होलोथूरिया (थीलोथूरिया) स्पैनिफेरा, होलोथूरिया (हलोडैमा) डोट्टा, बोहाडस्किया आरागस, बी. मारमोराटा, बी. विटैनसिस, स्ट्रिकोपस वेरिगैटस और एस. क्लोरोनोटस भारत में अब मान्मार और पाक की खाड़ी से होलोथूरिया मेट्रियाटैला स्कैत्रा और होलोथूरिया (थीलोथूरिया) स्पैनिफेरा संसाधन केलिए पकड़े जाते हैं। मान्मार खाड़ी के किलाकरै और वेदालै में संसाधन केलिए बोहाडस्किया मारमोराटा का भी इस्तेमाल हाल में किया जाता है। देश में होलोथूरिया हलोडैमा अद्रा, लक्षद्वीप में होलोथूरिया (मैक्रोतेले) नोबिलिस, बोहाडस्किया आरागस, स्ट्रिकोपस क्लोरोनोटस और अन्डमान में ऐक्टिनोगापैगा स्पीज़ीसों को इस्तेमाल करने का मुंजाइश है।

भाग II : मात्स्यकी

होलोथूरियन संग्रहण की विविध रीतियाँ

अभी तक होलोथूरियनों की पकड़ केलिए कोई विशेष जाल का निर्माण नहीं किया है। ये अप्रतिरोधी जीवी होने के नाते इसकी पकड़ बहुत आसान है।

हस्तेन रीतियाँ

होलोथूरियनों को अंतराज्वारीय क्षेत्र में निम्न ज्वार भाटा के अवसर पर और लैगूनों में एक मीटर के कम गहराई में हाथ से पकड़ना ही संग्रहण की आसान रीति है। श्रीलंका में इसकेलिए लंबी हैंडल का इस्तेमाल से बनाये काँटेदार फोर्क का उपयोग करता है। टनसनिया में 1985 में गठित कार्यशाला में यह बताया गया कि 2 से 3 मीटरों की गहराई में होलोथूरियन को पकड़ने केलिए मान्डा नामक एक दण्ड का प्रयोग करते हैं, जिसका अग्र काँटेदार होता है। फिलिपैनन्स की स्त्रीयाँ और बच्चे होलोथूरियनों को पकड़ने में समर्थ हैं। मर्द इन्हें पकड़ने केलिये गहरी पानी में जाता है। यहाँ हुक्का या कपेन्ना रीति का उपयोग कर सकता है। हुक्का रीति होलोथूरियन के संग्रहण में अत्यन्त प्रभावी है लेकिन खतरनाक भी है। इस रीति में डैवेर्स एक ब्रीथिंग होस की सहायता से समुद्र के नीचे 30-60 मिनट तक रहकर ककड़ियों का संग्रहण करता

है। साधारणतया होलोग्रिफ का संग्रहण 2 से 3 मीटर के उथला पानी में स्किन डैविंग (चर्म पनडुब्बा) से किया करते हैं। पकड़नेवाले सबेरे 6 बजे जौकों में जाते हैं और अपराह्न में वापस आते हैं। ये लोग अपने साथ नेट बैग ले जाते हैं और इस में जीवित होलोग्रिफ को डालकर तट पर ले आते हैं। अब दो वर्षों से पनडुब्बों के प्लास्टिक हस्तों का कीमत बढ़ने के कारण इसके बदले ऐलुमिनियम हस्तों का प्रयोग करते हैं। इसके प्रयोग से ये लोग जल की गहराई में कहीं दूर आकर अधिक चीज़ इकट्ठा कर सकते हैं।

सोलमन द्वीपों में होलोग्रिफ के संग्रहण के लिए एक मज़ेदार रीति का उपयोग होती है। इसके लिए मत्स्यन हुक का उपयोग होता है। मत्स्यन लाइन पर 7 कि. ग्रा. के भार लाटकर डैवर्स एक मीटर की दूरी से होलोग्रिफों पर डालते हैं। तब हुक उनके शरीर पर चुभ जाते हैं। इन्हें बोटों में संग्रहण करते हैं।

संग्रहण के क्षेत्र

इस समय होलोग्रिफों को माजार खाड़ी और पाक खाड़ी से संग्रहित करते हैं। माजार खाड़ी में पम्बान से टूटिकोरिन तक और पाक खाड़ी में विजपालम, वेदालै, मण्डपम, पेरियपट्टनम, किलाकरै आदि केन्द्रों से समुद्री ककड़ी प्राप्त होता है। पेरियपट्टनम, किलाकरै और टूटिकोरिन इन में प्रमुख है। लगभग 17 साल पहले टूटिकोरिन में होलोग्रिफ का मत्स्यन नहीं किया करता था। अब यहाँ अच्छे मौसम के समय प्रतिदिन 10,000 से 15,000 रुपये का नीलाम होता है। पाक खाड़ी के प्रमुख केन्द्र रामेश्वरम, देविपट्टनम, तिरुपालाकुडी, कराडगडु मललीमोने, टोण्डी, पासिपट्टनम, पुतुपट्टनम, कोट्टपट्टनम, अम्मापट्टनम और काट्टुमावाडी आदि हैं। तिरुपालाकुडी में अतिमत्स्यग्रहण होता है। टोण्डी और अम्मापट्टनम में समुद्री ककड़ी माल्लुवलै से पकड़ी जाती है। माजार खाड़ी और पाक खाड़ी के प्रधान पकड़ होलोग्रिफन (मेट्रिआटैला) स्कैत्रा और होलोग्रिफन (थीलोथूरया) स्पैनिफेरा है। हाल में वेदालै और किलाकरै में बोहाडस्क्रिया मोरमोराटा का संग्रहण और संसाधन शुरू हुआ है। 1975-1978 के दौरान होलोग्रिफन (मेट्रिआटैला) स्कैत्रा का संसाधन प्रमुखतः पोर्टब्लेयर और अन्डमान के आसपास किया करते थे। अब अन्डमान और निकोबार द्वीपों में होलोग्रिफन का मत्स्यन रोका गया है। लक्षद्वीप में अब इसका कोई उद्योग नहीं है।

संग्रहण का मौसम

पाक खाड़ी में मत्स्यन मार्च से अक्टूबर महीने तक होता है। यहाँ अप्रैल और मई मत्स्यन केलिये अच्छा है। माजार खाड़ी में मत्स्यन अक्टूबर से मार्च तक होता है और अच्छा मौसम दिसंबर और जनवरी है। मार्च और अक्टूबर पाक खाड़ी और माजार खाड़ी में मत्स्यन प्रारंभ करने का संक्रमण महीने होते हैं। पाक खाड़ी और माजार खाड़ी यथाक्रम अक्टूबर से मार्च तक और मार्च से अक्टूबर तक प्रक्षुब्ध हो जाती हैं। इसलिए इस अवधि में मत्स्यन आसान नहीं है। मानसून श्रुतु में संसाधन च्लता है और बरसात के कारण पदार्थ को सुखाने के लिए धूमित करना पड़ता है। अन्तराष्ट्रीय मार्किट में धूमित पदार्थ

से सुखाया गया पदार्थ का अधिक पसन्द है। श्रीलंका में मत्स्यन केलिए जनवरी से मई तक और अगस्त से अक्टूबर तक के दो अवधि होते हैं।

पकड़ एवं प्रयत्न की डाटा

यद्यपि हर साल में माजार खाड़ी और पाक खाड़ी से होलोग्रिफन पकड़ा जाता है तथापि इसकी कोई डाटा इकट्ठा नहीं किया गया है। पकड़ और प्रयत्न की डाटा स्टॉक निर्धारण के अध्ययन के लिए अत्यन्त आवश्यक घटक है। सी. एम. एफ. आर. आइ का एफ. ई. ई. डी. प्रभाग, अब डाटा संग्रहण का कार्य शुरू किया है।

स्टॉक निर्धारण

होलोग्रिफन के स्टॉक निर्धारण के बारे में प्राप्त सूचनायें बहुत कम है। लक्षद्वीप से प्राप्त होलोग्रिफा (मैक्रोतेले) नोबिलिस और एक्किनो पैंगा मौरिटयाना के स्थायी स्टॉक निर्धारण ट्रान्सेक्ट रीति से प्राक्कलित किया है।

अति मत्स्यग्रहण

होलोग्रिफन अप्रतिरोधी जीवी होने के नाते इसे अधिक मात्रा में पकड़ा जाता है। कुछ क्षेत्रों में पनडुब्बों की अधिकता अतिमत्स्यग्रहण का कारण बन जाता है। टूटिकोरिन में मत्स्यन का आरंभ कुछ वर्षों से पहले ही हुई है इसलिए यहाँ से प्राप्त होलोग्रिफन का आकार अन्यो की तुलना में काफी बड़ा होता है। ऐसे स्थानों में शोषण उचित रीति से करके अतिमत्स्यग्रहण को रोकना चाहिए।

आरक्षण

1897 के फिशरीज़ एक्ट में अग्रौड समुद्री जीवों की सुरक्षा के लिए कोई प्रबन्ध नहीं रखा है। यदि इसके आरक्षण के लिए कोई कदम नहीं उठाये जाते तो होलोग्रिफा (मेट्रिआटैला) स्कैत्रा और होलोग्रिफा (थीलोथूरया) स्पैनिफेरा खतरे में पड़ेंगे। वैज्ञानिकों के अनुसार मान्मार खाड़ी के होलोग्रिफा (मेट्रिआटैला) स्कैत्रा अवधय की अवस्था में है। भारत सरकार ने 1982 में 7.5 सी. एम. से कम आकार के बेश-द-मेर का आयात करने से प्रतिरोध डालने का उचित निर्णय लिया था। 7.5 सी. एम. आकार के होलोग्रिफनों की लंबाई जीवित अवस्था में 200 मि. मी. होता है। इस लंबाई में ये अप्रौढ होते हैं। स्टॉक कि संपूर्ति के लिए जीवन काल में कम से कम एक बार इन जीवियों को अंडजनन करने का अवसर देना अत्यावश्यक है। टूटिकोरिन में इस उद्योग का प्रारंभ हाल ही में हुई है। इसलिए यहाँ अति शोषण नहीं है। यहाँ से पकड़ने वाले होलोग्रिफनों का औसत अकार 217 मि. मी. है, अर्थात् सुरक्षा काल से ऊपर। यद्यपि होलोग्रिफन साल भर में अंडे देते हैं तथापि अंड जनन का अच्छे महीने जुलाई और अक्टूबर होते हैं। इस अवधि में इसे संग्रहण नहीं करके पदार्थ का संसाधन करने के लिए समय बिताना उद्योग के लिए उचित होगा। इसका पहला कारण यह है कि जनवरी से मई तक की महीनों में इसे सूर्यताप में सुखाना आसान है। आयात विपणी में सुखाया गया पदार्थ का धूमायित पदार्थ से अधिक माँग है। इसके अलावा पदार्थ को धूमायित करने केलिये अतिरिक्त खर्च

भी पड़ती है। दूसरा कारण यह है कि ग्रीष्म ऋतु अंडजनन का अच्छा समय नहीं है।

प्रबन्धन

किसी भी उद्योग एक स्पीशीज़ के सहारे चलते हैं तो उस स्पीशीज़ का प्रबन्धन अतिशोषण के बिना कमीकृत करना अनिवार्य है। भारत में इसकी वृद्धि अर्थकाल, प्रजनन और जननक्षमता, तथा फैलाव आदि पहलुओं के बारे में अध्ययन नहीं चलाया है। इन जैविकी पहलुओं के ज्ञान के बिना इसे शोषण करना खतरनाक भी है। होलथूरियन का शान्त प्रकृति अतिशोषण का एक कारण है। इसलिए इस संपदा के आरक्षण केलिये संप्रहण के समय के आकार पर नियन्त्रण डालना चाहिए। तमिलनाडु के मात्स्यिकी विभाग प्रशासकों के पकड़ पर जो नियंत्रण डाला गया है वह इसकैलिये भी लागू किया जा सकता है। दोनों के मत्स्य क्षेत्र एक होने के कारण इसके प्रयोग में लाना भी आसान होगा। होलथूरियनों का स्थलन केन्द्र सीमित है इसलिये इसका नियन्त्रण आसान होगा। 200 मि. मी. से कम आकार के होलथूरियनों को पकड़ने में प्रतिबन्ध डालना चाहिये। प्रजनन काल जैसे जुलाई और अक्टूबर के महीनों में संप्रहण पर रोक लगाना चाहिए। इस मौसम में पाक खाड़ी प्रशुब्ध हो जाने के कारण पानी मैला हो जाता है। इसलिए प्रभावी परिचालन भी सुसाध्य नहीं होगा। 1968 में 150 मि. मी. आकार के होलथूरियनों की पकड़ पर प्रतिरोध डालकर लक्षद्वीप ने होलथूरियन के आरक्षण के लिए पहला कदम उठाया था। अन्त्रोत और कवरट्टी में 1968 से इसका संसाधन हो रहा है।

आकार नियन्त्रण और प्रजनन मौसम की पकड़ पर नियन्त्रण आदि के कार्यान्वयन के साथ उत्पादन बढ़ाने केलिये स्पीशीज़ का संवर्धन करना भी आवश्यक है। स्कैत्रा होलथूरिया के संवर्धन केलिये हैचरी का विकास अनिवार्य पहलु होता है। भारत में पहली बार होलथूरिया (मोट्यू-टैला) स्कैत्रा को प्रयोगशाला में तापीय उद्दीपन द्वारा प्रेरित अंडजनन करने में विजय प्राप्त किया है। निषेचित अंडों को द्विपार्श्वक, कर्णकाम, डोलकाकार और पंचस्पर्शक आदि विविध अवस्था में विजयपूर्वक पालन किया था। आहार के रूप में आइसोकाइसिस गालबाना और डयटम मिश्रण का इस्तेमाल किया था। इस समय (अप्रैल, 88) में 3-26 मि. मी. आकार के 32,000 से अधिक किशोर जीवित हैं। इनको आहार के रूप में अलगा और सरगैसम से तैयारित चूर्ण देता है। जैपनीस और चैनीस स्पीशीसों की तुलना में वृद्धि दर में द्रुतता दीख पड़ती है। अब सी. एम. एफ. आर. आइ. में होलथूरियनों की किशोरावस्था में विपणन अवस्था तक पालने केलिये होलथूरियनों के संवर्धन नाम के एक अलग परियोजना शुरू की है।

बेश-द-मेर उद्योग

भारत के बेश-द-मेर उद्योग का पुरावृत्त

बेश-द-मेर उद्योग भारत के पुराने उद्योगों में एक है। होरनेल (1917) के अनुसार एक हजार वर्ष पहले भारत और चीन के बीच व्यापार संबन्ध था। बेश-द-मेर ढूँढते हुये चीनियों ने दक्षिण भारत

और भारत के अन्य भागों में पहुँचा था। सीमा शुल्क रेकोर्डों के अनुसार मद्रास से 1898 से बेश-द-मेर का निर्यात हो रहा है। पुरा-वृत्तों के अनुसार लक्षद्वीप में, जहाँ अब इसका उद्योग नहीं है, 1844-45 के दौरान इसका उद्योग चल रहा था। लेकिन धीरे धीरे यह उद्योग मन्द हुये और जब 1881-82 के दौरान श्री. डब्ल्यू. जी. अन्डरवुड लक्षद्वीप में आये तब बेश-द-मेर उद्योग वहाँ नहीं के बराबर थे। इस उद्योग के नाश का मुख्य कारण शायद यातायातों की अशुविधा थी। आज कल यह मद्रास से सिंगपूर और होंगकॉंग में आसानी से निर्यात कर सकता है। वहाँ से चीन की ओर यह पुनः निर्यात किया जाता है। क्लोस (1903) के अनुसार पहले अन्डमान द्वीप में भी बेश-द-मेर उद्योग चलाता था। आजकल तमिलनाडु के लोगों के प्रयत्न से यहाँ इसका उद्योग फिर से शुरू हुआ है। इस उद्यम में तमिलनाडु के लोगों की कमी यह है कि उनको सिर्फ होलथूरिया (मेट्रियाटैला) स्कैत्रा की संसाधन प्रणाली मालुम है इसलिये यहाँ इसके अन्य स्पीशीज़ों का संसाधन अभी तक नहीं हो पाया है।

वर्ष 1898 को भारत से स्टेट्स की ओर 15,380 रु का बेश-द-मेर निर्यात किया था। 1903-05 के दौरान 24,300 रु. का बेश-द-मेर निर्यात किया और धीरे धीरे यह कम होकर 1913 में सिर्फ 600/रुपये का हो गया। निर्यात संबन्धी सही डाटाये 1910 से उपलब्ध हैं। 1898-1910 तक के दौरान भारत से किया गया औसत निर्यात 5,534 कि. ग्राम बेश-द-मेर था। वर्ष 1910 से वार्षिक निर्यात घटकर 1,359 कि. ग्राम हो गया। इसका एक कारण पहला लोक महायुद्ध था और दूसरा कारण पेनांग में इसके दाम में हुई कमी थी। होरनेल (1917) के प्रलेखों के अनुसार इस व्यापार में उतार-चढ़ाव साधारण था। जब होरणल ने 1916 में इस उद्योग शुरू किया तब उद्योग क्षयावस्था में था। उन्होंने वैज्ञानिक तरीकों से इसका पुनरुत्थान करने की कोशिश की। 1915 में तिरुपालकुर्डी में उन्होंने बेश-द-मेर केलिये एक सरकारी फैक्टरी खोल दी और लाभदायक रूप में इस उद्योग चलाने की तरिका दिखाया गया।

लक्षद्वीप का बेश-द-मेर उद्योग इस से भिन्न था। यहाँ 1844-45 के दौरान अच्छा उद्योग चलता था। 1981-82 के दौरान इसका नाश भी हुआ। जब 1908 में होरणल ने यहाँ सन्दर्शन किया तब छोटी सी मात्रा में तीन स्पीशीज़ों के संसाधन करते हुये देखा। उन्होंने वहाँ के संसाधन रीति में भी अन्तर देखा माने यह रीति आस्ट्रेलिया और पोलिनेशिया में प्रचलित रीति के समान के था। श्री अय्यंकार (1977) के अनुसार लक्षद्वीप का बेश-द-मेर उद्योग संक्रामक रोगों से नष्ट हुये हैं। इसका कारण संसाधन की अनारोग्यकर स्थितियाँ थी।

हाल के वर्षों में लक्षद्वीप की मात्स्यिकी विभाग ने इस उद्योग का पुनरुत्थान करने की कोशिश की। इसके संसाधन पर अध्ययन चलाने केलिये वे दो अदमियों को भेज दिये। उन आदमियों ने होलथूरियन के विविध स्पीशीसों का संसाधन होलथूरिया स्कैत्रा के संसाधन केलिये स्वीकार की गयी प्रणाली के अनुसार किया। इसके तुरन्त बाद एक मद्रासी ने लक्षद्वीप में जाकर 7 टन होलथूरियन (मैकोतेले) नोर्बिलस

का संसाधन किया उन्होंने कवरत्ती में भी बेश-द-मेर का संसाधन किया। लक्षद्वीप के मात्स्यकी विभाग ने 15 सी. एम. से कम आकारवाले होलोथूरियन का संसाधन रोक लिया।

आन्डमान में पहले इसका संसाधन होता था लेकिन अब आन्डमान और निकोबार द्वीपसमूहों में इसका मत्स्यन पर अवरोध लगाई गयी है।

बेश-द-मेर उद्योग के स्थान

चीन का बेश-द-मेर उद्योग देश को व विदेश को खिलाती है। चीन ने खोज की दाह में दक्षिण भारत, जपान, पोलिनेशिया और आस्ट्रेलिया के तटों में प्रवेश किये थे। वैज्ञानिकों के निरीक्षण के अनुसार बेश-द-मेर का उद्योग विशेष रूप से चीना, जपान, आस्ट्रेलिया, बर्मा, कम्पोडिया, फिजी, भारत, इन्डोनेशिया, उत्तर व दक्षिण कोरिया, केनिया, लओस, मलयेशिया, मडगास्कर, मोज़ाम्बिक, न्यू गिनिआ, फिलिपीनस, सोलमन द्वीप समूह, दक्षिण अफ्रिका, श्रीलंका, तयवान, तायलान्ड, टानसानिया, उत्तर व दक्षिण वियटनाम, आदि देशों में होता है। उपर्युक्त स्थानों से यह स्पष्ट है कि इसका उद्योग पसफिक में समृद्ध होता है क्योंकि यहाँ होलोथूरियन की अच्छी संपदा है।

संसाधन की रीतियाँ

होलोथूरियनों के विविध स्पीशीज़ों का संसाधन प्रक्रिया अलग अलग है।

होलोथूरियनों का हस्तन

होलोथूरियनों का शरीर मृदुल होने के कारण पकड़ने के बाद इसका हस्तन ध्यान से करना चाहिये क्योंकि संसाधित उत्पाद की कीमत उसके आकार के अनुसार होता है। आकार बदलना इसका स्वभाव विशेष है माने उल्टेजित होने पर यह आकार बदलता है, कभी नष्ट हुए शरीर भागों का पुनर्बन्धन होता है। कुछ स्पीशीज़ों को इसके आन्तरिक भाग माने लसीले क्यूबेरियन ट्यूबूल बाहर छोड़ने की आदत है। इस आदत से बचने केलिये इन्हें बोट में लाते वक्त उसके अवस्कर के पास छोटा सा चोट लगाता है। इसके बाद मुँह के पास दबाने पर सारी आन्तरिक वस्तु विरजित हो जाती है। होलोथूरियन का स्वच्छ और स्वास्थ्यकर संसाधन केलिये यह तरीका बहुत ही उपयोगप्रद है। इसके बाद इन्हें एक एक करके मछली बोक्स में रखते हैं। इस प्रकार बोक्सों में रखने से बोटों से इसका स्थानांतरण आसानी से कर सकता है। यदि इन्हें रातों रात बोक्सों में रखने पड़ते हैं तो उनमें समुद्र जल भरकर रखना चाहिये। लेकिन अधिक समय इस प्रकार बोक्सों में रखने पर ये क्षीणित हो जायेंगे।

सफाई

संसाधन के पहले इन्हें स्वच्छ समुद्र पानी में साफ करने चाहिये इस वक्त इन्हें लिचोडने से सारा पानी बाहर जायेगा।

उपंत्रण

होलोथूरियन के पश्च भाग में एक विशेष प्रकार के चाकू से चोट लगता है। तुरन्त ही शरीर के आन्तरिक वस्तु बाहर निकल जाती है।

उबालना

उबालने के बर्तन पर बहुत ध्यान देना चाहिये क्योंकि उत्पाद की गुणवत्ता बर्तन के आकार पर और विलोडन पर निर्भर है। इसकेलिये बहुत ही अनुयोज्य बर्तन कास्ट अयन से बनाये सोसर के आकार के पान है। होलोथूरियनों को पान में डालकर उबालने से अच्छा उन्हें उबलते पानी में डालना है। विलोडन केलिये स्पाटुला आकार की चम्मचों का उपयोग करना उचित है। साधारणतः इसके उबालने केलिये 45 मिनिट लगेगा। इस बीच पहले 20 मिनिट में 3 मिनिट के बीचों बीच और बाकी 20 मिनिट में 5 मिनिट के बीचों बीच विलोडना चाहिये। यदि 40 मिनिट के अन्तर अच्छी तरह पका नहीं जाते तो 10 मिनिट भी रखा जा सकता है। अच्छी तरह पकी गयी ककड़ों रबड़ के समान हो जायेगी। इस अवस्था में पान से निकालकर ठंडा करनी चाहिये।

दफनाना

ठंडे की गयी समुद्री ककड़ियों को समुद्र तट में बनाये गड्डों में आड़ मिट्टी से ओढ़कर रखी जाती है। साधारणतः ये गड्डे 100 सी. एम. लंबा 75 सी. एम. चौड़ा और 20 सी. एम. गहरा होते हैं। गड्डों में इन्हें 15-18 घण्टे तक रखे जाते हैं। इस वक्त बाक्टीरिया का प्रवर्तन से ककड़ियों का विगलन होता है और ये मृदुल हो जाती हैं। गड्डों बनाने केलिये स्वास्थ्यकर और स्वच्छ मिट्टी चुनना बहुत ही आवश्यक है।

स्वच्छन

गड्डों में रखने से पिगली गयी ककड़ियों को हाथ में लेने पर उस से पेस्ट के समान की वस्तु निकलती है। इन्हें बाक्स्टों के आधा भाग तक भरकर समुद्री पानी में अच्छी तरह धोती है। तब बाहर के विगले गये चूने का लेयर और मिट्टी के अंश बह जाती है। अब तो ये ककड़ियाँ रबड़ के समान और सिलेण्डर के आकार में हो जाती हैं। यदि किसी ककड़ियों में सफेद पिगमेंट बाकी है तो उन्हें फिर से उबालना चाहिये।

सुखाना

सुखाने की सबसे अच्छी तरीका धूप में सुखाना है प्लाटफार्मों में बयर-मेश टेयों में रखकर इन्हें सुखाया जाता है। मिट्टी में डालकर सुखाना उचित नहीं है क्योंकि मिट्टी इस में चिपका जायेगा जिस से इसका गुण कम हो जायेगा। सूखकर कठोर होने तक माने इसके पानी का प्रतिशतता 8-10 होने तक इन्हें सुखाते हैं।

धूमन

वर्षा ऋतु में जब सूर्य का घूप कम होता है तब धूमन करता है।

गुणता-सुधार

गुणता को बढ़ाना इस उद्योग का लक्ष्य होना चाहिये। जपान और कोरिया की तुलना में भारत के बेश-द-मेर कम दाम पर बेचता है क्योंकि यहाँ आज कल अस्वास्थ्यकर वातावरण में इसका संसाधन हो रहा है। भारत सरकार ने 1978 में एक अध्यादेश द्वारा बेश-द-मेर को गुणता-नियंत्रण के अधीन लाया गया।

श्रेणीकरण

बेश-द-मेर का बाजार-मूल्य उसके स्पीशीज़ के अनुसार होने के कारण उत्पाद का श्रेणीकरण स्पीशीज़ों के आधार पर करना ही उचित है। प्रत्येक स्पीशीज़ों के श्रेणीकरण में लंबाई सब से मुख्य घटक है। भार के अनुसार श्रेणीकरण करना समीचीन नहीं है क्योंकि इस में मिट्टी का अंश हो सकता है। आकार, रूप, गन्ध, रंग व आद्रता के अनुसार श्रेणीकरण किया जाता है। सामान्यतः बड़ा आकारवाला बेश-द-मेर अच्छा माना जाता है। चिकनी त्वचा, काला रंग और सुखकर गंध भी अच्छा माना जाता है। आद्रता की अधिकता में फंगसों का आक्रमण हो सकता है इसलिये अच्छी तरह सुखाकर आद्रताहीन वातावरण में रखना चाहिये।

पैकिंग व परिवहन

उत्पाद की गुणवत्ता सुनिश्चित करने के लिये अच्छा पैकिंग बहुत आवश्यक है। इसके अलावा आकर्षक पैकिंग भी समय की आवश्यकता है साथ ही साथ पैकिंग वस्तु के दाम पर भी विचार करना होगा। इन तीनों पर विचार करने पर पोलिथीन पैकिंग सब से उचित देख लिया है। कार्टन में रखकर पोलिथीन थैलियों में पैक करने से उत्पाद का स्टोरेज लाइफ बढ़ा सकता है।

विपणन टैंडें व विपणन

बेश-द-मेर का मुख्य बाजार केन्द्र एशिया में स्थित है। सिंगपौर और हांगकॉंग में इसका अयात और पुनरियात होता है। यहाँ इसके साथ उत्पाद की गुणवत्ता बढ़ाने की प्रक्रियायें जैसे वर्गीकरण, स्वच्छन, शुष्कन और पैकिंग पुनः की जाती है। समुद्री ककडियों का सब से मुख्य बाजार हांगकॉंग है। यहाँ का वार्षिक माँग 600-700 टन है तो सिंगपौर का वार्षिक माँग 500-600 टन है। हांगकॉंग बाजार की माँग की पूर्ति पूर्व आफ्रिका के राज्यों और पसिफिक द्वीप समूह करते हैं तो सिंगपौर मार्केट की पूर्ति इन्डोनेशिया श्रीलंका और भारत करते हैं। बेश-द-मेर का उत्पाद और निर्यात करनेवाले देश हैं - फिलिपिंस, इन्डोनेशिया, जपान और

दक्षिण आफ्रिका। आस्ट्रेलिया इस क्षेत्र का नवागत है। समुद्री उत्पाद निर्यात विकास प्राधिकरण के सर्वेक्षण के अनुसार पेनिंसुलार मलेशिया में बेश-द-मेर का बड़ा अयात होता है।

हांगकॉंग मार्केट में जपान के इस उत्पाद को प्रशुल्क मिलता है। दूसरा अच्छा उत्पाद कोरिया का माना जाता है।

स्पीशीज़ों का पसन्द

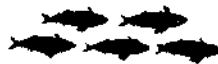
विविध स्पीशीज़ों की मान्यता के बारे में विभिन्न मत हैं। प्रकाशनों के अनुसार टीट फिश से तैयार किये गये बेश-द-मेर अच्छा माना जाता है। फिर भी विभिन्न मार्केटों विभिन्न स्पीशीज़ों का पसन्द करते हुये देखा है।

बेश-द-मेर का उपयोग

उच्च रक्त चाप, पेशीगत अस्वस्थता केलिये बेश-द-मेर अच्छा है। बेश-द-मेर में फाट बहुत कम होने के कारण कोलस्ट्रॉल रोगियों को इसे दे सकता है। इसके अलावा काली खाँसी और श्वसनी रोगों केलिये यह अच्छा माना जाता है। सीबु के मद्युण, कुवेरियन ट्यूच्यूल का उपयोग व्रणों की चिकित्सा केलिये करते हैं।

बेश-द-मेर उद्योग की समस्यायें

देश का बेश-द-मेर उद्योग अब माँग की पूर्ति करने में असमर्थ है। अब इसका शोषण सिर्फ मात्तार और पाक की खाडी से होता है। आन्डमान निकोबार और लक्षद्वीपों में इसकी संपदा की खोज करना समय की आवश्यकता है। कुछ स्थानों में अस्वास्थ्यकर वातावरण में इसका संसाधन हाने के कारण भारत के बेश-द-मेर उत्पाद का दाम कम हो गया है। अब इधर चुने गये स्पीशीज़ों का संसाधन होता है। अन्य स्पीशीज़ों को प्रोत्साहित करने को संसाधित नमूने सिंगपूर मार्केट में भेजकर इसकी गुणवत्ता व दाम समझ लेना चाहिये। होलोथूरियन के कृत्रिम प्रजनन में अब प्राप्त विजय समय की माँग भरने में असमर्थ है इसलिये समुद्र रैचन कार्यक्रम शुरू करना चाहिये।



GUIDE TO CONTRIBUTORS

The articles intended for publication in the MFIS should be based on actual research findings on long-term or short-term projects of the CMFRI and should be in a language comprehensible to the layman. Elaborate perspectives, material and methods, taxonomy, keys to species and genera, statistical methods and models, elaborate tables, references and such, being only useful to specialists, are to be avoided. Field keys that may be of help to fishermen or industry are acceptable. Self-speaking photographs may be profusely included, but histograms should be carefully selected for easy understanding to the non-technical eye. The write-up should not be in the format of a scientific paper. Unlike in journals, suggestions and advices based on tested research results intended for fishing industry, fishery managers and planners can be given in definitive terms. Whereas only cost benefit ratios and indices worked out based on observed costs and values are acceptable in a journal, the observed costs and values, inspite of their transitionality, are more appropriate for MFIS. Any article intended for MFIS should not exceed 15 pages typed in double space on foolscap paper.