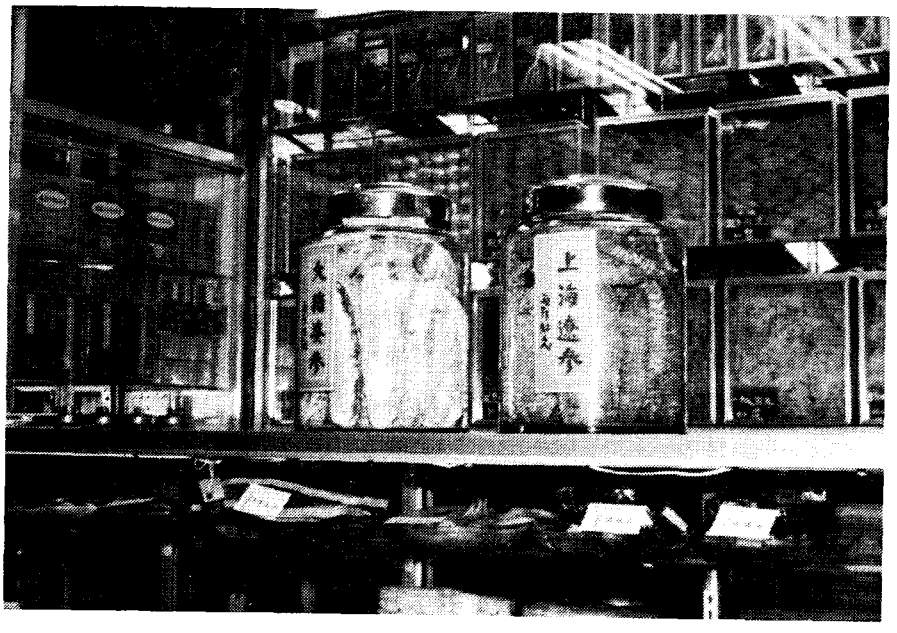
BECHE-DE-MER OF THE SOUTH PACIFIC ISLANDS

a handbook for fishermen

A handbook covering identification of commercially important species of *Holothurians* (bêche-de-mer or sea cucumber) with notes on their collection, processing, packaging and marketing in order to assist in efficient exploitation of the existing resources of the South Pacific.

South Pacific Commission
Noumea, New Caledonia



White stone and plum flower in a retail shop in Hong Kong.

PREFACE

This handbook is based on work by Kanapathipillai Sachithananthan, *Bêche-de-mer* Consultant to the South Pacific Islands Fisheries Development Agency (SPIFDA), and was edited by R. H. Baird, South Pacific Commission Fisheries Adviser.

SPIFDA was a UNDP/FAO Regional Fisheries Project with the South Pacific Commission acting as the counterpart agency on behalf of the territories in the South Pacific.

The text and most of the photographs have been supplied by FAO; editing and printing have been arranged by the South Pacific Commission.

Acknowledgements and thanks are due to Miss A. M. Clark of the British Museum, London, and Dr G. Cherbonnier of the *Laboratoire de Biologie des Invertébrés Marins, Muséum National d'Histoire Naturelle*, Paris, for verifying and correcting identifications and bringing up to date the nomenclature of the species illustrated.

It must be emphasized that positive identification of genera and species of holothurians is not possible without microscopical examination of sections of the body wall. Miss Clark and Dr Cherbonnier have both emphasized this point. However, the most authoritative identifications that are possible from photographs have been made by these two world experts.

It may be that the local names given for the various species are not in universal use in the countries concerned. The editor would welcome comments and suggestions for a more complete list of local names which can be incorporated as an addendum in later editions of this handbook.

Mr Seamus McElroy, Fisheries Officer in the British Solomon Islands Protectorate, was consultant in the final preparation of the handbook and assisted greatly in some of the difficult identifications. His experience of the animals in the field has been of particular value. He also supplied two additional photographs.

The photographs of *Actinopyga mauretania* and *Stichopus variegatus* were kindly supplied by Mr Neville Coleman, A.M.P.I. of New South Wales through the good offices of Miss A. M. Clark, who also made the identifications.

INTRODUCTION

Bêche-de-mer has been a prosperous fishery in the Pacific region in the past. Early Chinese settlers introduced curing methods to the native populations of the Pacific islands and enjoyed the benefits of the trade by shipping the produce to China and other East Asian countries. The fishery was very prosperous during the German, Spanish, French and Japanese occupations of the very many islands in the Pacific. Truk Island in Micronesia is said to have exported nearly one million pounds annually during the early years of this century.

The first and second world wars interrupted the activities of this fishery. The Second World War fought in the Pacific region brought this industry to a near standstill in Micronesia and in the New Hebrides. In Papua New Guinea, British Solomon Islands Protectorate and Fiji the trade is not as prosperous as it was before the war.

A bêche-de-mer processing factory has been established in Honiara in the British Solomon Islands Protectorate. Once an active enterprise in Queensland, Australia, this fishery has now more or less died out as it is less attractive economically.

Bêche-de-mer is in big demand among the Chinese population in South-East Asia where it is thought to possess some aphrodisiac qualities. The varieties produced in the Pacific have a consumer preference and fetch high prices. The Pacific has an extensive resource of sea cucumbers that can be processed and sent to these Asian markets; the natural supply in the seas immediately surrounding the islands in the Pacific is good.

Harvesting involves collection by hand in tidal flats and pools and by diving for them in the deeper waters within the reefs. Diving equipment can be used in deeper water in areas where facilities for training in the use of and facilities for the maintenance of the equipment exist. The animals are processed into bêche-de-mer near the places of collection.

The processing method is simple: the collected animals are cleaned, boiled, smoked—then dried and packed for export. Although most of the Pacific islands are in the tropics, storage of this dried product is not a great problem. Usual methods of storage for fishery

products (chilling or refrigeration) to maintain freshness and avoid spoilage are not needed for this product. Markets are within reasonably easy reach of the islands; many islands are connected by regular shipping services to the two important markets, Hong Kong and Singapore.

Sea cucumbers form a very important part of the bottom fauna within the reefs of the Pacific islands. The shallow water lagoons enclosed by the very many reefs, islands and islets in the Pacific offer a variety of situations which provide shelter for these sluggish creatures, although some species occur in deeper water (down to 50 metres).

The larger types move about slowly in the sandy and grassy bottoms away from the coast towards the reef. Some types bury themselves in sandy mud, crowd into crevices of the coral colonies and the underside of rock fragments. They are mostly bottom (or sediment) feeders. Any sea cucumber that is to be of use as bêche-de-mer must be large but it is not true that all large sea cucumbers will make a satisfactory preparation. Generally, the more valuable species have a thicker body wall.

Sea cucumbers are easy to capture as they offer no resistance. Some animals throw out white sticky threads when disturbed (see page 16). These threads are called cuiverian tubules and are harmless to humans.

Bêche-de-mer is a Chinese delicacy. It has become part of the life and traditions of the Chinese people to eat bêche-de-mer preparations on festive occasions; purchased in dry form, it is soaked in water, cleaned and cooked in many delicious ways. It is rich in protein. The dried product has the following nutritional composition:

Protein	43%
Fat	2%
Moisture	27%
Minerals	21%
Insoluble ash	7%

GLOSSARY OF BIOLOGICAL TERMS USED IN THE TEXT

anal teeth: usually five in number; each a hard (calcified) triangular structure embedded in the anal wall.

anterior: the front part (with the mouth).

anus posterior (rear) opening of the gut.

contractile: able to shorten or become shorter.

cuiverian organs: consisting of sticky white thread- or ribbon-like structures which are thrown out from the anus of some species; a special defence mechanism.

dorsal: the upper part, top or back.

eviscerate: to throw out its guts (through the anus).

external: outside.

fauna: all animals in an area.

holothurian: a free-moving, bottom-living, soft-bodied, worm-like animal closely related to the starfishes and sea urchins.

papillae: similar to tube feet but smaller (commonly a few millimetres up to more than a centimetre in length), they are conical and pointed. Occurring chiefly on the back, they are also often seen on processes of the body wall, such as the teat-like processes of *Microthele nobilis* and *Thelenota ananas*. In *Stichopus chloronotus* they appear conspicuously on the tips of the finger-like processes, being a bright orange-brown colour.

pedicels: adapted from tube feet, they are small and tubular, as distinct from the conical papillae. Occurring on the back, they are commonly only a few millimetres long.

posterior: the rear part (with the anus).

projections: processes, parts of the body wall that stick out.

species: a group of similar animals (or plants) able to breed with each other, but not normally with others.

teat: a conical process of the body wall measured in centimetres.

tentacle: specialized tube feet crowned with many sticky processes. Normally occurring in a ring around the mouth, they are used in feeding. Usually measured in centimetres.

tube feet: long narrow retractable tubes with a broad sunken end, used as a sucker. Occurring mainly on the lower surface, they act together to propel the animal forward across a surface. Commonly of several millimetres up to over a centimetre in length.

tubercle: a small lump, elevation or roughness upon the surface of the body wall.

ventral: the lower bottom surface.

Units of Measurement

Abbreviations:

mm — millimetre
cm — centimetre
m — metre

10 mm = 1 cm
100 cm = 1 m

Conversion ratio:

1 cm = 0.4 ins. (approx. 3/8 ins.)
1 m = 39.37 ins.
1 inch = 2.54 cm

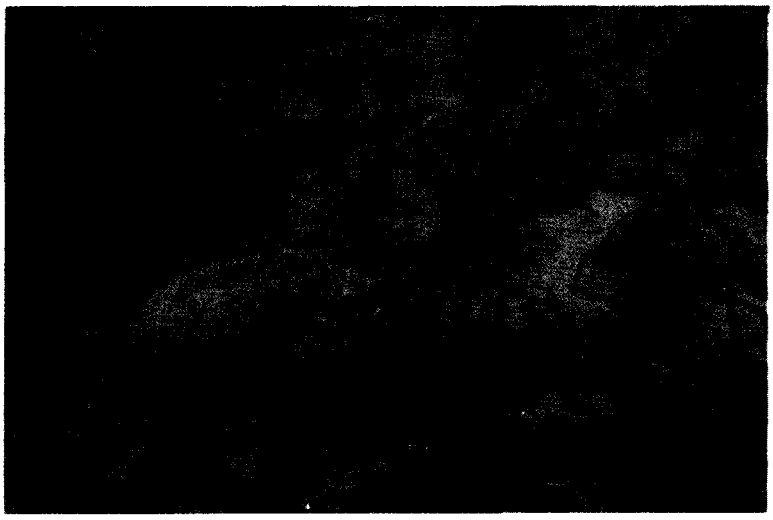
COMMERCIALLY EXPLOITABLE SPECIES OF BECHE-DE-MER IN THE PACIFIC ISLANDS

TEAT FISH *(Microthele nobilis)*

Chinese:	Seasom
Palauan:	Bakelungal
Trukese:	Majonpeth
Ponapean:	Matchip
Fijian:	Daro
Solomons:	Susu fish

Also known as **mammyfish**, it commands the highest prices in the bêche-de-mer market. The most distinguishing external feature is the presence of about six lateral teat-like projections (papillae), which are contractile. The body is a somewhat flattened oval in shape with a very thick body wall and five anal teeth. These animals are generally found in abundance in deeper water of more than 20 metres (65 ft.), on coral sand and grassy bottoms.

Colours found have been: dark brown or black on top and white beneath, all yellowish white; mottled black or brown on white.



Teat fish (white)
up to 500 mm (20 in.)

Teat fish (black)
up to 500 mm (20 in.)

BLACK FISH *(Actinopyga miliaris)*

Palauan: Erumrum
Trukese: Jan
Fijian: Dree

These are black or dark brown and cylindrical with numerous tube feet, tending to be arranged in three bands on the bottom side and have five anal teeth characteristic of both *Actinopyga* and *Microthele*. The juveniles of 20-35 mm (1-1½ in.) are generally found in murky shallow waters and are black in colour. Adults are found in depths of more than 2 m (6.ft.) in clearer water on coral sand bottoms. Prices in the market rank second or third to the teat fish.

Black fish
up to 350 mm (14 in.)

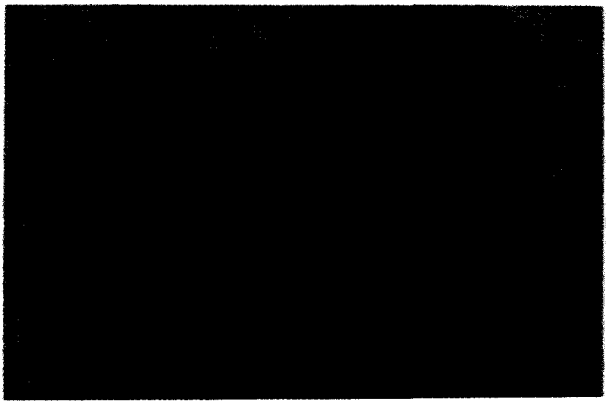
Other Species of Actinopyga

There are other species of the genus *Actinopyga* of commercial value, for example, *A. echinites* (Deep-water Red fish; Fijian: Dry Los-los or Dry-tala; Chinese: Hung-Hur) and *A. mauritiana* (Surf Red fish; Fijian: Dry-mata-mlia; Chinese: Hung-Hur) and *A. lecanora* (Stone fish; Fijian: Daro; Chinese: Seasom). All animals in this genus have five anal teeth and relatively thick body walls. All these species have a fairly high market value.

Physical differences are:

DEEP-WATER RED FISH *(A. echinites)*

Mid-brown, slightly darker on top. Papillae scattered on its slightly wrinkled dorsal surface. The body is stout in the middle, maximum breadth when contracted nearly half the length, tapering. It has three bands of tube feet on the bottom. Length up to 350 mm (14 in.).



Deep-water Red fish (A. echinites)
up to 350 mm (14 in.)

SURF RED FISH *(A. mauritiana)*

Chocolate-brown above contrasting with much lighter colour below. The tube feet are scattered all over the body surface forming small dark spots. A stout species, living in shallower waters than *A. echinites*. Length up to 400 mm (16 in.).

Surf Red fish (A. mauritiana)
up to 400 mm (16 in.)

STONE FISH *(A. lecanora)*

Has a dark upper surface ranging from brown to deep brownish black; the lower surface and a conspicuous area around the anus are much lighter, ashy or olive grey. Below, the tube feet are in three broad bands. Above, the papillae are scattered and very long. The body is almost cylindrical, but flattened below and slightly tapering anteriorly. Lives in shallow water, generally on the underside of large rocks. Length up to 400 mm (16 in.).

PRICKLY FISH *(Thelenota ananas)*

Chinese: Bufa som
Palauan: Temtamch
Trukese: Lachcha

Has many very large teats in groups of two or three together and numerous tube feet on its bright red flat bottom side. This shaggy-looking animal is abundant in most of the reef-enclosed lagoons of the Pacific. It ranks close to the teat fish in commercial value. Found mainly at depths of 2-10 m (6-33 ft.) on the reef flat, and is commonly between 300-600 mm (12-24 in.).

Prickly fish
up to 800 mm (32 in.)

SAND FISH *(Holothuria scabra)*

Chinese: Tok som
Palauan: Rebothal

Colours found have been as follows: upper surfaces can be light grey, dull cream, olive brown or almost black; lower surface, though, is usually white. It is also covered with fine black spots speckled on its wrinkled dorsal surface. The body is short and stout and flattened at the ends. It is commonly found on coral sand in estuarine waters, near river mouths and drainage outlets. It can burrow in sand and is found mainly in depths of water of 2-10 m (6-33 ft.) on the reef flat. Previously widely used for bêche-de-mer. The processing method is slightly complicated (see page 25).

Sand fish
up to 400 mm (16 in.)

LEOPARD (TIGER) FISH *(Bohadschia argus)*

Palauan: Ehosobal
Trukese: Asaya
Ponapean: Penepen
Fijian: Vula

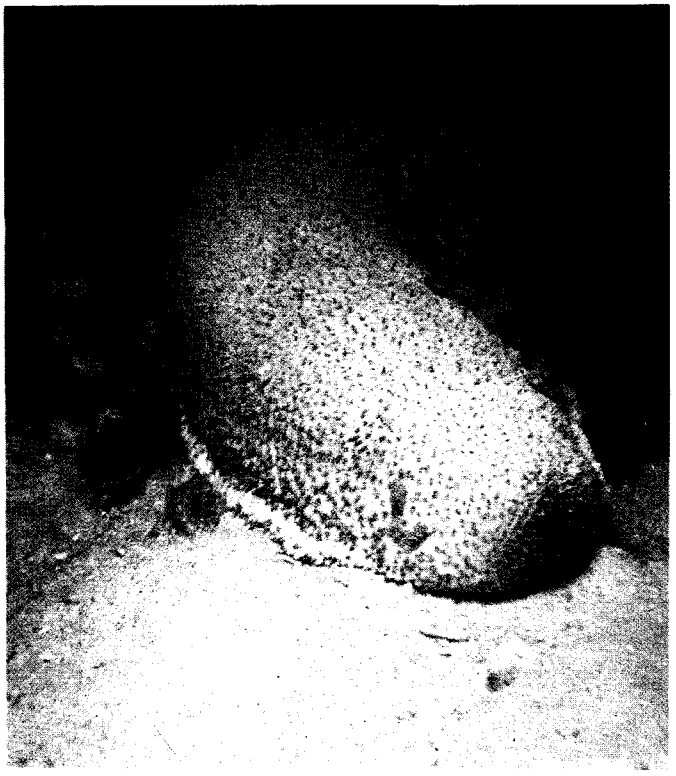
With eye-like spots all over its body, this is known as spotted or leopard fish. Previously known in some of the literature as tiger fish. The large brown spots are conspicuously encircled with a light colour (yellow, white or grey). It is found at depths of 2-6 m (6-20 ft.) and it throws out sticky white threads when taken. It is apparently of small commercial value.

Tiger fish
up to 400 mm (16 in.)

CHALKY FISH

(Bohadschia marmorata marmorata)

A lengthy animal, almost cylindrical in shape, with numerous tube feet distributed all over the body. It is sometimes all white in colour or with brown patches on its white top side. The bottom side is pure white. It is found in the waters of the lagoons enclosed by the reef. Has some market value.



Chalky fish
up to 400 mm (16 in.)

*) *Bohadschia marmorata vitiensis*

Fijian: Suthuwalu

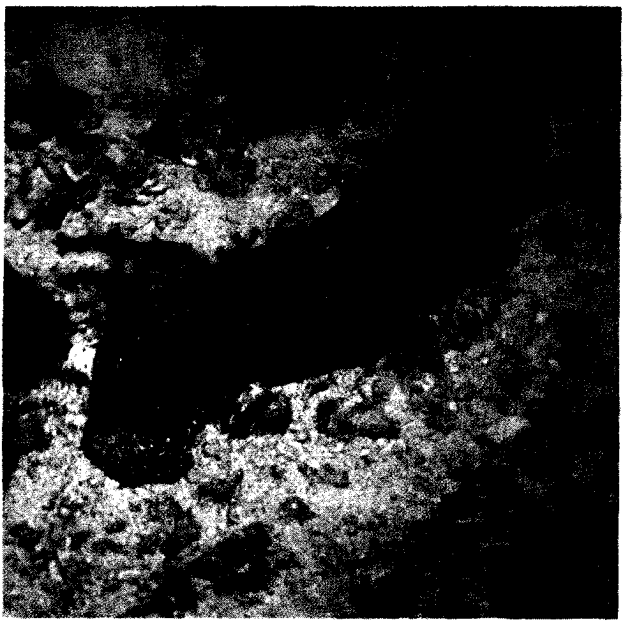
A common holothurian on fringing reefs of large land masses in the Pacific. Uniformly distributed dark brown spots contrast with the light yellow to light brown background. The lower surface is only poorly distinguished by being somewhat flattened. This usually short, thick-walled animal is found on sand flats, grassy bottoms and sometimes underneath coral rocks. The sticky threads are thrown out immediately when disturbed. It has a little market value.

*) *no common name*
up to 300 mm (12 in.)

LOLLY FISH *(Halodeima atra)*

Palauan: *Esengl*
Trukese: Perijan
Ponapean: Kotop
Fijian: Dree

Possibly the most common of all holothurians in the Pacific region. This is a black species with small papillae above. The smaller sizes occur in large numbers in shallow (less than 2 m (6 ft.)) grassy and sandy areas, habitually coating themselves with sand. Inside the reef this species reaches 300 mm (12 in.) in length and is found to a depth of 6 m (20 ft.). Outside the reef, in deeper water, larger animals of up to 600 mm (24 in.) may occur. The body wall of these larger animals is thicker. When the body surface is rubbed a red fluid stains the hands. The larger animals have some value as bêche-de-mer.



Lolly fish
up to 600 mm (24 in.)

*) *Stichopus variegatus*

Similar to the Prickly fish (*Thelenota ananas*) in size, this loaf-like animal lives exposed on sandy reef flats. Several irregular brown patches contrast with the yellow-grey background of the arched dorsal side. The flat lower side is white with numerous pink tube feet. It is considered to be of some commercial value.

*) *no common name*
up to 900 mm (35 in.)

NON-COMMERCIAL HOLOTHURIANS

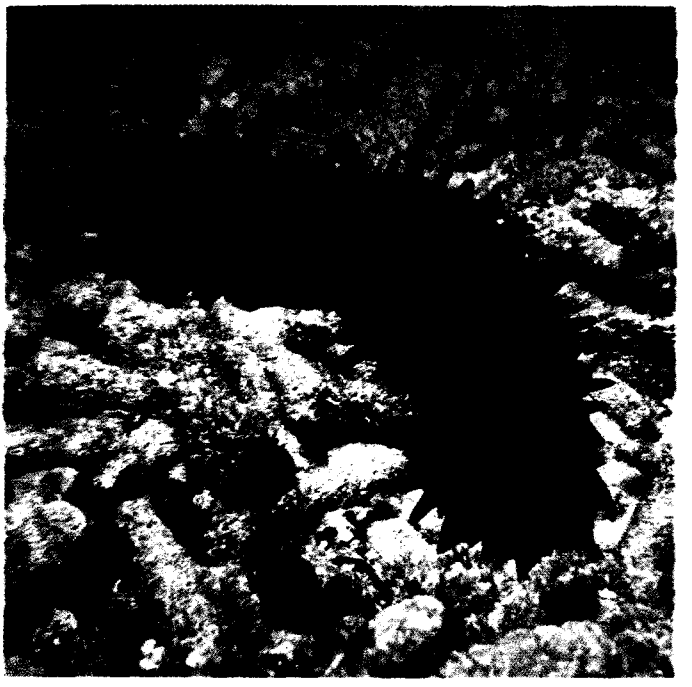
PINK FISH *(Halodeima edulis)*

Black or grey on top and pink below. This cylindrical animal is commonly found in shallow waters, in the open or attached to coral rocks.

Pink fish
up to 400 mm (16 in.)

*) *Stichopus chloronatus*

Dark green in colour with four rows of large finger-like processes or papillae. Found commonly in shallow water. It slowly disintegrates when taken out of water.



*) *no common name*
up to 400 mm (16 in.)

BIBLIOGRAPHY

CLARK, H. L. 1921.
The Echinoderm fauna of Australia: its composition and its origin. Pap.Dept.Mar. Biol., Carnegie Instn., Wash., 10 : viii + 223, 38 pls.
1946. The Echinoderm fauna of Australia. Publs. Carnegie Instn., No. 566 : 1-567 (descriptive of all species).

PANNING, A. 1944.
Die Trepangfischerei. Mitt.Zool.St.Inst., Hamb., 49 : 1-76, 40 figs. (description of most of the commercial species).

ROWE, F. W. E. 1969.
A review of the family Holothuridae. Bull. Brit.Mus. (Nat.Hist.) 18.4 (revision of nomenclature and key to the supra specific taxa level).

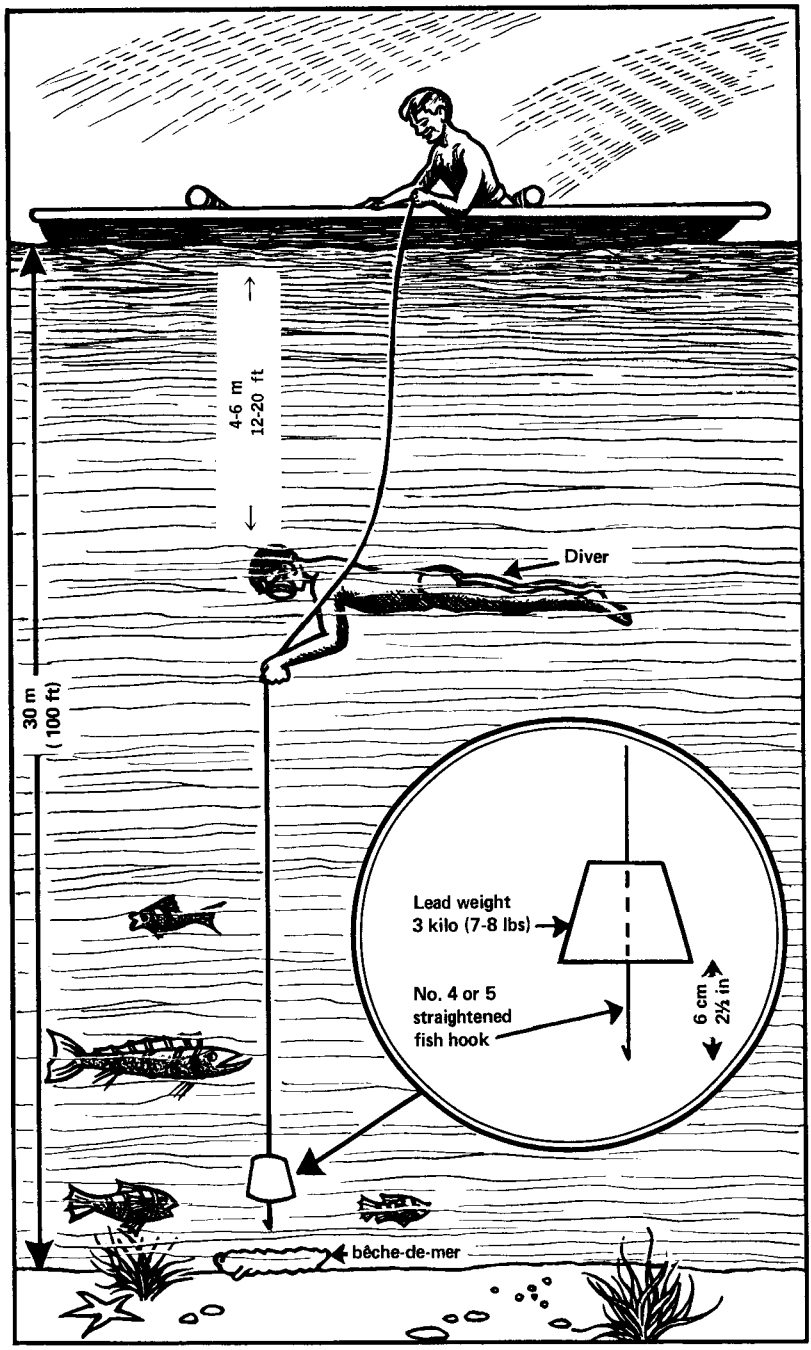
The original descriptions of species found in the Pacific were mainly published in the latter half of the nineteenth century and the first half of the twentieth. These publications are numerous and mostly out of print today. The bibliography above is of a general nature and is intended only as a starting point for people interested in discovering more about the commercial species of holothurians.

COLLECTION

Face masks or goggles are used universally for collection of bêche-de-mer except where quantities of commercial species can be found at low water on the reef.

They are collected by hand or spear at depths to 6-10 m (20-30 ft.). Fins and snorkels are aids sometimes used. Diving equipment is rarely used. For fishing in deeper water, the Solomon Islands fishermen have developed a technique using a straightened fish hook set in a piece of lead of about 3 kg (7-8 lbs) weight attached to a fishing line.

One end of the line is held by a man in the canoe while the diver positions himself and lowers the weight and straightened hook to a distance of about one metre (3 ft.) above the animal. He then releases weight and hook which penetrates the animal which is then hauled to the surface by the man in the canoe. This method is used at depths up to 40 m (130 ft.). At these depths, the diver frequently descends to about 6 m (20 ft.) in order to improve his visibility before releasing the line to spear the animal (see diagram opposite).


4-6 m
12-20 ft
Diver
30 m
(100 ft)
Lead weight
3 kilo (7-8 lbs)
No. 4 or 5
straightened
fish hook
6 cm
2½ in
bêche-de-mer

PROCESSING

Processing is a simple method of boiling, cleaning and drying.

Cleaning

Animals sometimes have a tendency to eviscerate (that is to throw out their guts) during handling. If the animal does not eviscerate on its own, a small opening is made near the mouth to effect gutting. Water inside the body cavity is also squeezed out. All types except the teat fish are gutted before boiling. Teat fish is boiled before removing the guts. All animals are washed before boiling.

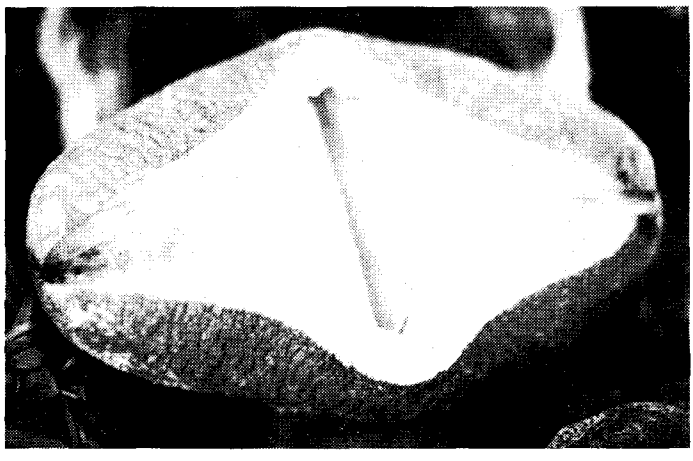
Cooking

Any suitable vessel will serve for boiling; for example, half a 44-gallon drum. OKAMA is the name of a shallow broad vessel which is sometimes used. Clean sea water is used. Animals are introduced when the water boils. Frequent stirring during cooking is necessary.

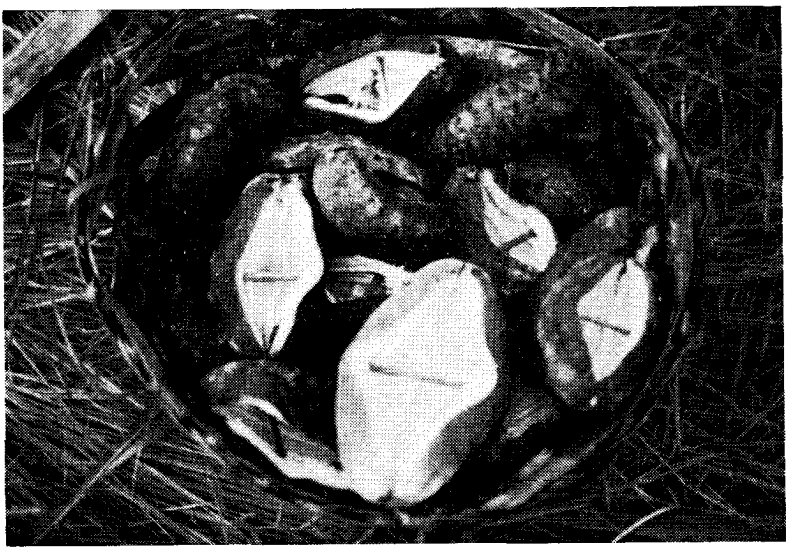
Animals of similar size should be boiled together as cooking time varies with the size of animal, for example, it takes 1-1½ hours to cook large teat fish. They attain a blubber-like form and bounce when dropped on a hard surface. On attaining this state the animals are cooled in a vessel containing cold sea water.

Second cleaning

Cooked animals are cleaned again. With teat fish, a longitudinal cut is made on the top side with a sharp knife and the guts are removed. The split walls are spread by means of a thin wooden splint.



Split dorsal body wall of bêche-de-mer spread with wooden splint



Bêche-de-mer ready for drying

Sand fish are cleaned by burying them overnight in clean, moist sand. Burial facilitates decomposition and easy cleaning of the outer skin layer. The outer skin layer is removed by hand scrubbing (coconut husks are used in some places). Special care is taken in cleaning the whitish lower layer of the skin. Sand fish is boiled again in sea water.

Drying

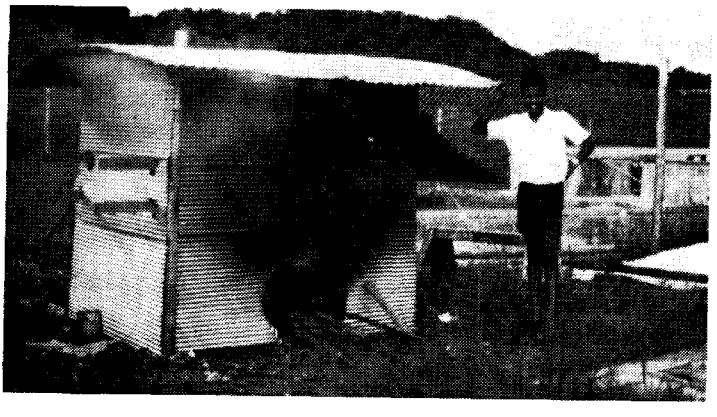
All varieties are dried after boiling and cleaning (and after re-boiling in the case of sand fish).

Sun drying is the cheapest method if climatic conditions are favourable. Cleaned animals are spread evenly over a mat or tray and left in the sun until they are hard and dry. This may take two or four days.

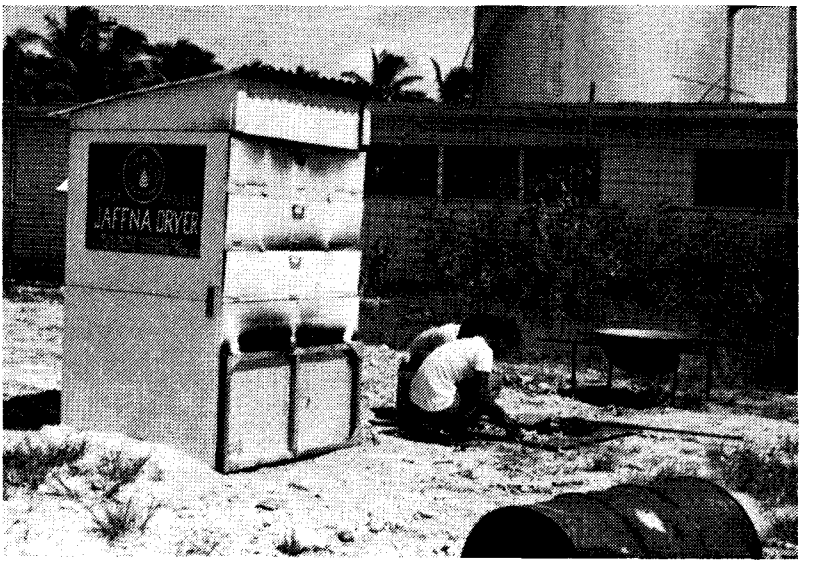
JAFFNA DRYER

For areas where relative humidity is high and rainfall is heavy, a drying unit is recommended. This dryer is essentially 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, where obtainable, is used to maintain the fire. The drying trays are of wire mesh with wooden frames. This drying unit can be a permanent construction or it can be portable. The technique of drying is very similar to that of copra drying.

A portable unit is built in three separate sections and assembled into 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 frames for support. The trays slide into the middle section and the drum containing the hearth is placed beneath them. Details of construction are shown below. Standard copra dryers are also frequently used.



Dryer constructed with corrugated sheets



Portable model of the Jaffna dryer

GRADING

Certain varieties of bêche-de-mer have consumer preference over others. Teat fish is called 'white stone' (and 'black stone') and is highly priced. Prickly red is called 'plum flower' and is priced next to 'white stone'.

Separation into species is the first step in grading. Size, appearance, odour, colour, moisture content and dirt content are other factors which determine the grade.

Size

Within a species, the larger the size the better the grade—and the higher is the price.

Appearance

A pleasing, smooth surface and a uniform shape are preferred to shrunken, uneven products. The body wall cut should be clean, not ragged.

Odour

A pleasing smell should be attained. Those smelling of decomposition should be discarded.

Colour

Dark coloration is generally preferred. The chalky white ventral surface of sand fish is to be avoided.

Moisture content

Bêche-de-mer stored in a humid atmosphere tends to absorb moisture and become soft. Twenty to thirty per cent moisture content by weight may be allowed. A hard, dry product is preferred to a soft, moisture-laden one.

Spoilage

Products should be free from bacterial and chemical spoilage.

PACKING AND STORING

Copra sacks are frequently used for storage. If possible, graded products are packed in polythene bags to be stored inside cartons before shipment.

Packed produce awaiting shipment should be stored in as dry an atmosphere as possible. Where the product has had to be stored for a long time in humid conditions, re-drying is generally necessary.

BECHE-DE-MER TRADERS

As it is difficult for a complete and up-to-date list of traders to be maintained, it is suggested that persons interested write to the Chambers of Commerce in the main trading centres, viz.:

Singapore

Hong Kong

Bangkok

Tokyo

Kuala Lumpur

Penang