FISHERIES INFORMATION PROJECT
SOUTH PACIFIC COMMISSION
PO BOX D5 - NOUMEA
NEW CALEDONIA

BECHE-DE-MER

INFORMATION BULLETIN Number 2 - November 1990

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NOTE FROM THE CO-ORDINATOR

Membership of the Special Interest Group on Bêche-de-mer has doubled since the first bulletin, showing not only the interest being taken in holothurians of commercial value and the bêche-de-mer market, but also the relevance of this newsletter. Our job is to act as a clearing-house for ideas, information and enquiries about the bêche-de-mer industry.

This fishery is often only given secondary importance, which explains the relative paucity of resources allocated for research. Increasing scientific interest may be noted, however in a number of countries and information is now available on the reproduction, distribution and abundance of various commercial species. Large gaps nevertheless still exist in the knowledge about recruitment, growth and mortality, which factors are essential to assess yield potential and commence rational management of stocks.

Scientific research on echinoderms is the theme for international meetings that have taken place every three years since 1972, bringing together specialists from various backgrounds. Following the 1987 Conference at Victoria in Canada, the 7th Conference recently took place in Atami, Japan, and was a great success. Echinoderm workshops are held regularly in Europe in the intervening periods. The papers tabled at these meetings are published and can be used to monitor developments in what is known about holothurian biology (cf. page 15).

Fisheries management will however require a better understanding of social and economic factors and research programmes should be developed in these areas and conducted in close conjunction with investigations into population biology.

Chantal Conand

Inside this issue

PIMRIS is a joint project of 4 international organisations concerned with fisheries and marine resource development in the Pacific Islands region. The project is executed by the South Pacific Commission (SPC), the South Pacific Forum Fisheries Agency (FFA), the University of the South Pacific's Pacific Information Centre (USP-PIC), and the South Pacific Applied Geoscience Commission (SOPAC). Funding is provided by the International Centre for Ocean Development (ICOD) and the Government of France. This bulletin is produced by SPC as part of its commitment to PIMRIS. The aim of PIMRIS is to improve the availability of information on marine resources to users in the region, so as to support their rational development and management. PIMRIS activities include: the active collection, cataloguing and archiving of technical documents, especially ephemera ("grey literature"); evaluation, repackaging and dissemination of information; provision of literature searches, question-and-answer services and bibliographic support; and assistance with the development of in-country reference collections and databases on marine resources.

PIMRIS

Pacific Islands Marine Resources Information System

BECHE DE-MER NEWS

Beche-de-mer species of commercial value - an update

by Seamus McElroy
FFA, Solomon Islands

Of the 1,200 species of holothurians, only a few species, mostly of the order Aspidochirotidae, are of commercial importance.

Worldwide, the single most important species by catch volume is *Stichopus japonicus*, which is gathered for local consumption, fresh or boiled, in Japan and Korea (12,688 t in 1983). This is a temperate species. The other main commercial species are tropical, from the Indo-Pacific region, and are prepared predominantly as beche-de-mer (in dried form) for export to Asian markets (around 13,000 t in the early 1980s). Total annual landings of holothurians are not known accurately because substantial volumes are taken for food in Asian countries such as China, Japan and Korea and in the subsistence economy of the tropical Indo-Pacific region.

Total recorded landings exceeded 25,000 t (live weight) in 1983 (Conand, 1986), since when the level of landings of *Stichopus japonicus* have declined somewhat (10,685 t in 1986) while the volume of trade through Hong Kong for tropical beche-de-mer (i.e. the dried product) has grown considerably.

Market area is an important determinant of unit price, with Hong Kong traditionally offering higher prices for a larger range of species and size grades than other Asian markets.

The main commercial species of beche-de-mer from the Pacific Islands on the Hong Kong market are listed in order of value as of mid-1990 in Table 1. The unit price depends upon (i) species and (ii) size grading, with the more valuable species being both larger in size and having a thick body wall (mostly 8-12 mm).

For a given species, the main determinant of value is size, the larger the size, the better the grade—and the higher is the price. Apart from species and size, other factors that affect price for the dried product are appearance, odour, colour, moisture content and spoilage. A pleasing smooth surface, uniform shape and clean (not ragged) body wall cut demonstrate proper handling and processing and a pleasant smell reflects proper storage.

The most valuable type from the tropical Indo-Pacific region is the teatfish which comprises two species, both of which are large in size, the white teatfish being more valuable than the black species. Both species shrink to approximately 50 per cent of their length and to 8 per cent of their weight when dried (Crean, 1977 and Conand, 1986).

Large dried white teatfish (*Holothuria (Microthele) fuscogilva*) 17.8 cm (7") and above fetched US$ 24/kg FOB ex Solomon Islands for shipment to Hong Kong in mid-1990, reflecting this product's high value food classification. Smaller sizes fetched substantially lower prices, with white teatfish 12.7 - 15.2 cm (5" - 6") and 15.2 - 17.8 cm (6" - 7") size grades selling for US$ 14/kg and US$ 20/kg respectively.

By comparison, the same two sizes (12.7 - 15.2 cm and over 15.2 cm) of black teatfish (*Holothuria (Microthele) Nobilis*) fetched US$ 11.50/kg and US$ 12.00/kg, while the smallest size grade for black teatfish of 10.2 - 12.7 cm (4"- 5") achieved US$ 11.00/kg. Comparing the white teatfish to the black teatfish, this price structure reflects:

(i) the generally larger size of the white teatfish;

(ii) The higher value of white teatfish for a given size grade, presumably because of differences in body wall thickness, ease of preparation, taste and/or colour;

(iii) the considerable jump in unit value for white teatfish from one size grade to the next compared to the smaller changes in unit value for black teatfish (increases of US$ 6.00/kg and US$ 4.00/kg between the 'small' to 'medium' and 'medium' to 'large' size classes for white teatfish compared to a flat increase of US$ 0.50/kg between the three size classes for black teatfish). Such large price differences by size grade do not appear to hold in Singapore.

Table 1. Ranking of beche-de-mer species by value (1"= 2.54 cm)

Common Name (1)	Scientific Name (2)	Size Grade	FOB Price (3 US$/kg
High value			
Teatfish white	*Holothuria fuscogilva*	5" - >7"	14 - 24
Teatfish black	*Holothuria nobilis*	4" - >6"	11 - 12
Prickly redfish	*Thelenota ananas*		12
Medium value			
Sandfish	*Holothuria scabra*	2" - >3"	5 - 15
Chalkfish (4)	*Bohadschia marmorata*		10
Greenfish	*Stichopus chloronotus*		8
Surf redfish	*Actinopyga mauritiana*	2" - >3"	7 - 8
Curryfish	*Stichopus variegatus*	2" - >3"	6 - 7
Blackfish	*Actinopyga miliaris*		6
Stonefish	*Actinopyga lecanora*	<2" - >3"	4 - 6
Low value			
Deep-red surffish	*Actinopyga echinites*		4
Leopardfish	*Bohadschia argus*		4
Amberfish	*Thelenota anax*		4
Elephant's trunkfish	*Holothuria fuscopunctata*		3
Lollyfish	*Holothuria atra*	2" - >5"	2 - 4
Brown sandfish	*Bohadschia vitiensis*	3" - >4.5"	2 - 3
Pinkfish	*Holothuria edulis*		2

Notes:

1. The common names are based largely on SPC, 1979. Beche-de-mer of the tropical Pacific. Hanbook No 18. South Pacific Commission, Noumea, New Caledonia.

2. The scientific names in the above publication have been checked and, where appropriate, corrected against a species guide: Guille, A., Laboute, P. and Menou, J.L., 1986. Handbook of the sea-stars, sea-urchins and related echinoderms of New Caledonia Lagoon. Collection Faune Tropicale No 25, ORSTOM. _____ signifies a change in species name from SPC, 1979.

3. The prices quoted are those offered to a major Solomon Islands marine products exporting company in mid-1990 by a Hong Kong based importer. They are assumed to be representative of the prices on offer in Hong Kong at that time. Where a range of prices is given, these refer to the lower and upper size grades specified. Otherwise, the price is the same for all sizes of that species.

4. Scientific names for the species chalkfish is not confirmed as correct. It is based on the SPC Beche-de-mer Handbook (1974). All other species scientific names have been taken from Guille et al., 1986.

3. Other species purchased include ripplefish (US$ 3.00/kg) and snakefish (US$ 1.00/kg). The scientific names of these two types are not known.

This price structure may also reflect a fourth factor, namely differences in the relative availability of these two species in total and within their respective size grades, with the lower value black teatfish being more common (black teatfish is certainly more commonly fished in the Pacific and is believed to account for the major part of total supplies of these two species on the Hong Kong market).

Beche-de-mer traders have traditionally graded the black teatfish separately from the white teatfish. However, prior to their separation into two distinct species by Cherbonnier in 1980, these two species were grouped together by biologists in the South Pacific as one species, *Holothuria (Microthele) nobilis*, differences between the black and mostly white colourations being considered as simply two colour varieties within the same species (see SPC, 1974, 1979).

In the South Pacific, the black teatfish is more commonly fished because of its shallower depth and higher average density, possibly due to its greater available habitat space and food supply. However, the deeper water white teatfish grows to a larger average size (*H. fuscogilva* 2.1 kg (± 0.5 kg) or 40 cm (16") ± 5 cm (± 2") against *H. nobilis* 1.8 kg (± 0.6 kg) or 37 cm (14.5 ") ± 6 cm (± 2") (after Conand, 1986)). Half the population reached sexual maturity in *H. fuscogilva* in subtropical New Caledonia at 32 cm (12.5") or 0.9 kg (drained weight, i.e. after making an incision to drain the internal fluids), while in *H. nobilis* half the population were mature at the smaller size of 26 cm (10") or 0.8 kg (drained weight).

Table 1 is subdivided into three groups by value: high value species—above US$ 10/kg (FOB ex Solomon Islands, destination Hong Kong), medium value species—in the range US$ 5 - 10/kg and low value species—below US$ 5/kg as of mid-1990. These subdivisions are clearly arbitrary. However, when ranked in order of value, the same species have occupied the top three positions at least over the past 15-20 years (refer SPC, 1974, 1979). Ranked in order by value they are (i) white teatfish, (ii) black teatfish, and (iii) prickly redfish. In the past blackfish was ranked fourth, but as Table 1 illustrates this position has been taken now by sandfish, at least in sizes over 2.5". The ranking of species by value in Singapore (origin South Pacific) is very similar as Figure 1 illustrates.

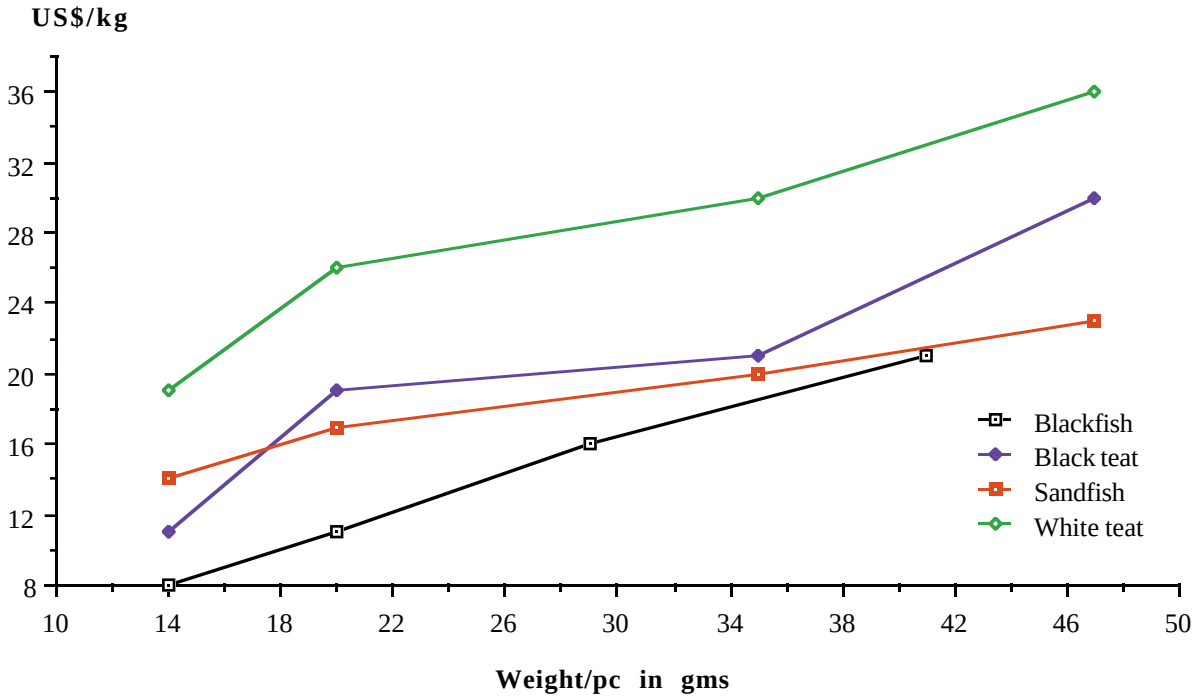

Figure 1. Beche-de-mer prices by grade and species C&F Singapore mid-1990

Formerly, some of the species which fall into the medium and low value groupings in Table 1 have been considered of little or no commercial value. Such species include the 5th and 17th ranked species, namely chalkfish and pinkfish. The two species appeared in the 1974 edition but were dropped from the 1979 edition of the SPC Beche-de-mer Handbook because they were considered then to be 'of no commercial value' (SPC, 1979 and all subsequent reprints up to the last in 1988).

For their part, SPC recognises the need for a new edition of this very popular handbook, to correct those omissions, increase the number of species covered to include those appearing in the commercial catch, correct some of the scientific names and provide up-to-date price and market information.

The most comprehensive beche-de-mer price list offered by any trader in the Pacific has 19 separate common species names subdivided into a total of 32 grades (comprising 1, 2 or a maximum of 3 size grades per species). Both editions of the SPC Beche-de-mer Handbook cover just 15 species each (allowing for the division into two species of the white and black teatfish).

The increase in the list of species of commercial value in recent years is due to an increase in total demand for beche-de-mer, particularly for the lower value species destined largely for consumption in mainland China.

The beche-de-mer industry has expanded and developed in the Pacific in the last five years largely on account of rising incomes in the main Chinese communities in Asia (Hong Kong, Singapore, Malaysia, Taiwan), who can afford the higher price species, and the increased demand from China, for the low value species. This recent surge in demand has led to an increase in fishing pressure in the Pacific, which was initially concentrated towards the high and medium value species.

The recent decrease in both the absolute and relative volumes of the high value species has led to a substantial rise in their unit value. This had led in turn to an increase in the unit value and hence catch of other beche-de-mer species which were previously considered of medium, low or no commercial value.

Table 2 charts changes in the indicative value of beche-de-mer species between 1974-1990.

Table 2. Indicated changes in the value of beche-de-mer species between 1974-1990

Common Name	Scientific Name	Price US$/kg 1990 (1)	Value Rank 1979 (2)	Value Rank 1974 (3)
High value				
Teatfish white	*Holothuria fuscogilva*	14 - 24	1	1
Teatfish black	*Holothuria nobilis*	11 - 12	2	2
Prickly redfish	*Thelenota ananas*	12	3	3
Medium value				
Sandfish	*Holothuria scabra*	5 - 15	M	M
Chalkfish (1)	*Bohadschia marmorata*	10	no	M
Greenfish	*Stichopus chloronotus*	8	L	no
Surf redfish	*Actinopyga mauritiana*	7 - 8	M	M
Curryfish	*Stichopus variegatus*	6 - 7	L	M
Blackfish	*Actinopyga miliaris*	6	4	4
Stonefish	*Actinopyga lecanora*	4 - 6	M	M
Low value				
Deep-red surffish	*Actinopyga echinites*	4	M	M
Leopardfish	*Bohadschia argus*	4	L	L
Amberfish (2)	*Thelenota anax*	4	M	ni
Elephant's trunkfish (2)	*Holothuria fuscopunctata*	3	L	ni
Lollyfish	*Holothuria atra*	2 - 4	L	L
Brown sandfish	*Bohadschia vitiensis*	2 - 3	L	L
Pinkfish (1)	*Holothuria edulis*	2	no	no

Key: no = no commercial value
ni = not included in Handbook, hence considered of no commercial value at that time

Sources: **1**. SPC, 1974. Beche-de-mer of the South Pacific Islands. South Pacific Commission, Noumea, New Caledonia

2. SPC, 1979. Beche-de-mer of the tropical Pacific. Handbook No 18 (1979). South Pacific Commission, Noumea, New Caledonia.

3. The 1990 prices (quoted in US$ FOB) are those offered to a major Solomon Islands marine products exporting company in mid-1990 by a Hong Kong based importer. They are assumed to be representative of the prices on offer in Hong Kong at that time.

Notes: (1). Species included in SPC, 1974, but excluded from SPC, 1979.

(2). Species included in SPC, 1979, but excluded from SPC, 1974.

For 1990, where a range of prices is given, these refer to specific lower and upper size grades (refer Table 1). Otherwise, the price is the same for all sizes of that species.

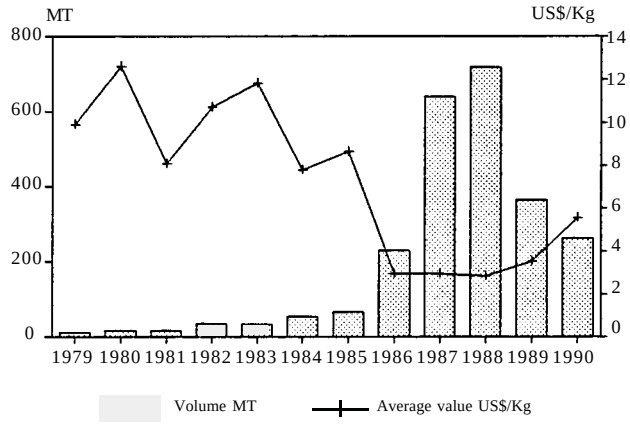

Figure 2a. Volume and average value of beche-de-mer exports from Fiji (Source: Fisheries Division, Fiji - 1990 volume data projected on January-June period)

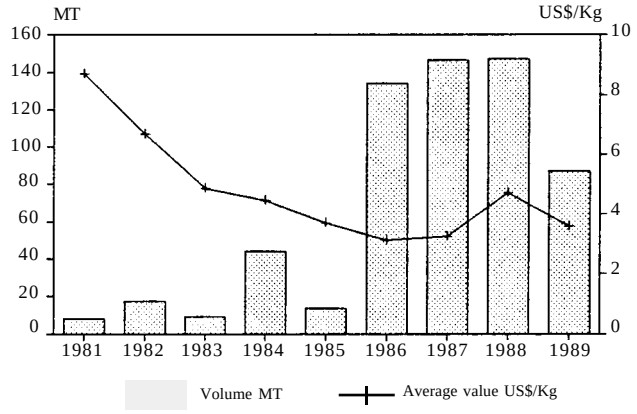

Figure 2b. Volume and average value of beche-de-mer exports from Solomon Islands (Source: Fisheries Division, Fiji)

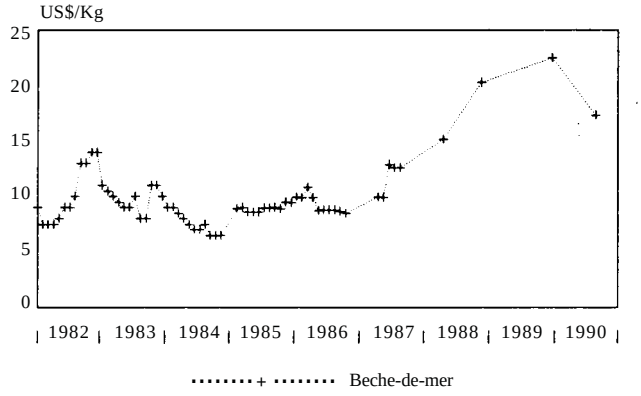

Figure 2c. Development of Beche-de-mer import price at Singapore (1982-1990)

In general those species which have traditionally been considered of moderate value (i.e. in 1974) remain in this category today, the only exceptions perhaps being the deep red surffish (*Actinopyga echinites*) and the amberfish (*Thelenota anax*) which at an FOB value of US$ 4/kg in Table 2 have slipped into the low value category. Interestingly, because of its large size (it is also known as giant beche-de-mer) and thick body wall (up to 23 mm), the amberfish was once in great demand. Its current price is considered to be on the low side.

The most common species in the medium value category are the sandfish (*Holothuria scabra*) and blackfish (*Actinopyga miliaris*). Both the greenfish (*Stichopus chloronotus*) and the curryfish (*Stichopus variegatus*) require care in processing as they tend to break up if kept out of water. For this reason, they have sometimes been considered of low to no value. The chalkfish (*Bohadschia marmorata*), though of good value, tends not to be very common.

The most common species in the low value category is the lollyfish (*Holothuria atra*), the most abundant species of beche-de-mer found in the Pacific. Only live specimens above 10 cms (4") are considered worth collecting. Dried lollyfish (which also shrinks to about 50 per cent of its live length in processing) fetched US$ 2/kg for small size (2" - 3"), US$ 3/kg for medium size (3" - 5") and US$ 4/kg for large (over 5") at mid-1990. The leopardfish (*Bohadschia argus*), often mistakenly referred to as tiger fish, also achieves a value of US$ 4/kg and is commonly found in 6 - 8 m of water on or near coral (live or dead).

The overall result of recent developments in the composition of demand, supplies and prices has been an increase in both the volume and total value of beche-de-mer exports from the region. But because this growth in demand and supplies has been made up largely of the lower unit value species, the average value of beche-de-mer exports from the South Pacific has dropped substantially recently (refer to Figure 2 which covers the development of market prices (US$/kg) for sandfish in Singapore against volume and average price of exports from Fiji and Solomon Islands during the course of the 1980s).

From a cursory examination of available biological and market information, it would appear that the main determinants of value among the medium and low value groups remain overall size and body wall thickness, with familiarity with the species (perhaps related to relative abundance) and ease of preparation also of some importance. Thus each species listed in Table 1 has appeared in either one or both of the two editions of the SPC Beche-de-mer Handbook.

However, two other 'low value' species, referred to as ripplefish (US$ 3/kg) and snakefish (US$ 1/kg) (scientific names unknown), also feature on the exporter's list of 19 species

Certainly, too, there are other low value species such as *Bohadschia similis* (see Guille et al, 1986), which is thin-walled (3 - 4 mm thick), and similar to brown sandfish (but more cream in colour) which is collected in shallow water and processed as beche-de-mer today.

This species has traditionally been considered of too low value and has been mistakenly classified by collectors and exporters as another colour form of brown sandfish. There are several other, less common but still valuable, beche-de-mer species in the Indo-Pacific region (see Guille et al, 1986).

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Beche-de-mer survey in Tonga

by Garry Preston
SPC, New Caledonia

A two-week survey of beche-de-mer resources was carried out in Ha'apai, Tonga, by the Tonga Fisheries Division, with the assistance of the South Pacific Commission and the Papua New Guinea Department of Fisheries and Marine Resources. The survey took place during June 1990.

45 SCUBA dives were completed and data gathered about the abundance and distribution of the sea cucumber species in the area. From this it was possible to draw some conclusions about the depth and geographical distributions of the six commercially useful species present.

The total standing stock of commercially exploitable sea cucumbers in water less than 30 m deep in the area was estimated to be about 1.01 million animals, although some of these would be inaccessible to fishermen because of their depth or distance from a land base. It is anticipated that beche-de-mer are also present in significant numbers below this depth but this was not demonstrated: if true, these animals would form an essentially inaccessible broodstock, at least for some species.

It was recommended that the Fisheries Division go ahead with their plan to promote the development of this industry, provided that harvests do not exceed half the total standing stock per year (about half a million animals). At an estimated value of between 1 and 2 Tongan Pa'anga per animal to the processor, this fishery could ultimately be worth between 0.5 and 1.0 million Pa'anga per year to the area.

No management of the fishery is proposed at present since this does not appear to be needed. However, it was recommended very strongly that all possible steps be taken, including implementing new legislation, to prevent or discourage the use of SCUBA gear or other underwater breathing apparatus for sea cucumber collection. It is also recommended that any Fisheries Division-sponsored development work in this fishery should also provide for the collection of basic production statistics to allow monitoring of the way in which the resource is being exploited.

Beche-de-mer research and development in Papua New Guinea

by Paul Lokani
Dept of Fisheries and Marine Resources, PNG

Fishery

PNGs Beche-de-mer fishery dates from the 18th century. At one stage in 1903 beche-de-mer became the fifth largest export for British New Guinea. In recent years, beche-de-mer has slowly become an important income earner for the coastal and island communities especially at this time of depressed copra prices which is the traditional cash generating product for the island communities.

A private beche-de-mer buyer in PNG shows local fishermen to correct way to process sandfish (Photo: Paul Lokani)

Average prices paid to the fishermen bringing in dried beche-de-mer in Kavieng in early 1990 was Kina 5.00/kg. Fishermen can however get a top price of K10.00/kg for super grade sandfish (*Holothuria scabra*), while the exporter can get up to K 23.00/kg (FOB).

Beche-de-mer is known to be consumed in a very few communities in PNG but it is not important in the diet of the local communities. The Kombe people in the West New Britain province consume some *Actinopyga* species and some areas in Manus use *Holothuria atra* to fish for octopus. Beche-de-mer is important only as an export commodity.

The beche-de-mer species are being exploited by free diving, wading and with the aid of a light during the night. Night fishing targets sandfish. Fishermen report a higher catch rate for the larger species of sandfish in the night compared to daytime collecting.

The species currently exploited are: sandfish, white teatfish (*Holothuria fuscogilva*), black teatfish (*Holothuria nobilis*), blackfish (*Actinopyga miliaris*), deepwater redfish (*Actinopyga echinites)* and surf redfish (*Actinopyga mauritiana)*. About 95 per cent of the products are shifted by air within the country and at export.

In 1989, sandfish accounted for 70 per cent of the total beche-de-mer export. This is a high valued species which was targeted as in a typical beche-de-mer fishery which targets the high valued species in the initial stages. Figure 1 shows the case of the Tigak Beche-de-mer fishery. As the production of the sandfish dropped, which was directly due to decreasing stocks, the other species picked up production.

Table 1 shows the production of beche-de-mer for the last 9 years.

Most of the products have been harvested from the Milne Bay, New Ireland, Manus and North Solomons Provinces. In the beginning of 1990, production has picked up in the East New Britain and West New Britain provinces.

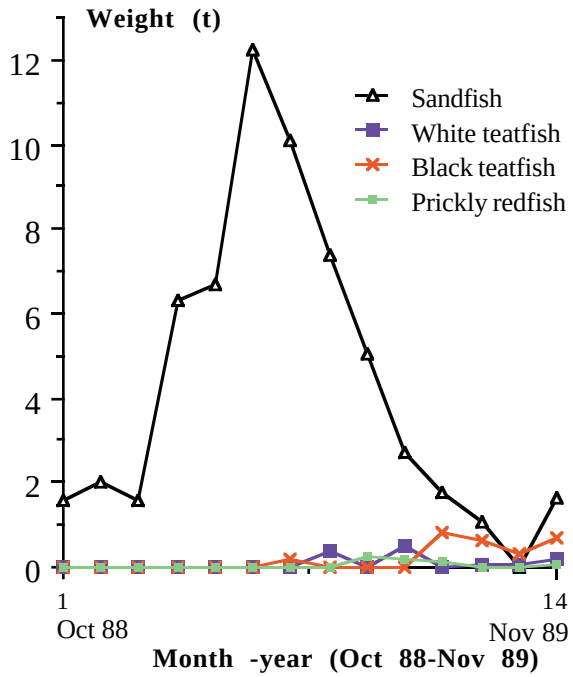


Figure 1. Beche-de-mer production by species for the Tigak area

Table 1. Beche-de-mer exports from PNG since 1982

Year	Weight (t)	Value (Kin
1982	8.415	26,201.11
1983	7.630	23,938.97
1984	4.668	13,472.49
1985	19.491	58,192.00
1986	105.942	349,158.00
1987	192.055	591,009.22
1988	202.789	801,770.13
1989	194.896	1,146.584.85
1990 (to March)	43.168	201,812.61

Research activities and results

There has been widespread concern from the provincial fisheries authorities that local overharvesting of beche-de-mer species was becoming very common and that there was a need to enforce some management regulations. This was discussed in the 1988 and 1989 Fisheries Advisory Committee meeting and also noted by the Fisheries Sector Review in 1988 which made the following recommendations:

1. Exports be subjected to tighter control, with species declared separately, as well as grades, and Province of origin specified.

2. Introduction of a minimum size restriction.

In connection with both of the above, some training of inspection staff would probably be needed.

3. Quick effective survey techniques need to be developed by RSD staff and recovery from exploitation monitored in selected areas.

4. Greater Provincial involvement in monitoring production should be encouraged.

Information on the biology and exploitation of beche-de-mer species in PNG is very limited or absent. Management will therefore be a problem as there are no facts to base any management regulations on. To compound the problem there is no known beche-de-mer fishery in the tropics that is managed. While the state of Queensland in Australia has a minimum size limit of 15 cm for beche-de-mer species the fishery in this area is not in existence.

The Department of Fisheries and Marine Resources in PNG is embarking on a research programme to study some aspects of the biology and ecology of beche-de-mer species for the rational development and management of this resource.

Gonad sampling:

Gonad sampling started in April 1989 for the following species:

1. *Holothuria scabra*
2. *Holothuria fuscogilva*
3. *Holothuria nobilis*
4. *Actinopyga miliaris*
5. *Actinopyga echinites*
6. *Thelenota ananas*

Populations of the above species are being sampled once every month for gonad to look at the seasonality in spawning. Gonad samples are running through on the second year and will continue until the full two years through to 1991.

Gonad Index (G.I.) is calculated as follows:

G.I. = gonad weight / whole weight x 100

G.I. is also being calculated as a ratio of the gutted weight. It appears that spawning occurs throughout the year under the influence of the lunar cycle.

Growth trials

Growth trials on *Holothuria fuscogilva* and *Thelenota ananas* in the field started on December 1990. The animals are kept in enclosures 2 m by 1.5 m at a depth of 12 m and 22 m. The enclosures are constructed of arch mesh wire and covered with half inch mesh chicken wire.

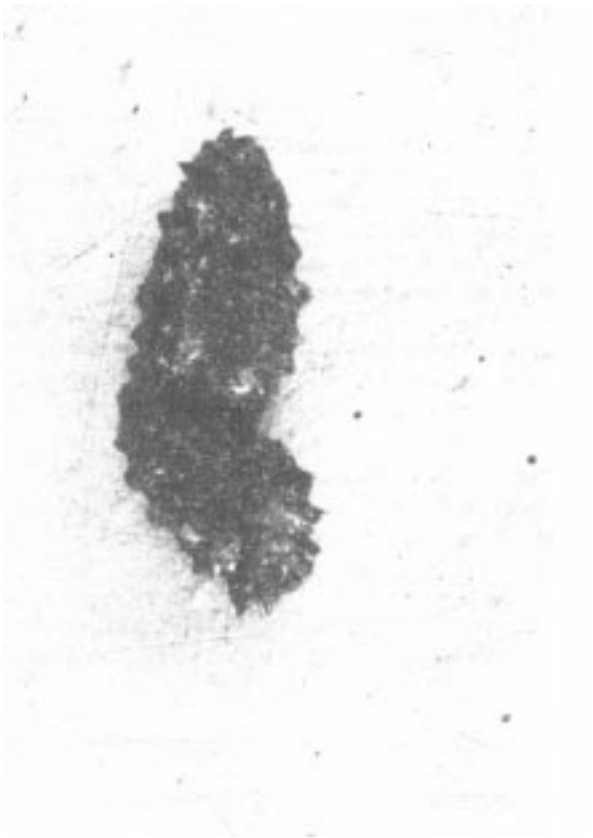
The enclosures for *Holothuria fuscogilva* were placed in a sandy substrate while the enclosures for *Thelenota ananas* were placed in a rubble and stony substrate. The substrate types were chosen according to their association with each species.

PNG sea cucumber fishermen use simple fences made from sticks and chicken wire to accumulate enough supplies for processing (Photo: Paul Lokani)

Measurements of the length and weight are taken every month. The length is taken at the seafloor while the animal is stretched on its natural stage while the weight is measured at the surface. *Thelenota ananas* had a very high escape rate. After 4 weeks, all the animals escaped. Some of the animals developed lesions sustained while trying to escape.

Only one *Holothuria fuscogilva* died while in the enclosure. The rest of the *Holothuria fuscogilva* were very healthy after five months in the enclosures.

There has not been any significant growth detected after four months in the enclosures. This is perhaps due to the fact that food has been limited. To remedy this situation, the enclosures will be moved every week a few meters from the original position, so the animal has a new feeding ground every week.



Prickly redfish (*Thelenota ananas*) with lesions (injury) sustained while trying to escape from the enclosures in the growth trials. (Photo: Paul Lokani)

Pilot survey

A pilot survey has been conducted in May 1990 and to be completed on July 1990. The aim of the pilot survey is to test the different survey methods (transect, quadrat and Manta Tow) and test the different sizes for sample optimisation in terms of cost and the precision of the abundance estimate.

Results of the distribution of the commercial species in terms of habitate and depth from the pilot survey will be an invaluable help to the above. Plans and the survey methods to be used in the provincial surveys will rely on the results of the pilot survey.

Sea cucumber research in Washington State

by Alex Bradbury
Washington State Department of Fisheries, USA

The only species of commercially exploited holothurian in Washington State, USA, is *Stichopus californicus*. Alex Bradbury, biologist in charge of managing echinoderm fisheries with the Washington State Department of Fisheries, sent us the following notes about his work.

' We have a single commercial species here, *Stichopus californicus*. The commercial dive fishery is long established, but only in the last few years has it grown to a size that warranted more than cursory management. We also have an experimental beam trawl fishery that began in 1987.

Over the last few years, the urchin and cucumber fisheries have grown seven-fold in terms of fleet size, and this winter I have been swamped in legislative battles for limited-entry, lawsuits, emergency closures, etc. I have little time to think about biology.

We still do not actively survey state waters for these animals; only during our dive surveys for sea urchins and geoduck clams do we make incidental counts of cucumbers. This began in 1986, and I have real reservations about its usefulness to management. I have requested funds for video equipment, since this seems the ideal way to make quantitative surveys. So far, we haven't got either the money or time to do these surveys. Instead, our management continues to rely on analysis of fisherman logbooks for catch-per-unit-effort data.

When we do our underwater surveys, we swim a 900 square-foot transect (83.6 square meters) and simply count animals. We use a spool containing 150 feet of polypropylene line weighted at intervals with bits of lead. The spool itself has handles that extend 3 feet on either side of the spool centerline, so that we survey a 3-foot by 150-foot area. Two divers operate the spool, one on either handle, so that each has to count a 450 square-foot area—with our poor visibility in these waters, that's about the most we can expect to cover and see all animals. During our regular geoduck clam surveys, we run continuous transects from the -18 foot level to -60 foot level, with a line of such transects made every 500 feet of shoreline; we survey about 300-500 acres of geoduck habitat each year. During our sea urchin surveys, we run about 70 transects per year. As I said, we count sea cucumbers during both the geoduck and urchin dives.

This year's season began on May 1; by the time you receive this, we'll have completed our seventh underwater survey at Pulali Point, the area we are monitoring for recovery following commercial harvest. So far we have performed six surveys prior to the area being fished; these surveys were performed every two months over a year's time. During each survey, we counted sea cucumbers within 12 transects, each measuring 83.61 square meters. Transects were placed at four different depths, ranging from -7.62 m to -25 m (corrected for datum tide level). Our seventh survey will be the first since the area was opened for fishing on 1 May 1990. We are monitoring the fishery at this site via mandatory fishing logs, so we should have some catch-per-effort data as well as total harvest data. Naturally, we will continue our dives every two months for several years to monitor recovery.

We have done some simple research projects near our lab on Hood Canal. We have completed two years of work collecting monthly samples of cucumbers from a discrete, unfished area. While we haven't fully analysed the results, the data show pretty clearly that cukes cease feeding in the fall and lose weight in the winter. Longitudinal muscle weight during the first year peaked in May and reached its lowest level in November, a drop of 37 per cent. Body wall weight peaked in October and reached its lowest level in January, declining 20 per cent. Peter Fankboner found a similar thing occuring to cukes during the winter.

We began an ambitious tagging/movement study in fall of 1988. Our objective was to determine if cucumbers moved between shallow and deep water. We used Floy tags with a double 'T' at each end (on the assumption that cukes could withdraw a single-T tag into their body cavity and expel it). We held 18 tagged cukes for 88 days and found that 28 per cent died during this time. Untagged 'control' cukes experienced no mortality during the same period, although all animals held for this study showed a decrease in size index. Only one cuke that survived this 88-day period lost its tag. We then dived an open, rocky area near our lab and tagged 720 cukes in 35 feet of water over a three-day period. Every two months since then we have dived the area, counting cukes at various depths within a series of 900

square-foot transects. Our most recent survey occurred 380 days after the initial tagging, and we found only one tagged individual out of 274 counted along transect lines. We don't closely examine all the cukes along the transect lines, but we have noticed on occasion that some cukes have tag scars; we have also picked up 7 loose tags. In short, we suspect that tag loss rather than movement or any other biological factor probably accounts for our findings, and the experiment is a dud. We did find one animal that had moved from 35 feet down to 90 feet, the deepest depth we have surveyed. This whole area will be opened to commercial diving for six months beginning May 1990, and we will be looking for tags in the catch, but I doubt we'll find many. We think that the hole never really heals and that the tag works its way out of the skin eventually.

Our fourth stab at cucumber research began in April 1989. We have been running a series of 900 square-foot transects along four depth contours in a nearby area every two months since April 1989. We will continue this procedure for several years. Meanwhile, we'll be opening up the fishery there in May 1990 for a six-month period. We'll be able to monitor the catch there and follow the recovery of the population over time. This strikes me as a much more realistic approach than making density counts in a small area and then experimentally removing animals; here we have the experimental area being harvested as well as a huge surrounding area, so that recovery cannot depend simply on animals from nearby unfished areas migrating into the experimental area. Obviously, it will be some time before we have any results, but I'll keep you posted.

Otherwise my principal concerns at this point are developing a long-lasting tag (i.e., one that will be retained more than six months), developing a reliable method of sizing live cucumbers, age/growth studies, recruitment studies, and long-term movement studies.'

Pollution problems

by Bernard Fao
Bureau des Pêches et de l'Aquaculture, New Caledonia

Background

Interest in beche-de-mer harvesting, for export in dried form, was revived in New Caledonia through the efforts of a number of private operators and exporters and has greatly grown in recent years. Beche-de-mer fishing helps diversify the sources of income of New Caledonia's coastal communities.

In the past three years, beche-de-mer exports have amounted to 96 tonnes, 136 t and 55 t respectively, i.e. a total of 287 tonnes.

Besides the need to monitor the factors affecting the sustainability of the resource (stock renewal, recruitment, markets), the development of beche-de-mer harvesting, or more precisely the increasing number of processing workshops springing up on the foreshore, entails a number of serious hazards for the neighbourhood and the marine environment.

Toxicity of beche-de-mer

Case of Pam Bay (in the Ouegoa District)

Following a protest lodged through a process-server on the marine pollution caused by waste from a beche-de-mer storing and processing workshop, two officers from the territorial fisheries department inspected the site.

They found an abnormal number of dead bivalves on the foreshore adjacent to the workshop. The above-mentioned report furthermore mentioned the presence of several thousand dead sardines.

From discussions with the fishermen it emerged that both the fluid released by fresh stored beche-de-mer and the water in which they have been boiled are poured directly into the sea, while the guts are partly buried in the sand but always within the upper limit of wave wash at high tide.

Samples of the fresh juice and cooking stock were tested at ORSTOM-Noumea for ichtyotoxicity. The tests revealed the presence of a toxin called "holothurine". This toxin is thermostable and believed to interfere with the action of the fish branchiae, a property which has long been made use of by Pacific fishermen to catch fish by poisoning.

Test methods and results

About ten small fish (tilapia and guppy) in a one-litre tank were exposed to various concentrations.

- Fresh juice :

1 cc/litre:	all fish dead within 1 hour
55 cc/litre	all fish dead within 15 minutes

- Cooking stock :

1 cc/litre:	1 dead within 6 hours
	2 dead within 12 hours
	2 still alive after 24 hours
5 cc/litre:	all dead within 1 hour

To guard against pollution, the operators were advised to dispose of the fresh juice, the cooking stock and the guts in ditches dug at a sufficient distance from the sea, in the hope that the sand will act as an effective filter.

Marine pollution caused by waste from a beche-de-mer storing and processing

Welcome to new members

Jean-Paul Gaudechoux
SPC, New Caledonia

The Beche-de-mer Special Interest Group is growing. We have received additional completed questionnaires from the individuals listed below. The previous list of members is available in the first SPC Beche-de-mer Information Bulletin.

If you are on the list and your name and address is wrong, please send us a correction. If you are not on the list and want to be, fill in the form enclosed with the bulletin or write to us for a new one.

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7th International Echinoderm Conference

The seventh International Echinoderm conference took place in Atami, Japan in 1990. The papers tabled at these meetings are published and the abstracts below summarise the articles presented regarding tropical sea cucumbers:

Comparisons of larval development and growth of the sea cucumber *Actinopyga echinites* : ovary-induced ova and DDT-induced ova, by Chang-Po CHEN*, Hui-Wen HSU and Dar-Chyi DENG
* Institute of Zoology, Academia Sinica, Nankang, Taipei, Taiwan 11529, Republic of China

Adult *Actinopyga echinites* (Jaeger) were collected from northern Taiwan (121°55' E, 25°03' N) in summer. Some gonadal tubes were fixed in Bouin's solution as the control. Other gonadal tubes were cut into pieces and set for 1 hour (ovary-induced ova). The other ovocytes were collected, bathed in 10^{-2} M Dithiothreitol (DTT) solution for 10 minutes and then in fresh seawater for 50 minutes (DTT-induced ova). The percentage of germinal vesicle breakdown at this three cases was 0.4 per cent (the control), 6.4 per cent and 84 per cent, respectively. After artificial insemination, the embryos were cultured in seawater (U.V. light-irradiated, $35_{/00}$, 25-28°C) with the alga *Isochrysis aff. galbana* at 10^{4-5} cells/ml. Larvae developed from the ovary-induced ova grew to the auricularia stage with hydrocoel at the 13th day, to the doliolaria at the 18th day, to the pentacula with one podium at the 19th day after insemination. Pentacula settled on the substratum and became juveniles. The DTT-induced larvae developed slowly and took 15 day, 20 day and 21 day, respectively to the above stages. The size of the ovary-induced larvae was larger than that of the DTT-induced ones, i.e., 1.13 mm vs 0.62 mm at 17 days, and 0.78 mm vs 0.37 mm after metamorphosis. At the 12 th day, the body of ovary-induced larvae accumulated gradually light-yellow lipid spheres. The number of spheres is positively related to the size of larvae.

Long-term movements of some tropical sea-cucumbers monitored by tagging and recapture, by Chantal Conand, Université de Bretagne Occidentale, Laboratoire d'Océanographie Biologique, 29287 Brest Cedex, France.

In addition to their utility in studying growth and mortality parameters in a population, tagging experiments followed by a series of recaptures are useful in following movements. Tagging experiments have been conducted on seven aspidochirotid holothurians from the different lagoonal and reefal habitats of the New Caledonia lagoon. On reef flats, with high density populations, the position of tagged individuals was located inside quadrats which were marked out by pegs and orientated. At deeper stations, where population densities are usually lower the quadrats were larger and were not precisely demarcated. Recaptures were generally made each three months. Recapture rates are highly variable, depending on the species. Their progressive decline is mostly due to the loss of tags. Concerning the reef-flats species *Actinopyga echinites* and *A. mauritiana* the movements of some tagged individuals were followed over one year. Their amplitude was rather limited as many individuals were found inside the inner quadrat after six months. The average direction of the movements has been determined for these species. It is apparently random for *A. Echinites* and orientated towards the reef crest for *A. mauritiana*.

Trends in tropical sea-cucumber fisheries, by C. Conand[1], G. Preston[2], C. Hoffschir[3]
[1] Université de Bretagne Occidentale, Laboratoire d'Océanographie Biologique, 29287 Brest Cedex, France.
[2] South Pacific Commission, Noumea, New Caledonia
[3] ORSTOM, Océanographie, Nouméa, New Caledonia

Temporal and spatial variability in tropical holothurian fisheries, as well as recent trends, are described from the trade statistics of the main beche-de-mer world markets, Hong Kong and Singapore. Imported, then re-exported tonnages show wide variations and a marked increase during the last years. The importance of the tropical Indo-Pacific fisheries varies in each country, according to political, economical, sociological factors and to the state of the biological resource. The detailed study of the New Caledonian fishery, during the XIXth and the XXth centuries, clearly shows the temporal variability and also a variability of the captures species and of the exporters.

Ultraviolet light-absorbing compounds in coral reef holothurians: organ distribution and possible sources, by J.M. Shick, W.C. Dunlap, A.T. Banaszak, and T.K. Rosenzweig. Australian Institute of Marine Science, Townsville, and Department of Zoology, University of Maine, Orono, USA.

Seven UV-absorbing, mycosporine-like amino acids (MAA) have ben identified in organs of *Thelenota ananas* from the Great Barrier Reef. Concentrations of MAA are greatest in the external layer of the dorsal body wall and very low to undetectable in most internal organs, except for gut tissues. Four of the compounds are present in coral sand from the habitat of *T. ananas*, at concentrations 1000-fold lower than in tissues. Relative to habitat sand, sand in the gut is enriched about threefold in its content of these compounds, which appear to be removed from the gut contents prior to their defecation. Gut contents and feces contains asterina-330, a compound absent from habitat sediment, but which is the single most concentrated MAA in the tissues. Mycosporine-glycine is the next most concentrated MAA in epidermis, and is absent from habitat sand, gut contents, and feces. The organ distribution of MAA supports the adaptive interpretation that MAA provide protection from solar UV radiation in exposed epidermal tissues. The high concentrations of MAA in the gonads of other holothurian species are consistent with this interpretation since broadcast gametes would also require protection from UV. Metazoans are unlikely to synthesize MAA de novo; it is uncertain whether MAA are obtained directly from ingested materials, but the presence in the tissues of certain MAA absent from the diet suggests secondary metabolic modification of dietary compounds. Enrichment of gut contents with MAA compared to habitat sand may indicate selective feeding on MAA-rich particles, or synthesis by enteric microbes of MAA which are then absorbed and concentrated by the gut.

New references in SPC library

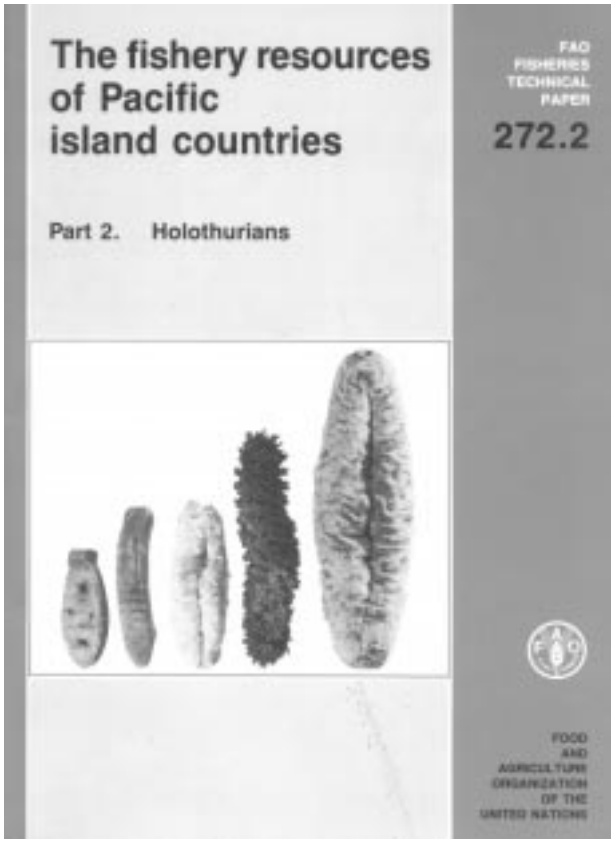
The FAO Fisheries Department has undertaken a review of the fishery resources of the Pacific island countries. This paper on holothurians (which was in French) has been translated into English by the South Pacific Commission. It was prepared on behalf of the FAO by Mrs C. Conand in conjunction with the 'Institut français de Recherche Scientifique pour le Développement en Coopération' (ORSTOM) and the 'Université de Bretagne Occidentale'. The chapter about beche-de-mer market and the appendices were prepared with the assistance of Mr Van Eys, international trade specialist with INFOFISH.

An abstract of this FAO Fisheries Technical Paper is given below.

The main species of holothurian exploited in the South Pacific are *Holothuria scabra*, *H. fuscogilva*, and *H. nobilis*, which have high commercial value, *Actinopyga echinites*, *A. miliaris* and *Thelenota ananas*, of medium commercial value, and *Holothuria atra*, *H. fuscopunctata* and *H. mauritiana*, whose commercial value is low.

Knowledge of the biology of these species is reviewed in detail, as are resource assessment methods. An example of the possible use of remote sensing for estimating potential is given.

Harvesting and processing techniques and commodity grading are also discussed, while a chapter focussing on the principal markets for beche-de-mer, Hong Kong and Singapore, concludes that an increase in exports from the countries and territories of the South Pacific is possible if they can supply a consistently good-quality product on a regular basis.



Conand C.
The fishery resources of Pacific island countries
Part 2. Holothurians.
FAO Fisheries Technical Paper
Rome, FAO, 1989, 143p.

SPC has a stock of about 50 copies of this document. Single copies are available to individuals working in the Pacific Islands on a first-come first-served basis. Individuals outside the SPC region (see map on back) should contact FAO for copies.

We have also, now available, in the SPC library the following references:

Bradbury A. (1990). **Sea cucumbers in Washington**. Informal Bulletin, 6p.

Bradbury A. (1990). **Management of the commercial dive fisheries for sea urchins and sea cucumbers**. Proceedings from the Forum on Puget Sound's Biological Resource - Status and Management, September 11-12, 1989, Seattle, Washington, pp 56-65.

Cameron J.L. and Fankboner, P.V. (1986). **Reproductive biology of the commercial sea cucumber *Parastichopus californicus* (Stimpson) (Echinodermata: Holothuroidea**). I. Reproductive periodicity and spawning behavior. Can. J. Zool. 64: 168-175.

Conand, C. (1988). **Comparison between estimations of growth and mortality of two Stichopoid holothurians: *Thelenota ananas* and *Stichopus chloronotus* (Echinodermata: Holothuroidea).** Proceedings of the 6th International Coral Reef Symposium, Australia, 1988. Vol 2.

Conand C. (1989). **Croissance et mortalité de quelques Holothuries du lagon de Nouvelle-Calédonie**. Vie Marine, HS 10: 160-176.

Da Silva J., Cameron J.L. and Fankboner P.V. (1985). **Movement and orientation patterns in the commercial cucumber *Parastichopus californicus* (Stimpson) (Echinodermata: Holothuroidea**). Mar. Behav. Physiol. 1986, Vol 12, pp 133-147.

Ez El Din Z. (undated). **Beche-de-mer processing trials along the egyptian red sea coast**. Fao Fisheries Report 321 Suppl. pp 286-290.

Fankboner, P.V. and Cameron J. L. (1985). **Seasonal atrophy of the visceral organs in a sea cucumber**. Can. J. Zool. 63: 2888-2892.

McElroy S. (1990). **Beche-de-mer survey of the Gilbert Islands**. 14 pp. (report referenced in Beche-de-mer Information Bulletin #1, now updated by the author).