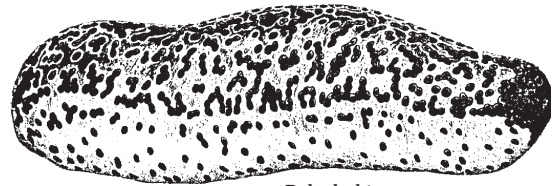


B E C H E - D E - M E R  
I N F O



*Bohadschia argus*

**The beche-de-mer industry in the Solomon Islands: recent trends and suggestions for management**

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**Introduction**

Beche-de-mer is purchased from all provinces in the Solomon Islands. Processing is often done at the village level and involves the whole community. Processed beche-de-mer is usually traded at a local store for commodities and cash. The storekeeper contacts an exporter in Honiara once there is sufficient beche-de-mer to warrant collection. The storekeeper then trades the beche-de-mer with an exporter, for merchandise. The exporters grade the beche-de-mer, pack it in hessian sacks and ship it to Hong Kong, whenever there is sufficient cargo.

There are two major exporters of beche-de-mer in Honiara (Sunking Enterprises and Western Pacific Shells) and a few smaller companies. In the last few years, fishermen have been able to command a higher price for beche-de-mer, owing to increased competition between exporters. There are, however, two reasons why this situation may not persist. The first is that the government has introduced a tax of 10 per cent, effective from January 1993, for all beche-de-mer exports. Secondly, the exporters have stated that there has been a general decrease in beche-de-mer landings since 1991 (though no figures are as yet available from the Fisheries Division, Honiara). This has led some small marine export companies to divert their interests to other marine products.

In this paper, the features of the beche-de-mer industry in the Solomon Islands between 1982 and 1992 are examined. In particular, the species harvested; the relative importance of the fishery in each province; the value of the fishery; variation in catch of individual species; potential management strategies and the possibility of re-seeding to enhance the industry are described.

The information presented here was gathered from local indigenous knowledge, exporters and the Solomon Island Fisheries Division. At present, the Fisheries Division only records data on the total exports of beche-de-mer from each province. These data are used to summarise recent trends in the

relative importance of the provinces and the value of production. The company records of one of the two major exporters of beche-de-mer in the Solomon Islands were used to describe the species composition of the catch, and recent annual variation in the exports of individual species.

**Species of commercial value**

In 1993, 22 species of sea cucumbers were exploited. Eighteen of these species are listed in Table 1. The other four species are snakefish, hongpay fish, stonefish (black) and ripplefish. Scientific names for these are unavailable. There is some discrepancy between exporters as to the name given to stonefish (black). One exporter names this species 'blackfish', though it is a different species from *Actinopyga*

**Table 1: Eighteen species of sea cucumber harvested in the Solomon Islands**

Scientific name	Common name
<b>High-value species</b>	
<i>Holothuria (Microthele) fuscogilva</i>	White teatfish (susufish)
<i>Holothuria (Metriatyla) scabra</i>	Sandfish
<i>Holothuria (M.) scabra var versicolor</i>	Sandfish
<i>Thelenota ananas</i>	Prickly redfish
<i>Stichopus chloronotus</i>	Greenfish
<i>Stichopus variegatus</i>	Curryfish
<b>Medium-value species</b>	
<i>Actinopyga lecanora</i>	Stonefish
<i>Actinopyga mauritiana</i>	Surf redfish
<i>Bohadschia graffei</i> *	Orangefish
<i>Holothuria (Microthele) nobilis</i>	Black teatfish
<i>Actinopyga miliaris</i>	Blackfish
<i>Bohadschia marmorata</i> *	Chalkfish
<i>Bohadschia argus</i>	Leopard fish
<b>Low-value species</b>	
<i>Bohadschia vitiensis</i>	Brown sandfish
<i>Thelenota anax</i>	Amberfish
<i>Actinopyga echinites</i>	Deep-surf fish
<i>Holothuria (Halodeima) atra</i>	Lollyfish
<i>Holothuria fuscopunctata</i>	Elephant's trunk fish
<i>Holothuria edulis</i> *	Pinkfish

\* Species that have only been fished since 1988

*miliaris*. 'Black stone' is the name given to black teatfish by Hong Kong importers, so to avoid further confusion the unknown species will be called stonefish (black) in this review.

In 1988, only 15 species of beche-de-mer were exploited. The seven new species now being caught are of low to medium value (Table 1). The Hong Kong importers are now accepting species of lower value because there is an increasing demand for them in Asian markets, especially since China has entered international trade. The classification of species into categories of high, medium and low

value is based on average price received from five Hong Kong importers (CIF) in 1993 (Table 2). Species of high value fetched more than US\$ 10 per kg, those of medium value between US\$5 and US \$10 and the low-value species were sold for less than US\$5 per kg.

The relative value of species has changed since the report by McElroy (1990). He recognised three species of high value; white teatfish, prickly redfish and black teatfish. The latter species has now slipped to tenth position (Table 2).

**Table 2: Average annual price of the 21 species of beche-de-mer exported from the Solomon Islands between 1988 and 1993 (prices are the average of those offered by five Hong Kong exporters)**

Common name	Grade	Number	1988	1989	1990	1991	1992	1993
Price (US\$/kg)								
<b>High value species</b>								
White teatfish	1	<5	12.9	13.0	22.9	22.9	25.3	25.3
	2	5 to 7	11.4	11.7	19.5	19.5	21.4	21.4
	3	8 to 10	9.6	8.2	10.6	14.3	14.3	14.3
Sandfish	1	<20	10.8	11.2	11.7	11.7	11.7	20.0
	2	21 to 40	6.8	8.1	8.6	8.6	8.6	12.0
	3	41 to 80	2.6	3.1	3.6	3.6	3.6	6.0
Prickly redfish		<10	7.5	7.5	10.6	11.9	13.6	13.9
Greenfish		<55	6	6	8.1	10.4	12.6	13
Stonefish (black)		20 to 120	3.4	4.2	6.8	7.6	9.1	11.7
Curryfish	1	<15	4.4	4.7	6.9	7.4	9.1	10.6
	2	15 to 30	3.8	4	6	8	10.1	11.7
<b>Medium value species</b>								
Stonefish		20 to 120	3.1	3.1	3.9	5.6	7.5	9.7
Surf redfish	1	20 to 30	3.8	4.3	6	6.9	8.4	9.1
	2	31 to 80	3.4	3.4	5.1	6.2	8.2	8.2
Orangefish	1	<100				5.2	7.5	9.1
	2	>100					7.1	7.1
Black teatfish	1	<10	8.3	8.3	8.3	8.8	9.1	8.4
	2	>10				2.9	5	8.4
Blackfish	1	<11	3.4	4.2	5.4	6.5	7.5	8.4
	2	>11	2.2	2.2	3.6	4.8	5.2	4.3
Chalkfish		<8			7.5	7.9	7.9	7.9
Leopardfish		<15	2.5	2.5	4	4.6	5.4	5.7
<b>Low value species</b>								
Brown sandfish	1	<18	1.9	1.9	2.5	4.4	4.8	4.7
	2	18 to 34	1.5	1.6	1.9	2.1	2.8	4.2
	3	35 to 80	1.1	1.1	1.9	2.1	2.8	4.2
	4	81 to 130	0.6	0.6	0.6	0.6	0.6	0.6
Amberfish		<8	2.3	2.7	2.7	3	4.3	4.3
Deep-surf redfish		<7	1.8	2.5	2.9	2.9	3.0	3.2
Hongpay fish		<45				3.0	3.0	3.2
Lollyfish	5"	<15	2.5	2.5	2.5	2.5	2.6	2.6
	3" to 5"	15 to 50	1.8	1.6	1.8	1.9	2.0	2.0
	2" to 3"	>51	0.8	0.9	1.0	1.2	1.3	1.3
Snakefish		<25				1.3	2.5	2.5
Elephant's trunkfish		<5	1.8	1.8	1.8	1.9	1.9	2.1
Pinkfish		<30				1.2	1.2	1.3

Apart from the fact that grades are based on the size of the animal and that Grade 1 brings the highest price, several other points emerging from Table 2 are:

- White teatfish and prickly redfish have consistently attracted a high price;
- Sandfish have almost doubled their value in the last two years;
- Grade 2 curryfish commanded a higher price than Grade 1 because the smaller animals do not fall apart as readily on boiling, thus rendering a higher quality product;
- Some species are not graded by size.

### Relative importance of the provinces

The species composition of beche-de-mer caught from each province does not differ greatly. How-

ever, there are large variations in total catch among provinces, due mainly to differences in the ability of the local free-divers, and the extent of suitable habitat. A summary of the nature of each province, and the relative importance of its beche-de-mer fishery, is set out below.

#### Western Province

More than 30 per cent of the Solomon Islands' land-mass and 21 per cent of its population is contained within this province. It consists of the New Georgia Islands, Choiseul and the Shortlands. Along with Malaita Province, the Western Province produces the majority of beche-de-mer in Solomon Islands. In recent years, at least 20 per cent of the beche-de-mer exported came from this region (Figure 1). In 1989, it yielded 58 per cent of total production. There are five large lagoons in the Western Province: Marovo; Roviana; Tetepare; Vella Lavella; Vonavona. All of the commercial species are caught in these lagoons.

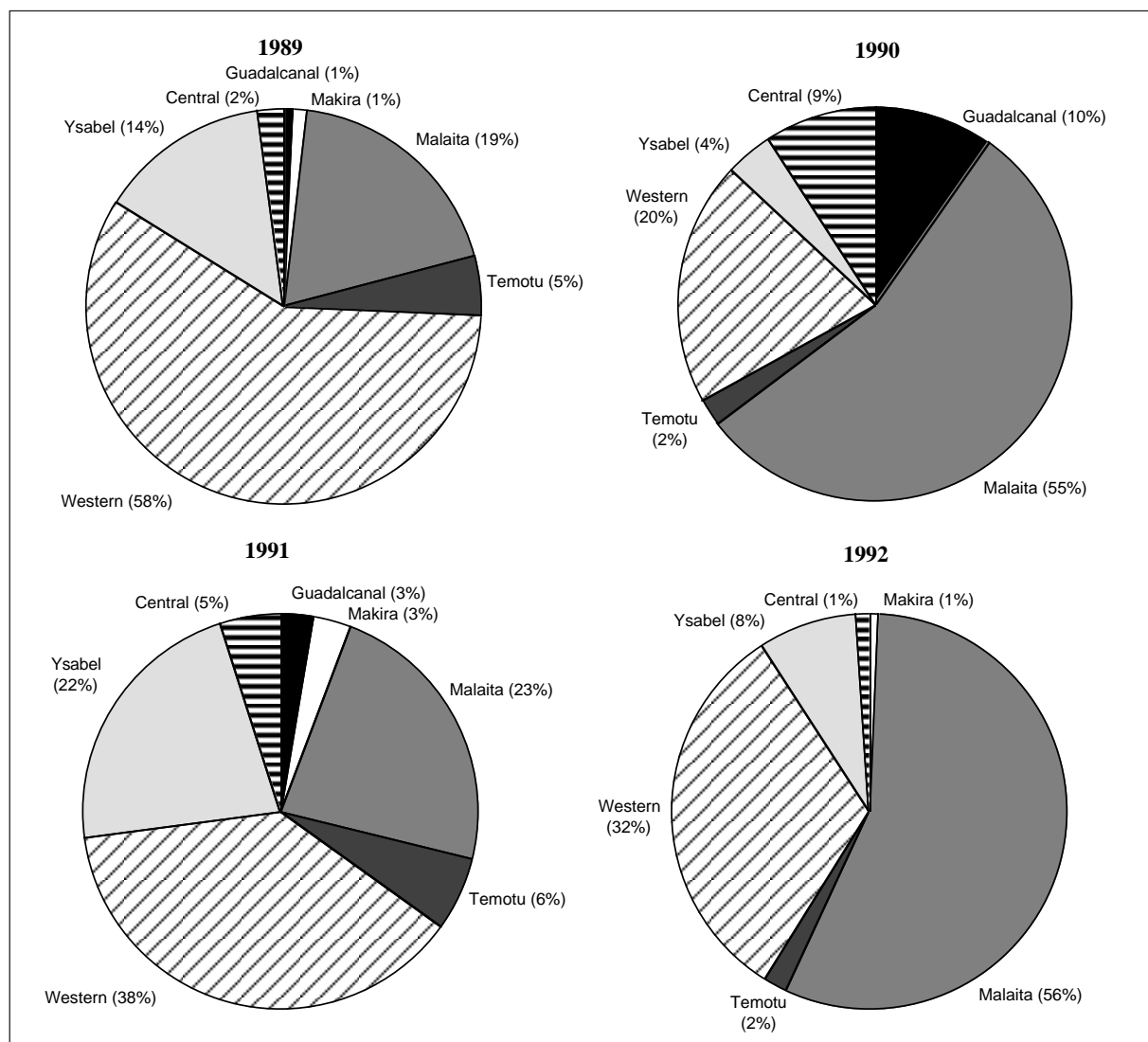


Figure 1: Percentage of beche-de-mer produced in each Province between 1989 and 1992

Other places, however, have a high abundance of a few species. For example, Choiseul produces a large amount of greenfish. Also, much of the white teatfish and brown sandfish come from Wagina where the fishermen use hookah to search for these species.

The Western Province is noted for its relatively high production of sandfish. This species prefers brackish water and is harvested mostly from the lagoons of Vonavona and Marovo, which receive a high run-off of freshwater.

Before the civil war in Bougainville, Papua New Guinea, production from the Western Province was enhanced by the catches of fishermen from the small islands around Bougainville. They would often trade beche-de-mer with people from the Shortlands and Choiseul. However, trade embargos imposed recently by the Papua New Guinea Government have decreased beche-de-mer trading, although the high value of the Kina still encourages some illegal transactions.

#### **Malaita Province**

The most important area for beche-de-mer in Malaita Province is Ontong Java, a large atoll lying 270 km north of the island of Ysabel. The atoll is 70 km long, 36 km wide and has two main islands, Luaniua and Pelau. Some features of this fishery have been reported previously by Crean (1977).

Ontong Java is still governed by chiefs, whose opinions and laws are respected. The chiefs allow beche-de-mer to be fished on 'even' years only. In these years, not all the species of beche-de-mer are fished. Usually the villagers concentrate on two species in particular. One of these is always white teatfish (called 'susufish' in Solomon Islands Pijin). The second species is chosen on the basis of its relative abundance. For example, greenfish were caught in 1990 and amberfish in 1992. The chiefs have acknowledged the need for management of the fishery and their system will persist whilst they hold power.

The people of Ontong Java were taught to process beche-de-mer by the Japanese prior to the Second World War (Crean, 1977). Most of the white teatfish processed is Grade A (1), because the animals have attained a larger size during the period when the fishery is closed; and the processing techniques are to a higher standard.

When the fishery at Ontong Java is open, the atoll produces the greatest quantities of white teatfish in the Solomons. The high catch can be attributed to

two factors. First, the Polynesians who inhabit the atoll can free-dive far deeper than most Melanesians. Second, the large lagoon within the atoll is an ideal habitat for white teatfish.

In the years when Ontong Java is closed, most of the catch from this province comes from north Malaita, especially Lau Lagoon, and Tasman Island. In the case of Tasman Island, which belongs to Papua New Guinea, beche-de-mer is traded for commodities with the people from Ontong Java. In the even years of 1990 and 1992, Malaita Province produced over half of the beche-de-mer in the Solomon Islands (Figure 1). In the years when the Ontong Java fishery was closed, the percentage of beche-de-mer produced fell to around 20 per cent (Figure 1).

#### **Ysabel Province**

Most of the beche-de-mer is purchased in the north region of Ysabel, around Kia. In this region, there are many sheltered islands with sandy lagoons. Ysabel Province is the third largest producer of beche-de-mer (Figure 1). Much of the total catch of brown sandfish comes from this area.

#### **Temotu Province**

This remote province lies at the south-eastern border of Solomon Islands (Figure 1). It consists of three groups of islands: Santa Cruz, a group of high, volcanic islands; the Reef Islands, with their coral terraces and atolls; and the extinct volcanoes of the Duff Islands and also Utupua, Vanikolo and Tikopia.

Much of the beche-de-mer purchased from Temotu Province is from Utupua and Vanikolo. The fishery started in 1988 due to improved communication with Honiara and the increased demand for beche-de-mer. The majority of beche-de-mer processed in the Temotu Province is leopardfish, followed by brown sandfish. Exports ranged between 2 per cent and 6 per cent of the national total between 1989 and 1992 (Figure 1).

#### **Central Province**

The Florida (Nggela) Islands, Russel Islands, Savo, Rennel and Bellona make up this province. Most of the beche-de-mer produced here comes from lagoon habitats around Nggela and Russel Islands, although Indispensable Reef, an isolated atoll to the south, is also fished. With the exception of 1990, less than 5 per cent of the beche-de-mer produced in the Solomons came from the Central Province (Figure 1).

### Guadalcanal Province

The north-east coast of Guadalcanal has alluvial plains with seagrass beds and shallow lagoons. The south coast has steep drop-offs and is largely inaccessible, due to bad anchorages and reefs. The majority of beche-de-mer is collected from the northern shore near Honiara. With the exception of 1990, when Guadalcanal produced 10 per cent of the beche-de-mer in Solomon Islands, catch has not exceeded 3 per cent and was negligible in 1992 (Figure 1).

### Makira Province

Between 1988 and 1992, production of beche-de-mer from Makira did not exceed 3 per cent of the national total (Figure 1). This is due to the steep volcanic nature of the islands, which provide limited habitat for beche-de-mer.

### Value of the fishery

Total exports of beche-de-mer from Solomon Islands increased from 17 t in 1982 to 622 t in 1991 (Figure 2). The increase in exports of beche-de-mer has been at the expense of other non-fish, which declined from 731 t in 1986 to 180 t in 1991 (Figure 2). By 1991, beche-de-mer comprised 78 per cent of all non-fish exports, and had a value of SIs\$ 7.6 million.

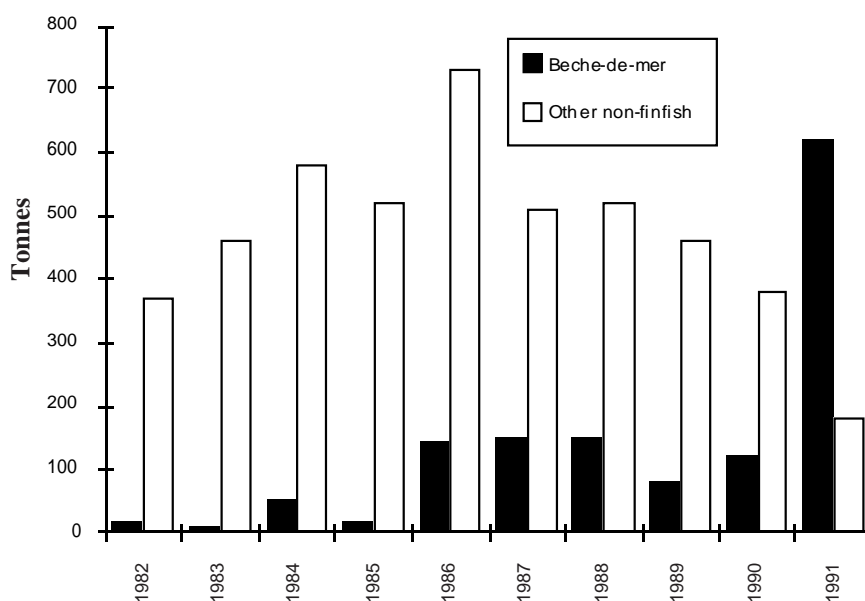
It is interesting to note that, despite the high value of beche-de-mer in 1991, it accounted for only 1.4 per cent of the total weight of fisheries products from the Solomon Islands in that year.

However, processed sea cucumbers average only 6.2 per cent of their initial weight (Preston, 1990). When the fresh weight of the beche-de-mer is calculated, the industry represented 20 per cent of all fisheries products in 1991.

The large increase in production of beche-de-mer between 1990 and 1991 can be attributed to four factors:

- There was a dramatic decrease in the catch of trochus (apparently due to the combined effects of overfishing and an increase in export duty). It fell from 92.4 per cent of the non-fish exports in 1990 to 14.1 per cent in 1991. This caused a switch in fishing effort to beche-de-mer;
- Increased fishing for beche-de-mer in remote areas, e.g. Temotu Province;
- Decline in copra prices, inducing villagers to fish for beche-de-mer;
- Establishment of new marine export companies in some provinces. e.g. at Gizo in the Western Province.

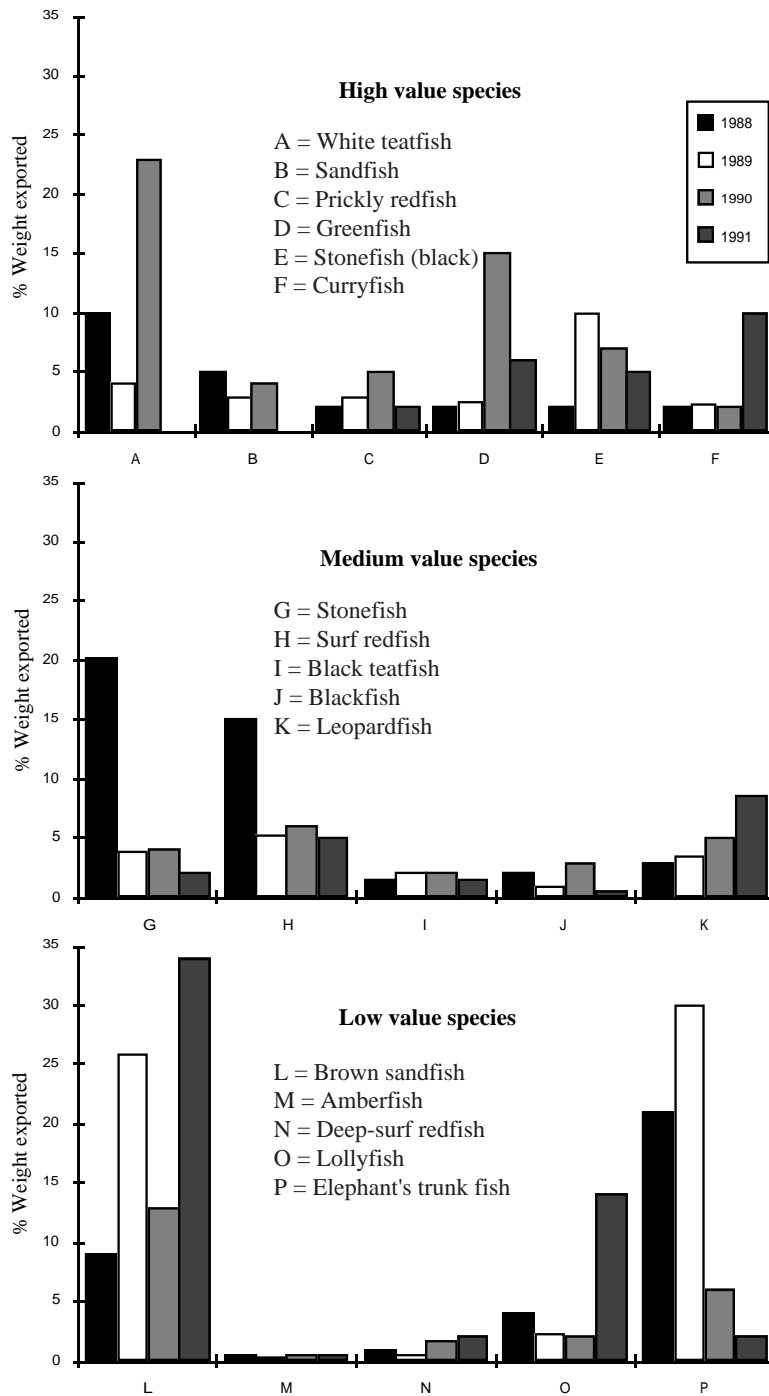
The price of beche-de-mer per kg from the Solomon Islands, in terms of SIs\$, has been increasing due to the depreciation of the SIs\$. However, the average price of beche-de-mer in terms of US\$ has changed little in the past decade. This is in contrast to the prices (US\$) of individual species, e.g. white teatfish and sandfish, which have increased (Table 2). This trend is due to the higher proportions of low-value species in the catch in recent years (see below).



**Figure 2: Importance of processed beche-de-mer and other non-fish exports from the Solomon Islands between 1982 and 1991**

Since 1988 the SI\$ price per kg has fluctuated substantially from month to month. This undoubtedly reflects changes in the proportions of high- and low-value species exported each month. For example, in 1990, the average price of beche-de-mer was significantly positively correlated with the percentage of white teatfish, greenfish and prickly redfish, in the exports of Sinking Enterprises (Spearman Rank Correlation Coefficient  $r_s = 0.63$ ,  $p < 0.5$ ,  $n = 9$ ).

There have been no apparent seasonal trends in the quantity of beche-de-mer exported, despite marked seasonality in the Hong Kong market (Van Eys & Philipson, 1989). However, with the exception of 1987 and 1989, exports were relatively high in November and/or December. This is because fishermen need to trade for money just prior to Christmas. Sea condition also dictates the collection of beche-de-mer. For example, exports between January and April 1990 were low following Cyclone Ofa in January of that year.



**Variation in catch among species and years**

In recent years, there have been large variations in catches of different species of beche-de-mer (Figure3). The species caught in the greatest quantities were brown sandfish and elephant's trunk fish. These were previously described as being of negligible commercial value (Anon. 1979). Other species that were considered non-commercial until recently are the leopardfish (called tigerfish by exporters) and curryfish, both of which were caught in relatively high quantities (8-10 per cent of total catch) in 1991. Other species that were harvested in relatively high quantities were white teatfish, greenfish, stonefish and surf redfish. The reason why brown sandfish has dominated exports from Solomon Islands since 1989 is that the fisheries in Marovo Lagoon and Temotu were opened in 1988. Kia and Vonavona Lagoon also yielded high quantities of brown sandfish.

Production of each species also varied greatly among years (Figure3). In many cases this variation did not represent annual variability in the abundance of the animals. I have already pointed out why the catch of white teatfish is higher in even years. It is also interesting to note that when the Ontong Java fishery is closed, catches of brown sandfish increased dramatically. Surf-redfish exports were high in 1988, probably because fewer species were of commercial value at that time (Table 2).

**Figure 3: Annual variation in exports of the principal species of beche-de-mer harvested in the Solomon Islands between 1988 and 1991**

The decrease in the highly valued sandfish after 1989 can also be attributed to factors other than natural variation in abundance, or over-fishing. The processing of this species to a high standard is complex (Anon, 1979) and a large proportion of the catch is rejected by exporters because of its poor quality. The difficulties in processing sandfish have led fishermen to collect other species, notably curryfish and lollyfish (Figure 3).

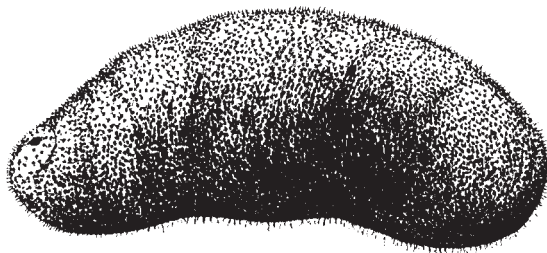
Recent data for 1992 reveal that beche-de-mer landings were in slight excess of 700 t (Fisheries Department statistics). However, in 1993 catches dropped substantially (although as yet no data are available) due to over-fishing which has led to a severe reduction of initial adult biomass. Additional income from logging royalties may have led to a decreased fishing effort for beche-de-mer, although this is speculative.

### Management of the fishery

There are two self-imposed restrictions on the catch of beche-de-mer in Solomon Islands. One is the situation at Ontong Java, described earlier. The other is in Makira. There, the local population has experienced fish poisoning. They believe that the decrease in stocks of sea cucumbers has induced this problem, and that the fish are now 'eating the poisons' on the reef that were once consumed by sea cucumbers. The people of Makira have placed a moratorium on beche-de-mer fishing in certain areas to replenish the stocks.

Official data for use in management of the beche-de-mer fishery in Solomon Islands are limited. At present, the Fisheries Division only requires exporters to record the area where the beche-de-mer is caught, and the quantity and value of the processed beche-de-mer purchased there. It also requests information on the destination, quantity and value of the exports. A breakdown of the species, and proportions of the different grades for each species, can currently only be obtained from the private records of the exporters.

Optimal management will depend on reliable data on distribution, age and growth, fishing mortality,



natural mortality, catch per unit of effort, fecundity and recruitment of each species. Because the fishery involves 22 species and is spread over a wide area, collection of such information is beyond the current resources of the Solomon Islands.

Official knowledge of the fishery could, however, be improved if the form used to record exports of beche-de-mer was modified to include data on the processed quantity of each grade for every species. Changes in the proportions of the grades and in the total quantity of the species could then be used to assess whether over-fishing is occurring.

Adams (1993) has recommended several measures for the management of beche-de-mer in the Solomon Islands (see *Beche-de-mer Information Bulletin #5*).

There are some other measures that could be introduced for the benefit of both the fishermen and the stocks of those species sold by grades. The first is a minimum size limit. As Grade 1 product fetches the best price, yield per recruit could be maximised by placing a minimum size limit corresponding to the size needed for Grade 1. If the size limit was above the length at first maturity, this would also contribute to the sustained production of propagules. Length at first maturity is already known for several species (Conand, 1981, 1990).

Fishermen may have difficulty following a size limit because many of them have no means of accurate measurement. One way this could be resolved for large species is only collecting animals that are at least as long as an adult fisherman's forearm. For smaller species, a common manufactured product could be used as a yardstick. For example, an animal should not be collected if it fits inside a 'Solomon Blue' tuna can. The exporters also have a role to play here. It is in their interest to sell Grade 1 product, therefore they could provide disincentives for harvesting lower grade animals.

The need for this type of management is not as crucial for white teatfish and brown sandfish as it is for some of the other species. More than 50 per cent of the white teatfish and brown sandfish exported in 1988 and 1991 was Grade 1. This was not the case for sandfish and lollyfish.

Curryfish, which fetches a higher price at a smaller size, could not be managed efficiently by a lower size limit. Its relatively high price, and the preference for smaller individuals, make it a possible candidate for aquaculture (see below).

The second way that management of the fishery could be improved is to upgrade the skills of processors through training. At present, a proportion of animals is rejected by purchasers due to decomposition caused by incomplete drying and improper storage.

Restricting collection to free-diving only, as recommended by Adams (1993), would limit the amount of time available to search for animals hidden away in the coral reef, and would prevent most fishing below 30m. This is a conservative method that should reduce recruitment over-fishing because up to half the stock of some species live at depths greater than 30m (Preston & Lokani, 1990).

### Stock enhancement

A promising method of sustaining and maximising the catch of beche-de-mer from tropical areas is the reseedling of habitats with juveniles reared in hatcheries. Techniques are being developed for the propagation of beche-de-mer in captivity in Japan, Guam and Hawaii (see *BDM Information Bulletin #4* and *#5*). The techniques focus mainly on larval rearing (R. Richmond, pers. comm.) and reproduction by fission (Harriot, 1982). If juveniles can be produced economically, they could be released onto reefs for subsequent harvest. This will be a major thrust of future research at ICLARM's Coastal Aquaculture Centre near Honiara.

The viability of this option cannot be assessed without further research. Important questions that need to be answered are:

- Which species would be most suitable for aquaculture?
- What is the best method for tagging juveniles? (so as to distinguish which animals were produced in hatcheries)?
- At what size and density should the juveniles be released?
- Where should the juveniles be liberated to maximise their survival and recapture?

This report has identified at least two species with high values and particular habitat preferences that should be suitable for enhancement. One is white teatfish, which are unlikely to disperse from lagoonal atolls, like Ontong Java, if seeded there. The other is sandfish, which should remain in lagoonal areas of high freshwater run-off. Curryfish is also a candidate for reseedling or farming because of its relatively high value and the fact that it should be ready to harvest in a relatively short time.

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