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BECHE-DE-MER

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NOTE FROM THE EDITOR

Since the last issue, new members have joined our Special Interest Group. They are welcome and invited to send comments, information and articles to the next bulletins which will be published now, we hope, twice a year. Thanks to those who have contributed to this issue.

The first section of this issue contains useful information on our main areas of interest, i.e. markets and fisheries, the biology and ecology of sea-cucumbers, and management. Several articles present recent data on world markets, marketing and local fisheries in the tropical Pacific and the Indian Ocean. According to world market statistics, beche-de-mer imports have peaked in 1988, but recent figures are needed to interpret the 1989 decline.

Within the Pacific region, fishery statistics present contrasting trends. In Papua New Guinea, production appears stable. In Solomon Islands, production first increased in 1986 when it passed 100 t; in 1991 it peaked at 662 t. The mean value per kg has not changed much since 1988. In Fiji, production has declined since 1989, but the mean value per kg for exported products has doubled since that time. The decline is probably related to the population decline described by Tim Adams in his article.

Most of the recent progress made on the biology and ecology of holothurians is presented in the section on publications. The reply by Lyle Vail to the request for information on spawning provides some interesting data. If you have made similar observations, please provide them, and we will publish them in the next issue.

Chantal Conand

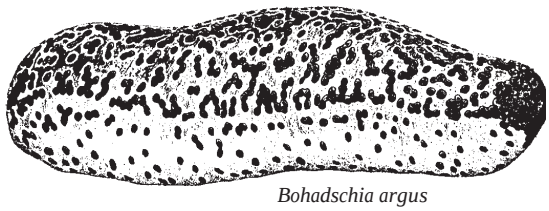
Inside this issue

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

B E C H E - D E - M E R

I N F O



Bohadschia argus

Marketing of beche-de-mer

by William S. Sommerville,
Asil Group Ltd,
Wellington, New Zealand

Despite the fact that I have been marketing beche-de-mer for a relatively short time I have been involved in marketing marine products to most Asian destinations for well over a decade.

I am happy to share my experiences with other members of this special interest group. I am not an expert and continue learning new things about this fascinating business every day.

The only people who consume beche-de-mer in any quantity are the Chinese, who, when it comes to trading, have at least a 4000-year head start on most of us. This is a factor we should bear in mind in all our dealings with the Chinese.

Successful commercial relationships with the Chinese are built up over many years through the development of mutual trust and respect. There are no short cuts to building up this level of trust and once you have achieved it then it is a very valuable asset.

I will cover the major factors as I see them under the various headings.

Quality

This is undoubtedly one of the major factors in dealing with any natural product and certainly very important with beche-de-mer. Within the quality guidelines it is very important to be consistent both within a parcel of product and more importantly from one shipment to the next.

This is crucial in gaining the buyers' confidence which, once achieved, could well have an effect on the prices and more importantly on the maintenance of regular business. It is recognised that it is difficult to maintain consistent quality when the beche-de-mer is sometimes being processed by many different people even within individual villages. Despite this fact the maintenance of consistent quality is a critical factor and short cuts should never be taken.

Pricing

The marketing of beche-de-mer is unusual in several respects. Generally the Chinese buyer will be purchasing a 'parcel' of beche-de-mer and rather than look too closely at individual prices he will be wanting to ensure that he makes his profit on the overall parcel. This may sometimes tend to distort individual prices in a particular parcel.

Prices are definitely affected by the main holiday season in the Chinese culture i.e. the Chinese Lunar New Year.

This generally occurs in the early part of February and it is really the Chinese equivalent of Christmas with regards to holidays and gift giving etc. Prices will often rise leading up to Chinese New Year and taper off afterwards.

Different factors affect pricing and we all would have noticed about 12 months ago when the white teatfish price plummeted from US$ 25 per kg down to about US$11 as the Hong Kong market was flooded by large quantities of Vietnamese white teatfish landing in Hong Kong at US$10 per kg. The markets overall certainly appear to be growing, with prices generally increasing even if somewhat slowly.

It should be remembered that virtually all beche-de-mer is consumed at restaurants rather than in the home and happily the Chinese tend to eat out a lot more than we do (in New Zealand anyway).

There is an enormous re-export trade in beche within the main Asian importers of Hong Kong, Singapore and Taiwan. An ever increasing percentage of total beche-de-mer trade ends up in the People's Republic of China (PRC) and while its economy, particularly, in Southern China, continues to grow at an alarming rate, then its consumption should rise accordingly. It has been said that generally China will not take any beche-de-mer over US$10 per kilo in value.

The re-export trade is strongest in Singapore and Hong Kong and it is often carried out through strong family connections back into Southern China which may involve barter trade, counter trade and often extending credit to the Mainland Chinese buyers. If for no other reasons than these this business is difficult and it may be inadvisable to seek direct sales to the PRC.

Taiwan is sometimes the recipient of re-exports but because import duties are still applicable into Taiwan re-export from there is unusual. Generally the Chinese buyer does not want the exporter's name and contact details on the outside of the bag. This tends to severely hinder his re-export activities. The varying value of the PRC currency (Renminbi) against the US$ also has an effect on prices.

Payment terms

While there will always be some flexibility, particularly between long term business partners, it is certainly accepted practice in Asia when they are selling something to insist on letter of credit payment terms.

For this reason even if for noother I certainly believe it is important to insist on letter of credit payment when selling to the Chinese. Letter of credit should be checked out by the bank to ensure that the exporter can comply with the terms and conditions.

Strategy

The beche-de-mer trade between Singapore, Hong Kong, China and Taiwan is close and generally even competitors within this trade have a working relationship. A Singapore buyer will buy a parcel and depending on the mix will keep some for this local market, re-exporting the rest to Hong Kong or China. It is to the producer's advantage to sell his beche-de-mer to one buyer 'all in' rather than have several small shipments. In order to build up a long-term relationship with your buyer it is better not to sell to more than one buyer in each market.

It is not unusual for a buyer to break even or take a loss on a particular parcel. He will have a strategic reason for this which could be to maintain faith with a supplier for the future or to ensure the parcel is not taken up by a competitor. It is also not unusual for a buyer to offer high prices for some species in an attempt to disrupt the market.

This usually happens with species in low supply or when a supplier is out of stock. He may buy at the inflated price, losing money just to get a foot in the door, but he will certainly be looking to recoup the loss in future business and will not keep losing money.

Sometimes fishermen find new species of beche-de-mer for which there is no ready market. It may be possible to create a market for the product which will have obvious benefit for the fishermen.

In order to do this work the fishermen and processing sectors need to be working closely with the marketing sector.

Close co-operation, trust and understanding are vital between the fishing, processing and marketing sectors to carry out this work successfully.

Values

While there are some outrageous values published from time to time, particularly in *INFOFISH*, there are many things that affect values, most of which have been covered above. As beche-de-mer business is becoming more active with new suppliers the prices are fluctuating more widely due to supply / demand factors. For these reasons it is difficult to give market prices as they would be taken quite wrongly as a firm guide. *[Editor's note: The opinion expressed in this article is that of the author and is not necessarily shared by the editor and the South Pacific Commission.]*

It is most important to realise that people at different stages of the marketing structure usually fail to account for the fact that everyone involved in the chain must make a profit. I have come across many examples where a fisherman will be upset when he sees that the market price (sometimes the retail price) for his fish is 100 or 200 per cent more than what he is being paid. The fact is that there are usually a number of people who have to be involved in the transaction between the fishermen and the end user to make the business happen.

These people incur all sorts of direct costs (processing, packing, freight, insurance, commissions, wastage, interest), indirect costs or overheads (power, transport, wages, fuel, travel, communications etc. etc.) before adding a profit margin for themselves. Often these people will make substantial investments in plant and equipment which must yield a satisfactory return or it just will not happen.

Herewith is a list of indicative grades and values covering a range of popular species traded regularly in the Pacific. These prices are shown in US$ per kg C+F main Asian Ports. Please remember that these must be considered along with the above

factors and certainly cannot be compared for example to beach prices being paid to fishermen. Prices do fluctuate.

AGL is involved in the beche-de-mer business in fishing processing and marketing and are happy to help prospective partners in all facets of the business and would welcome any enquiries to:

ASIL GROUP LTD
9th Floor, World Trade Centre
173 Victoria Street, Wellington
New Zealand
Phone: 64 4 3854 888;
Fax: 64 4 3854 728

List of indicative grades and values as at 1/5/93

Code	Species	Scientific name	Pcs/kg unless stated Grade	C+F per kg Asian ports US$
	Giant BDM (Amberfish)	*Thelenota anax*	One grade	2.65
A	Black teatfish	*Holothuria nobilis*	A = large	9.00
B	Black teatfish	*Holothuria nobilis*	B = small	6.00
	Blackfish	*Actinopyga miliaris*	One grade	7.50
A	Brown sandfish	*Bohadschia marmorata vitiensis*	A = 4.5" (+)	4.00
B	Brown sandfish	*Bohadschia marmorata vitiensis*	B = 4.5" (-)	2.50
	Curryfish	*Stichopus variegatus*	One grade	7.00
	Surf redfish	*Actinopyga mauritiana*	One grade	6.50
	Elephant trunkfish	*Holothuria fuscopunctata*	One grade	9.00
	Greenfish	*Stichopus chloronotus*	One grade	9.00
	Lollyfish	*Halodeima atra*	One grade	0.80
	Prickly redfish	*Thelenota ananas*	One grade	11.50
A	Sandfish	*Holothuria scabra*	A = 15-30	20.00
B	Sandfish	*Holothuria scabra*	B = 31-50	14.00
A	Stonefish	*Actinopyga lecanora*	A = 2" (+)	5.50
B	Stonefish	*Actinopyga lecanora*	B = 2" (-)	3.80
	Snakefish		One grade	0.60
	Leopard (tiger) fish	*Bohadschia argus*	One grade	4.50
A	White teatfish	*Holothuria fuscogilva*	A = 3-4	14.00
B	White teatfish	*Holothuria fuscogilva*	B = 5-7	10.00
C	White teatfish	*Holothuria fuscogilva*	C = 8-10	6.00
	Triangle fish		One grade	0.62
A	Golden sandfish		A = <15	25.00
B	Golden sandfish		B = 15-30	20.00
C	Golden sandfish		C = 30-50	14.00

Recent evolution of Hong Kong and Singapore sea cucumber markets

by Chantal Conand,
Laboratoire de biologie marine,
Université de la Réunion

The world beche-de-mer market has always been largely controlled by chinese traders. Historical data, from as far back as 1917, and the evolution up to 1986 have been presented previously (Conand, 1986, 1989).

The recent statistics are presented for the two main markets, Hong Kong and Singapore, which serve also as re-exporting centres.

Hong Kong market

It is by far the major centre. The available statistics for the last years were analysed and the results are recorded in Table 1a and 1b for imports and re-exports respectively. They relate to tonnage values in Hong Kong dollars and average value per kilogram. The number of countries of origin, or destination, with tonnage over 1 tonne, is given to illustrate the diversity of trading patterns and countries over 50 tonnes highlight the most important countries. For these, the statistics are expressed in terms of percentages of the annual tonnage and value.

Imports

The historical record for tonnage and value was in 1988, followed by a drop in 1989; nevertheless the mean price per kg is still increasing. Hong Kong imports come from ten main countries and islands, classed by decreasing importance in 1989: Indonesia, Singapore, Philippines, Fiji, China, Maldives, Solomon Islands, Papua New Guinea, Madagascar, New Caledonia. The mean value per kilogram is low for the products imported from Philippines and Indonesia, slightly higher for the Pacific Islands. Products coming from the Western Indian Ocean (Madagascar, Tanzania, Mozambique) fetch good prices but the highest are for the temperate Pacific countries.

Re-exports

These peaked in 1987 with nearly 5,000 t. During the last years, the average price has always been lower for re-exports. This is due to cheaper products destined for China, which still represents three quarter of the re-exports.

Table 1a: Hong Kong imports

Year	Tonnage T (t)	Value V (HK$)	Value v (HK$/kg)	Number of countries > 1 t	>50 t
1986	5,193	110,947,000	21.4	26	10
1987	5,896	131,820,000	22.4	28	19
1988	7,716	191,240,000	24.8	26	10
1989	4,526	134,306,000	29.7	25	9

Year	Main countries of origin											
	Philippines			Indonesia			Pacific Islands			Singapore		
	% T	% V	v	% T	% V	v	% T	% V	v	% T	% V	v
1986	30	19	13.5	47	31	13.8	6.7	11.3	36.1	6	11	39.7
1987	33	16	10.9	37	28	17.1	12.9	14.0	24.4	6	13	44.4
1988	22	13	14.2	40	31	19.0	18.4	19.4	26.0	10	14	33.5
1989	14	8	16.3	39	29	21.7	9.4	8.7	27.6	23	20	25.4

Table 1b: Hong Kong re-exports

Year	Tonnage T (t)	Value V (HK$)	Value v (HK$/kg)	Number of countries > 1 t	>50 t
1986	4,535	59,822,000	13.2	12	4
1987	4,975	55,479,000	11.2	13	3
1988	3,303	56,322,000	17.1	11	3
1989	1,847	46,723,000	25.3	11	4

Year	Main countries of origin											
	China			U.S.A			Taiwan			Singapore		
	% T	% V	v	% T	% V	v	% T	% V	v	% T	% V	v
1986	86	54	8.2	1	10	84.0	6	15.8	31.9	3	14	56.2
1987	87	52	6.7	1	8	96.9	8	19.8	26.6	2	13	71.5
1988	79	45	9.6	1	9	119.5				4	14	66.3
1989	74	46	15.7	3	15	60.6				3	7	60.6

Singapore market

This is the second market for imports and re-exports, but the local retail market is also very important. The available statistics for the last years are analysed and the results are recorded in Table 2a for imports and Table 2b for re-exports. As noted by Van Eys and Philipson (1991), the import statistics are 'in a sense unreliable' as beche-de-mer does not carry import duty; it is not always specifically mentioned in shipments of dried seafoods. This explains why, in 1986, the re-exports exceeded the imports. Yet for the last years, the figures seem more accurate.

Domestic consumption is estimated from the difference between imports and re-exports, as there is no local production; it has increased from 22 t in 1987 to 69 t in 1988 and to 85 t in 1989, but appears to be reducing, with 42 t in 1990.

Compared with Hong Kong, there has been only a slight, more or less regular, increase in the tonnages imported, which as for Hong Kong peaked in 1988. On the whole, for the recent period, Hong Kong represents six times more than Singapore.

Nowadays the major suppliers are the Maldives, the Pacific Islands, Tanzania and Malaysia. Up until a few years ago, the main exporters were Sri Lanka, India and the Philippines.

Re-export destinations have also changed. More than half of the re-export tonnages are now destined for Hong Kong. Based on the mean values per kg, high grade beche-de-mer goes preferentially to Taiwan and low grade to Malaysia.

Table 2a: Singapore imports

Year	Tonnage T (t)	Value V (S$)	Value v (S$/kg)	Number of countries > 1 t	>50 t
1986	814	9,599,000	11.8	18	8
1987	840	9,251,000	11.0	18	6
1988	1,225	14,614,000	11.9	22	7
1989	1,023	11,863,000	11.4	18	6
1990	1,068	12,321,000	11.5	18	7

Year	Main countries of origin											
	Malaysia			Tanzania			Pacific Islands			Maldives		
	% T	% V	v	% T	% V	v	% T	% V	v	% T	% V	v
1986	17	10	6.7	14	6	5.1	23	24	12.1	0.4	0.5	15.6
1987	17	12	7.8	24	12	5.5	16	17	11.3	2.0	3.0	15.5
1988	8	4	5.9	21	15	8.6	14	12	10.0	28.0	34.0	14.5
1989	7	3	5.1	16	11	7.8	23	17	14.4	25.0	22.0	10.8
1990	6	3	5.3	10	5	6.8	15	17	13.4	29.0	25.0	9.9

Table 2b: Singapore re-exports

Year	Tonnage T (t)	Value V (S$)	Value v (S$/kg)	Number of countries > 1 t	>50 t
1986	1,217	6,683,000	5.5	6	3
1987	818	7,395,000	9.0	7	3
1988	1,156	11,232,000	9.7	6	3
1989	938	10,043,000	10.7	7	3
1990	1,026	11,022,000	10.7	9	3

Year	Main countries of origin								
	Hong Kong			Malaysia			Taiwan		
	% T	% V	v	% T	% V	v	% T	% V	v
1986	54	47	4.8	35	33	5.1	9.0	16.0	9.4
1987	47	55	10.5	36	27	6.8	14.0	13.0	8.6
1988	54	62	11.1	34	20	5.8	7.0	13.0	16.0
1989	46	46	10.6	27	14	5.7	16.0	29.0	18.5
1990	63	56	9.6	15	9	6.7	12.0	21.0	18.9

Trade between Hong Kong and Singapore

Trade between Hong Kong and Singapore obtained from their respective import and re-export statistics is presented in Table 3.

If there was good correspondence between the statistics, imports from Singapore (1) should be equal to re-exports to Hong Kong (4) and imports from Hong Kong (3) should be equal to re-exports to Singapore (2).

This is not the case and on the whole Hong Kong values are higher than those of Singapore. The general tendency is a flux from Singapore to Hong Kong which is just the opposite to the flux which existed between 1981 and 1984. The exchange is made through sister companies, with higher grades imported in Singapore and lower grades in Hong Kong, probably in relation with the China market.

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Table 3: Bêche-de-mer exchanges between Hong Kong and Singapore (T = tonnage; V = value in local currency; v = mean value per kg)

				1986	1987	1988	1989	1990
HONG KONG	1	Imports from Singapore	T	301	399	798	1,068	
			V	11,938,000	17,719,000	26,710,000	27,138,000	
			v	39.7	44.4	33.5	25.4	
	2	Re-exports to Singapore	T	152	103	123	55	
			V	8,551,000	7,364,000	8,157,000	3,334,000	
			v	56.2	71.5	66.3	60.6	
SINGAPORE	3	Imports from Hong Kong	T	84	30	48	18	47
			V	1,744	542,000	847,000	301,000	1,060,000
			v	20.8	18.1	17.6	16.7	22.6
	4	Re-exports to Hong Kong	T	656	386	631	439	651
			V	3,157	4,068,000	6,977,000	4,660,000	6,221,000
			v	4.8	10.5	11.1	10.6	

Beche-de-mer harvesting in the Northern Province of New Caledonia

Source: Northern Province Fisheries Division Kone, New Caledonia

Forty-eight species of holothurians have been recorded in the lagoon around New Caledonia. At present, four of these are being harvested for the food market: blackfish, sandfish, teatfish and lollyfish. According to figures supplied by the four main exporters, total 1991 production was over 100 tonnes dry weight, 95 per cent of which came from the Northern Province.

Blackfish, found mainly in the northern lagoon, accounted for 68 per cent of the total. In second place came sandfish, with 28 per cent of the total catch. This species occurs primarily in the western lagoon.

Beche-de-mer is purchased unprocessed from fishermen by local groups and fishing concerns

(Népoui, Poum, Arama, Pouébo) which do all the preparation work (gutting, boiling, drying). Prices are 20 to 30 CFP francs per kilo for blackfish and 40 CFP francs per kilo for sandfish. The weight loss during processing varies from species to species. On average, 100 kg of fresh fish are required to obtain 8–9 kg of dried beche-de-mer.

These are the highest tonnages for any product from an artisanal fishery anywhere in the Territory.

After drying, the beche-de-mer, also known as trepang, is sold to exporters for between 400 and 500 CFP per kg for blackfish and between 1,000 and 1,500CFP francs per kg for sandfish.

No estimate of potential harvest has yet been made and fishermen are now asking themselves questions about resource management, since scarcity problems have begun to emerge.

Harvesting seasons are already being applied by the people of Arama (during the crab season – April to January – bêche-de-mer fishing is suspended), while a size limit is imposed by the fishermen of Népoui, Poum and Pouébo.

Distribution of 1991 beche-de-mer production by species and by area (gross weight in kg)

	Blackfish	Sandfish	Teatfish	Lollyfish
North	826,152	516	57,024	1,140
West	166,632	392,160	0	0
East	0	0	0	0
Total	992,784	392,676	57,024	1,140

Total production (kg) **1,443,624**
Value at first sale (CFP francs) **43,308,720** (100 CFP francs ≈ US$ 1.00)

Evolution of New Caledonian beche-de-mer exports from 1987 to 1991 (net weight in kg) by exporters and by countries (according to Customs Service statistics)

Year / Exporters	1987	1988	1989	1990	1991
A	71,300	63,650	32,114	89,660	60,956
B	16,584	36,000	10,000	12,445	19,329
C	10,605	36,157	12,740	200	
D				24,293	29,685
E					3,625
F	3,100				
G				2,766	
H					100
I					
Total	101,589	135,807	54,854	129,364	113,695

Year / Countries	1987	1988	1989	1990	1991
Hong Kong	46,684	125,876	54,754	122,678	109,970
Singapore	27,405	9,731		2,766	
U.S.A	19,500				
Taiwan	8,000			3,720	3,625
Japan			100	200	100
Total	101,589	135,607	54,854	129,364	113,695

Statistics on beche-de-mer production

Compiled by J.P. Gaudechoux,
South Pacific Commission
Noumea, New Caledonia

We have collected statistics from various sources and countries. Figures are presented for the following countries: Fiji, Solomon Islands and Papua New Guinea.

We hope to be able to present a regular statistical column in this bulletin in the future.

Fiji

Local beche-de-mer production 1987–1992 (weight in metric tonnes; value in Fijian dollars)

Year	Weight (mt)	Value (F$)
1987	640.39	2,233,460
1988	717.41	2,852,270
1989	365.17	1,890,820
1990	323.33	3,048,860
1991	319.40	3,428,910
1992	402.76	4,972,000

Source: Fiji Fisheries Division Annual Report, Ministry of Primary Industries, Suva

Note: As much as 350 t of BDM per year is known to have been exported from Fiji as 'Miscellaneous molluscs', and these figures are not included here.

Papua New Guinea

Beche-de-mer exports from Papua New Guinea (1991 – first quarter 1993)

	Month	Quantity (kg)	Value (K)
1991	January	83,569.50	412,632.86
	February	20,158.00	176,657.59
	March	58,303.00	348,457.00
	April	30,923.00	256,185.00
	May	54,716.00	311,852.00
	June	23,928.50	225,183.63
	July	37,129.00	357,329.67
	August	66,826.50	547,518.79
	September	71,496.50	571,528.79
	October	68,319.00	627,149.20
	November	54,094.00	294,325.74
	December	56,584.50	508,987.16
	Total	626,047.50	4,637,807.43

	Month	Quantity (kg)	Value (K)
1992	January	51,873.00	396,276.65
	February	41,400.00	383,329.73
	March	35,900.00	317,904.15
	April	32,290.00	287,107.00
	May	52,064.00	404,425.40
	June	45,731.60	347,321.30
	July	50,889.00	420,727.50
	August	18,931.60	185,132.14
	September	48,287.50	399,556.55
	October	64,394.00	506,718.96
	November	48,556.50	434,576.00
	December	55,514.70	423,254.26
	Total	545,831.90	4,506,329.64

	Month	Quantity (kg)	Value (K)
1993	January	35,279.50	215,473.40
	February	38,849.00	217,081.32
	March	35,743.00	175,788.45
	Total	109,871.50	608,343.17

Note: Government revenue is 5 per cent of the total value (1 PNG Kina ≈ 1 US$).

Source: Department of Fisheries and Marine Resources, Konedobu, PNG

Solomon Islands

Beche-de-mer exports Solomon Islands (1983–1991)

Year	Weight (t)	Value (SI$)
1983	9.26	51,755
1984	44.29	251,872
1985	13.62	74,880
1986	134.18	733,793
1987	146.38	839,533
1988	146.86	1,469,117
1989	87.10	721,236
1990	118.90	1,880,957
1991	622.38	7,631,952

Local purchase of beche-de-mer by Province (1988–1991)

Province	1988		1989		1990		1991	
	Weight (kg)	Value (SI$)	Weight (kg)	Value (SI$)	Weight (kg)	Value (SI$)	Weight (kg)	Value (SI$)
Unknown			5,276.40	50,563.65	35.30	249.00		
Guadalcanal			281.80	3,105.90	12,630.15	92,321.89		
Malaita	569.21	6,734.97	7,762.90	46,513.62	68,513.40	819,485.09		
Temotu			1,957.50	4,647.39	2,767.90	17,303.11	11,732.80	58,378.38
Western			23,500.64	90,647.27	25,136.80	355,889.60		
Isabel			5,534.50	24,484.47	11,609.85	64,445.24	149.50	702.55
Central			999.10	2,855.09	12,630.15	92,321.89		
Makira			498.60	2,241.89	243.20	1,407.60		

Note: The local purchase figures have been taken under the Solomon Islands licensing system which requires local exporting companies to provide all data related to their trade in marine resources. This data collection system was first implemented in 1988; the coverage of local buyers for 1989 and 1990 is incomplete (30 per cent and 77 per cent respectively)

Source: Fisheries Division, Ministry of Natural Resources, Honiara, Solomon Islands

Sea cucumbers

by Walter G. Meyer
(Excerpt from an article published in* Baja Explorer, *Sept–Oct 1992)

They are disgusting to look at before they're cooked, and even less appetising after boiling. The smell of them cooking would make anyone lose an appetite, and the polite name *sea cucumber* conceals the fact they are more closely related to sea slugs than to any garden vegetable.

But, in the quest to get more food from the sea, the little creatures are fetching top dollars in the Far East (US$20,000 a ton in Japan) and are becoming a delicacy elsewhere (US$17 a serving at restaurants in British Columbia). The demand to harvest more is putting political, social and economic pressure on the Mexican Government to increase its export of what it calls 'pepinos del mar.'

The species endemic to the Sea of Cortez, *Isostichopus fuscus*, is much more sought after than its Pacific Ocean counterpart, and in fact accounted for 80 per cent of the sea cucumbers exported last year.

Although it is legal to take sea cucumbers for personal consumption, commercial diving for the animals requires a permit. After four years of commercial exploitation, the Mexican government has begun a study of the *fuscus* population in the Sea of

Cortez to determine how many tons can be taken each year and still leave enough to support a self-sustaining population.

While Lily Romina Salgado Castro of PESCA, the Mexican Department of Fisheries, continues her count and finds far fewer cucumbers than she expected, the government continues to issue permits.

Not much is known about the slow-growing animals which may live 25 years. Salgado advises, 'We should stop any (commercial) diving activity until we know exactly how many we have, what size, and at what age the juveniles become adults.'

Although diving for the cucumbers is dangerous for both Salgado and those who do it for money, the market value of the strange little species makes it worth the risk. The competition for permits is growing as is the price for the small brown slug. Salgado worries that the cucumber may be fished to less than commercial numbers before her study is even complete.

Recent publications on beche-de-mer fisheries

by Dr Tim Adams,
South Pacific Commission,
Noumea, New Caledonia

Review of the beche-de-mer (sea cucumber) fishery in the Maldives, by Leslie Joseph, Programme Officer, Bay of Bengal Programme (April 1992), 34pp. Document number BOBP/WP/79 of the Bay of Bengal Programme, 91 St.Mary's Road, Abhiramapuram (Post Bag No.1054), Madras 600 018, India, Fax: 044-436102.

This is a brief, but comprehensive review of the beche-de-mer fishery in the Maldives – the extensive island chain to the southwest of Sri Lanka in the Indian Ocean. The species exploited, and the recent rapid rise of the fishery, will sound familiar to South Pacific readers.

The description of the gradual shift from high-value to low-value species since the fishery started in 1986, and the worries that are expressed about economic losses due to poor-quality processing gave me, at least, a strong sense of *déjà-vu*.

As well as a description of the fishery, including export figures, prices, descriptions of processing, a brief economic analysis, examples of catch rates, length frequency histograms, and social consequences, there is a seven-page annex describing the nine major exploited species, with colour photographs of each, either processed or as they appear fresh out of the water.

It may be useful to reproduce the review's recommendations in full:

Recommendations

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

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

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

*(b) The collection of beche-de-mer using scuba diving should be banned. This will take the pressure off the spawning stocks of the valuable species **T.ananas** and **M. nobilis** (white teatfish) inhabiting deeper waters.*

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

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

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

(e) A data collection and monitoring mechanism should be established for the fishery. It should be possible to collect some basic data on the fishery without too much effort. For instance, the Island Chiefs, or the Government officials responsible for

fisheries matters on the islands, could periodically gather data on the number of fishermen or craft involved in the beche-de-mer fishery. If a system is introduced requiring exporters to keep records of quantities and varieties of beche-de-mer obtained from different islands, these data, together with the fishing effort from the islands, would serve to establish prevailing trends in the fishery in the different islands/atolls so that the requisite management strategies could be developed. Since the resource is very vulnerable to exploitation and highly sensitive to over-exploitation, the need for a monitoring mechanism cannot be over emphasised.

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

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

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

740 tonnes of processed beche-de-mer were exported from the Maldives in 1990, the latest year included in this report: an amount that has escalated rapidly from the 3 tonnes exported at the start of the fishery in 1986. It would be very interesting to have some information on the progress of the fishery through 1991 and 1992, and on the effects of implementing the recommendations outlined above.

All in all, this is a very competent case-study cum resource-profile, and recommended reading for anyone who has to consider the management of a tropical bêche-de-mer fishery.

Evidence for a marked decline of beche-de-mer populations in the Suva and Beqa areas of Fiji, and a preliminary description of a method of identifying beche-de-mer individuals based on characteristic body wrinkles, by Brian Stewart, University of Otago, New Zealand (1993), 20pp. University of the South Pacific Marine Studies Technical Report No.1/93. ISSN 1018-2896.

This report describes part of the research work that Brian Stewart performed in Fiji in February and March 1992 towards his Masters degree.

The transect surveys in the Suva area are particularly interesting because they can be related to the only previous baseline available for Fijian beche-de-mer: the work of Mark Gentle around Suva in 1979 and 1980.

Brian extends the observations to other species, and to Beqa Island, and provides a useful new benchmark for monitoring the state of the resource in the Suva area. It is notable (but not entirely unexpected) that the catch rate for *Holothuria scabra* (sandfish) appears to be less than 20 per cent of that reported in 1979, although in 1979 sandfish (Fijian: *dairo*) was already fairly well exploited around the Suva area for subsistence consumption.

Some length-weight (fresh and processed) body measurements and gonad weights are provided for *H.scabra* , and the potential utility of photographic records of wrinkle patterns for identifying holothurian individuals is pointed out.

Regional Sea Cucumber Meeting

by Dr Tim Adams,
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Noumea, New Caledonia

From 3 to 5 March 1993, regional fisheries officers, biologists and an economist met at the University of Guam Marine Laboratory to discuss aspects of sea cucumber biology, ecology, fisheries, and economics to determine the possibilities for developing a regional approach to sea cucumber resource utilisation and management.

The meeting was funded by the National Marine Fisheries Service (NMFS) under the Saltonstall-Kennedy (S-K) programme, and was sponsored by the University of Guam.

Participants included representatives from NMFS, the South Pacific Commission, and the marine resources divisions of Guam, Kosrae, Palau, Pohnpei, Chuuk and the national office of the Federated States of Micronesia.

Data from a five-year study on the reproductive biology and larval ecology of commercial valuable sea cucumbers were discussed along with several different fishery models and economic analyses for the sustainable development of sea cucumbers fisheries.

SPC Senior Inshore Fisheries Scientist, Dr Tim Adams, pulls the following notes on the meeting from his trip report (Note that the term *beche-de-mer* is not common parlance in Micronesia, where *sea-cucumber* refers to the animal and *trepang* is often used for the dried product):

☞Paul Callahan's (University of Guam College of Business & Public Administration) presentation focused on some economic and trade issues for sea-cucumber, particularly as they affect the small-scale fisherman.

One interesting example here was an analysis of the profitability of sea-cucumber fishing to the average harvester, taking all factors into account including the opportunity cost of processing. Since the price structure of the beche-de-mer export trade is strongly stratified by size (bigger specimens having a much higher price per kilogramme than smaller specimens), it was shown that there can be a strong economic justification for minimum size-limits, in addition to the biological justification of trying to prevent growth-overfishing.

The economic analysis shows that fishermen will often actually lose money by collecting small sea-cucumbers, because the unit price is low whilst the cost of collection and processing is still the same.

However, since the vast majority of village fishermen measure profit by the amount of cash that goes into their pocket, they will continue to collect small ones without appreciating that they would be better off, in total, by working half as hard and processing only the big ones. There are complications of course, but this is a potent political argument for the introduction of sea-cucumber fishery management practices. It provides a short-term economic justification in addition to the long-term one of trying to flatten out the boom–bust cycle and thus encourage more permanent investment.

☞The University of Guam (UOG) Marine Lab has concentrated mainly on the biology of surf redfish (*Actinopyga mauritiana*), black teatfish (*Microthele nobilis*) and prickly redfish (*Thelenota ananas*), and these are the commoner economically important species in the fairly high-energy coastal environment of Guam. Sea cucumber larvae are planktotrophic.

The larvae hatch with minimal food reserves, and spend a long time floating around in the plankton, metamorphosing through numerous stages before settlement. Sea cucumber larvae may drift for considerable distances before settlement, and the finding that a temperature increase can trigger settlement is probably a signal to the maturing larvae that they have drifted into a lagoonal or coastal area. Considerable progress has been made in elucidating the breeding biology of these species.

The discovery of a germinal vesicle around the eggs of the prickly redfish means that artificially propagating this species is presently a high-technology option, but surf redfish and black teatfish are more straightforward and often spawn in response to the simple stress of collection. Work remains to be done on developing a reliable feeding regime for sea-cucumber larvae, right through the planktonic part of the life-cycle to settlement, but UOG reckons that this is only a matter of time.

☞Sea cucumbers, like many other marine invertebrates, coral polyps and giant clams included, appear to spawn in synchrony in response to pheromones released into the water column. Success in fertilisation would thus appear to be dependent on the density of the population (and the quality of the water?), but sea cucumbers do at least have the option of 'getting together' denied to the more sedentary invertebrates.

Although the reliable artificial production of settled seed of these species has not yet been accomplished, bucket-culture of tropical sea-cucumber larvae is already feasible. Whilst there is no present way of knowing whether the release of sea-cucumber larvae artificially into the ocean would have any noticeable effect on recruitment, the possibility of mitigating the constraints of density-dependent fertilisation on a depleted species is interesting.

☞Sea cucumbers are an item of local diet across all of Micronesia. The meeting didn't get down to the level of the individual species used, and these apparently vary. In Palau, several *Stichopus* and *Actinopyga* species are consumed fresh, and the intestines of some of these are a delicacy.

☞Nobody has apparently investigated the broader (or ecological) effects of sea-cucumber overharvesting. Several studies have shown that sea-cucumbers have an important *bioturbation* role: in turning over the lagoon floor, returning nutrients (and pollutants) to the surface, and oxygenating the upper layers of sediment, but the significance of this to the total productivity of the lagoon is not well understood. It is not known whether the diet of sea-cucumbers would include *Gambierdiscus toxicus*.

☞The search for a satisfactory method of identifying individual sea-cucumbers still continues. Paul Lokani's experiments with internal tags have been described in a previous issue of this bulletin, and Brian Stewart's photographic logs of the unique wrinkle patterns of certain species provide another possibility (although perhaps without the *cachet* of photo-identification of the larger cetaceans).

At UOG they have had some success with 'scar-tagging', particularly of surf redfish (although such marks were found to disappear from teatfish and sandfish within a couple of weeks in Fiji). Observation of marked animals in Guam suggests that sea cucumbers tend to stay around the same area, although they will tend to aggregate and become very visible at spawning time, and may seem to disappear completely around the occasion of a cyclone. If the animals are local in their wanderings, it may provide some encouragement to continued experimentation on ranching.

☞Several small holothurians are now apparently targeted for the aquarium trade. Since many holothurians are toxic to some extent (the red, saponin-containing fluid that is released by *Holothuria atra* being the best-known example, but similar toxins are contained in the skin of several species, and in the Cuvierian tubules of the genus *Bohadschia*), this may lead to some interesting domestic species interactions.

The huge species diversity of holothurians, particularly towards the western side of the Pacific, is also likely to be attractive to bio-prospectors looking for pharmacologically useful molecules. The fissioning ability of certain species is of interest to researchers studying the processes regulating cell-division and ageing, and the non-reactive nature of certain holothurian proteins to the human immune system has already provided a role for certain sea-urchin spines in human bone-grafts. Pacific island sea-cucumber fishery management may need to take much more into account than simply *trepang*.

These observations are drawn pretty much at random from my incidental notes on the discussion, and do not reflect the full content of this interesting and broad-ranging meeting, whose main focus was to consider the practical possibilities of both developing and sub-regionally managing a sea-cucumber fishery in Micronesia.

Further information can be obtained from Dr Bob Richmond, at the address given below, and I believe that a full report of the meeting is being prepared, outlining the consensus perception of a co-ordinated Micronesian sub-regional sea-cucumber fishery.

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Management of beche-de-mer (sea cucumber) Fisheries

by Dr Tim Adams, South Pacific Commission, Noumea, New Caledonia

The recommendations on the management of the Maldives bêche-de-mer described on pp. 11–12 above could be applied, in large part, to just about any tropical insular beche-de-mer fishery.

We have decided to publish in this bulletin recommendations that have been made about the management of South Pacific bêche-de-mer fisheries. Whilst some of these recommendations may appear obscure outside the context of their covering documents (apologies to those authors whose work may be thus distorted), it is likely that some consensus recommendations may emerge, of value as general principles applicable in different situations.

FIJI

Fiji Fisheries Division recommendations on regulating exploitation in the beche-de-mer fishery, made before the start of the Fiji beche-de-mer boom (i.e. when the Government was actively trying to develop the resource), were approved by Cabinet in 1984 and the resulting Bêche-de-mer Exploitation Guidelines were published in *Fishery resource profiles: information for development planning*, edited (and mainly written) by A.D. Lewis (1985), Fisheries Division, Ministry of Primary Industries, Fiji, as follows:

> *(1) Harvesting and processing of product to be restricted to Fiji nationals;*
>
> *(2) No size limits are necessary as prices vary with size and small individuals are neither collected nor are they commonly seen;*
>
> *(3) The use of SCUBA gear for the collection of beche-de-mer is forbidden.*

Following a 10- to 20-fold increase in exploitation by 1988 the second of these guidelines was reversed by the Fisheries (Amendment) Regulations, 1988. Amongst other things, these inserted a new regulation 25A to enact a 3-inch minimum size limit on all beche-de-mer exported (whether processed or not), and to ban the export of *Holothuria scabra* (sandfish, *dairo*) (*Fiji Republic Gazette Supplement*, 16 December 1988).

This was designed to put a sharp brake on the industry in an attempt to mitigate almost certain over-exploitation, although it was not clear if the subsequent halving of the export volume was a direct result of the size limit, of overfishing already accomplished, or of a reduction in fishing effort (there had been a marked upsurge in exploitation of all sedentary marine resources for export in 1988, due to the number of people thrown onto the subsistence sector after the 1987 coups, but the economy started to recover in 1989). The protection for *H. scabra* reflected the importance of this species as a local and emergency item of diet.

Note that the Minister for Primary Industries had the power to waive the requirements of Regulation 25A and to permit the export of sandfish under specified conditions. In practice, such permission was only given at the explicit request of the customary fishing rights owners for *dairo* originating from certain areas, and only exporters who could demonstrate the ability to produce a good quality sandfish product were to be permitted.

After a resource survey, concentrating on blackfish (*Actinopyga miliaris* and relatives) in Vanua Levu, the SPC Inshore Fisheries Research Project made the following recommendations to the Fiji Government early in 1989 (in *Exploitation of the sea cucumber* Actinopyga miliaris *(blackfish,* driloli*) in Northern Fiji* by G.L. Preston, V. Vakamoce, P. Lokani and F. Viala (1989). Unpublished report of the SPC IFRP to the Government of Fiji):

> *1. The least favoured management technique is to allow harvesting to go uncontrolled until such time as it ceases either because the resource is depleted or market conditions make harvesting uneconomic.* [Editor's note: the simplest alternative to this 'default' method of management is the periodic moratorium, as is practised on a one-year-on / one-year-off basis at Ontong Java in the Solomon Islands (mainly fishing *Microthele*), or apparently on a two-year rotating basis in Yemen for *H. scabra*]

2. The main objective of management of this fishery should be to ensure that the stock does not crash because of recruitment failure. To this end a temporary but very strict mechanism of control needs to be imposed to prevent growth overfishing. The blanket size limit on all beche-de-mer species imposed by the Fiji Government may well achieve this.

3. Steps should be taken to ensure that harvesting and processing of beche-de-mer continues to be carried out largely on a small scale basis by village processors. The trend towards large scale operators and centralised processing facilities should be discouraged. These steps would maximise returns to coastal villages and help avoid localised resource depletion.

4. Once biological information on recruitment becomes available a move away from size limits and towards the establishment of catch quotas would be preferable. The imposition of quotas would tend to encourage the selective harvesting of the larger and more valuable animals. For a quota system to work properly, however, there needs to be in place some means of gathering data on the catch being taken and some legal means of enforcing this quota. To this end the Fiji Government should introduce legislation which makes the acquisition of an export licence mandatory for all beche-de-mer exporters. [Editor's note: Legislation was prepared, but never introduced, since it was found that relevant business licensing powers were already vested in the Ministry for Trade & Commerce. For data-gathering purposes, the informal 'Export Licence' issued by the Fisheries Division (which acted as a *certificate of origin* for the importing authorities, and a *certificate of inspection* for Fiji Customs at the point of export) could be effective.]

5. Establish an Association of Seafood Exporters in Fiji whose function would be to liaise between the Fisheries Division and the exporters. Membership of the Association would be mandatory for all exporters and all members should agree to provide detailed statistics on harvesting activities to the Fiji Fisheries Division. Regular meetings between the Association and the Fisheries Division should ensure a two-way flow of information on the management of the fishery. [Editor's note: some of the subsequent history of the Fiji Beche-de-mer Exporters Association is described in Issue #4 of this bulletin. Whatever its value in other areas, it should be noted that no member of the Association ever actually volunteered any hard information about harvesting activities or purchases.]

Beche-de-mer Information Bulletin #4 contains most of the recent history of the Fiji bêche-de-mer fishery. Whilst the Cabinet guideline banning the use of SCUBA was never given the force of law, it was influential in preventing investment in the purchase of SCUBA gear for commercial fishing.

However, by 1991 it apparently became essential to fish deeper and more distant waters to maintain reasonable catch rates. It was also realised that whilst the Cabinet ban applied to SCUBA, it did not include Hookah (surface-supplied air), and a secondary boom took off, this time sweeping the outer islands of Fiji and extending to Tonga.

Unfortunately, in the absence of detailed catch data, this secondary boom, combined with a gradual progression of exploitation through the species, gives the Fiji yearly beche-de-mer export tonnage graph the appearance of a fishery approaching stability. Total exports have hovered around 300 tonnes for the past three years after the 1988 spike to over 1,000 tonnes.

TONGA

Proposed regulations under the Fisheries Act include, in addition to a ban on the use of both SCUBA and any diving equipment that utilises compressed gas for the purpose of fishing, a blanket 12 cm minimum size limit on dried beche-de-mer, and a ban on the export of any beche-de-mer without a permit from the Minister.

We have recently heard from Tonga that the 12cm blanket size limit will be impractical, and that a separate size limit is likely to be implemented for each species exported.

In 1990 the SPC Inshore Fisheries Research Project performed a beche-de-mer resource survey for the Tonga Government (*Report of a survey of the sea cucumber resources of Ha'apai, Tonga*, by G.L. Preston and P. Lokani, June 1990) and included the following advice on management should a beche-de-mer fishery ever develop in Ha'apai:

The most meaningful approach to management at this stage in the fishery would be to legislate against or otherwise prevent or discourage the use of underwater breathing apparatus for sea cucumber collecting. The introduction of SCUBA gear, Hookahs, or other types of underwater breathing apparatus would radically alter the development of the fishery and require an entirely different management approach. In addition, the use of SCUBA gear without adequate training brings with it a very high risk of permanent disability or death. The seriousness of such risks has been demonstrated in Tonga in the past.

... Focus should now be placed on promoting the development of the fishery. As an integral part of this, provision should be made for instituting a scheme to collect production statistics, hopefully in co-operation with local processors, so that the growth of the fishery, and the response of the resource, can be monitored and later management approaches be planned in advance.

A beche-de-mer fishery subsequently developed very rapidly in Tonga, at the same time, and probably in response to the same factors, as the boom in the neighbouring Lau group of Fiji (see box).

Anecdotal reports from both Lau and Tonga early last year used similar phraseology: that a beche-de-mer fever was sweeping the islands, with whole villages fishing for beche-de-mer. In Fiji, there was concern that gardens and plantations were being neglected and that villages would thereby lose capacity for self-sufficiency.

There were also complaints raised by certain islands against other islanders poaching on their traditional fishing grounds: a type of complaint that was normally settled by traditional means, and only raised with the authorities against non-Fijians.

Tongan gold (sea cucumbers) exported to Asia, France, Canada

by Fuai'api Sime

'The most needed gold in Asia is found in Tonga', according to Mrs Eseta Tapueluelu, a Talafo'ou exporter of that gold – sea cucumbers.

Her firm dries sea cucumbers for export not only to such Asian destinations as Hong Kong and Korea, but also to France and Canada.

'Very delicate fishing methods are used for sea-cucumbers to avoid scratches which would show during the drying process', Mrs Tapueluelu said.

Both white and black varieties are collected, as are sandfish.

After a period of resting in containers of sea water, the sea cucumbers are cooked three times, then smoked and dried using different methods for different varieties. Some are even buried in sand for a few days as part of the curing process.

Bags of the dried product are exported monthly at an average price of T$9,548 for 20 bags.

'Despite the fact that we rely on fishing for a large part of our income, we make sure that the marine environment is not disturbed', Mrs Tapueluelu said. For example, workers collect only sea cucumbers that are nine or more inches long.

Mrs.Tapueluelu noted the food value of sea cucumbers, which contain 43 per cent protein, 2 per cent fat and 21 per cent minerals.

Since starting the business in June 1991, she and her husband Semisi have shared their experience with others, including fishermen in Ha'apai and Vava'u. As a result, similar businesses are now flourishing at Hu'atolitoli Prison, at 'Ata Island, and in Ha'apai.

As Mr Tapueluelu is Deputy Superintendent of Prisons, Mrs Tapueluelu sees her involvement in teaching the business skills to convicts as a way of helping her husband in his work.

'An investment of about T$20,000 is needed to initiate such a business', Mrs Tapueluelu said. Requirements include a vessel and fishing gear.

Mrs Tapueluelu worked from 1986–89 in Victoria, Australia, for a firm which exports seafood to Asia.

Tonga Chronicle
(1/10/1992)

SOLOMON ISLANDS

Beche-de-mer exports from the Solomons increased dramatically (by 500% over the previous year) in 1991, after a downturn in 1989/90 (see Seamus McElroy's article in *BDM Information Bulletin #2*).

No legislation specifically concerning beche-de-mer currently exists in Solomon Islands, and the only documented case of any management practice is the biennial year-long moratorium on bêche-de-mer harvesting in Ontong Java.

According to sources in Malaita and the New Georgia group, beche-de-mer does not appear to be a dietary item in the larger Solomon islands. It is likely that there has never been any need for traditional controls on exploitation except in the low, outer islands.

The Solomon Islands *Marine resource profiles* (FFA Report 90/61) does not make any recommendations concerning the management of beche-de-mer, except the need to gather *baseline information on catch rates, species and size composition, and total fishing effort in areas of high exploitation such as Ontong Java, Temotu, Malaita and Western Provinces. Basic data such as species composition and average sizes should gathered for other areas and the information gathered routinely by traders and exporters should be collated and analysed.*

The SPC Inshore Fisheries Project made a brief study of invertebrate export resources in the Western Province of Solomon Islands in 1992 (*Pilot survey of the status of trochus and beche-de-mer resources in the Western Province of the Solomon Islands with options for management*, by T. Adams, J. Leqata, P.Ramohia, M. Amos, P. Lokani (June/July 1992). Unpublished SPC report to the Solomon Islands Government).

Field work showed that beche-de-mer stocks across the New Georgia Group were very heavily exploited. The recommendations on beche-de-mer management are not easily extricated from the general discussion covering several species, but are broadly as follows:

☞*Measures should be taken, as a matter of urgency, to rehabilitate stocks. The most effective form of management will be one that operates on a reef-by-reef basis and selectively reduces fishing effort on the most overfished areas. The encouragement of communities to impose appropriate restrictions on reefs under their customary jurisdiction, with Government empowerment and support, is the preferred option. The system is already understood and appreciated by the fishermen; it is flexible and quickly adaptive to changes in resource status; it makes use of local knowledge and feedback, and it is fine-grained. Even though the system will be less effective in some areas than others, due to the erosion of traditional values or other factors, the overall effect could be considerable and, most importantly, such a system would be feasible. It would cost the Government far less than a Province-wide 'officials-only' law-enforcement effort, and would probably be far more effective.*

☞*The standby alternative for reducing catches* [if beche-de-mer proved to be too untraditional to be drawn into the community management model] *would be commercial control via a restriction in the number of export businesses allowed to operate, and the imposition of firm yearly product export quotas on each.* [This option might be difficult to sustain politically, as was proven by experience with the Fiji Beche-de-mer Exporters Association, which didn't even get as far as quotas. Note that it is the quota, and not the restriction on the number of exporters, that is the management tool. Restricting the number of exporters is mainly to permit each operator to be profitable under a limited total quota. For an idea of the amount of grief that can be caused to Government fisheries officers by the introduction of such a scheme on an established fishery, refer to the introduction of transferrable quota systems to New Zealand and Australia].

☞*Make sure that any official size, effort, gear, or season limitations apply to 'taking' as well as 'selling'. That is, that they apply to the subsistence fishery as well as the commercial fishery.* [Otherwise an enormous loophole is introduced. For beche-de-mer in the South Pacific, the commercial fishery is prosecuted almost entirely by subsistence fishermen and women.]

☞*It was recommended that the Western Province appoint a specialist dedicated officer to enforce fisheries and conservation regulations in the Province. Such an officer would preferably have familiarity with bringing prosecutions, but would mainly be responsible for liaising with, listening to reports from, advising and encouraging honorary fish wardens and local communities in the management of their reefs.* [Also, the case often arises where different traders can form different alliances within a reef-owning community, requiring outside arbitration].

☞ [Another possible Governmental option, which arose from the equally depleted nature of trochus shell (*Trochus niloticus*) stocks in the Western Province, and recognising the need for rural fishermen to maintain some source of income, would be to] *impose alternate closed seasons for beche-de-mer and trochus for 6 or 12 months at a time.* [However, this was not considered particularly feasible in face of the need by established trochus button factories to obtain a year-round supply of shell.]

☞*Ban the use of SCUBA or Hookah apparatus for fishing except by conditional permit for certain fisheries (e.g. gold-lip pearl shell collection for pearl-seeding);*

☞*Consider setting up marine reserves, either in little-fished areas or close to tourism centres. The aim is to preserve broodstock to help replenish surrounding areas, but the area must be completely enforced, and this is easiest when non-destructive users (e.g. dive operators) have a stake in keeping the area pristine.* [Note: this recommendation was made concerning a whole group of organisms. It is possible that the long planktonic stage in the life-cycle of sea-cucumbers would mean that broodstock reserves were of little **local** value, and that beche-de-mer reserves really need to be co-ordinated on a national or sub-regional basis. It would be interesting to look at the genetic variation of beche-de-mer, at regional, national, and individual reef levels, to get an idea of the extent of reef-to-reef and country-to-country genetic mixing.]

☞*Monitor beche-de-mer size-frequencies for each species periodically, at traders' warehouses. As well as providing an opportunity to get news about the industry, a continued decline in average size of a species from a particular area will indicate that management measures in that area may need to be strengthened.*

Note that no recommendation was made in this report to impose a minimum size limit of the kind imposed in Fiji and suggested in Tonga. At the time, no account was taken of the stratification of market prices by size, and the Western Province Government already had it within its power to put a severe brake on the industry, if so desired, through limiting and applying conditions to commercial licences (an option which was not available to the Fiji Fisheries Division).

COOK ISLANDS

When *Resource Profile No.6, Beche-de-mer, Rori of the Cook Islands* was prepared in 1988, there was no beche-de-mer export industry established in the Cook Islands, and *Actinopyga mauritiana* (surf redfish) was considered to be the only species with any commercial potential.

To that list might be added *Stichopus chloronotus* (greenfish) and *Holothuria atra* (lollyfish), which have since become of some commercial importance in Melanesia. The *Profile* has the following detailed section on Management Recommendations:

Management of rori [generic term for sea-cucumber in the Cook Islands] *resources is extremely important as it is very easy to overfish these sessile, slow-moving animals. In the Philippines, where there has been little or no management effort, many areas have been stripped of high commercial value species and others of all* rori *species (M.J. Trinidad-Roa, 1987* [Beche-de-mer fishery in the Philippines. *Naga, the ICLARM Quarterly*, Manila, 10 (4):15-17]*). In the Cook Islands the reef area and* rori *resources are relatively limited, making management essential to ensure a long term commercial yield. Because of this and the fact that relatively little is known about* rori *life cycles, management guidelines at this point in time should be conservative.*

Before starting any commercial fishery, baseline surveys of the areas to be exploited should be done. Results and recommendations (including management plans) from the Ministry of Marine Resources should be presented to the governing body (i.e. the Island Council) so that it can implement a suitable programme. Possible management plans are listed as follows:

(a) harvest bans during rori *breeding seasons, which for some species in New Caledonia seem to be from November to January, and from June to July for rori-u (black teatfish). If possible, these times should be confirmed for the Cook Islands.*

(b) dividing any reef area to be harvested into sections, with each section opened to harvesting during a certain time period on a rotational basis (this equates to the traditional raui *system). Alternatively, all the reef area could be harvested during certain time periods over the course of a year (i.e. one day a month). Either of these would lessen harvest-*

ing pressure during breeding seasons and allow time for stocks to recover.

(c) rotate harvests between participating islands, and pool beche-de-mer produced in Rarotonga. This will make it easier to get enough beche-de-mer to fill containers for export, and also relieve pressure on individual islands.

(d) the establishment of quotas and minimum size limits for each species, to ensure that the total depletion of any species will not occur (larger animals are the most valuable anyway). The current limit for all species in Fiji is 7.6 cm [3"], and 15 cm in Queensland, Australia (C. Shelley, 1988) [The status of the beche-de-mer fishery in Queensland. In: *Proceedings of the SPC Workshop on Pacific Inshore Fishery Resources, Noumea*]. [Editor's note: the Queensland size limit appears to apply to the animal before processing. The Fiji size limit technically applies to the animal at all stages of processing, but is only used on dried, processed animals].

(e) the establishment of permanent survey sites, to be surveyed before, after and between harvests. These will be used to monitor harvesting pressure on the rori *populations, their recovery from harvests, and seasonal variation. Results from these surveys should be used to determine when harvests are feasible, and to set their quotas.*

(f) the establishment of a reserve area, which may help in the recruitment of stocks.

(g) limiting entry at first to a few (maybe to those who first show interest) on each island, to help prevent over-harvesting. Entry could then be increased, according to the potential of the exploited stocks.

(h) the keeping of good records from the time of harvesting to sale. These records should include: harvesting date, time, duration, location, catch (species, amount and weight); processing times and methods (noting any variations); dry weights of beche-de-mer and price obtained.

(i) banning the use of SCUBA from harvesting, except for any species found only in very deep waters. [Note that the Cook Islands used to hold the world free-diving record until recently, so deep may need to be interpreted relatively!]

Whilst such management plans are ambitious, and would require a great deal of Government investment, it should be noted that the Cook Islands Government and the Aitutaki Island Council between them have been successful in regularly surveying and managing the Aitutaki trochus fishery and maintaining good stocks of trochus at a time when trochus is overfished in much of the rest of the South Pacific.

A management infrastructure is already in place in the Cook Islands, and plans are obviously easier to implement in small island fisheries and relatively homogeneous communities.

During the reporting phase of the SPC Aitutaki trochus fishery case study to the Ministry of Marine Resources, in 1992, some informal recommendations were made concerning the potential management of beche-de-mer resources on Aitutaki:

> *The* rori puakatoro *(surf redfish) resource occupies a similar reef stratum, and has a similar population density to trochus shell, and a similar management pattern might be adopted (i.e. a short open harvesting season, determined by the length of time it took to reach a quota set by a sample transect survey. A harvest of 30 per cent of the population of sexually mature animals might be allowed in the first instance (and adjusted from year to year as results became apparent); an appropriate minimum size limit determined; and the existing trochus sanctuary also be declared a* rori *sanctuary).*

The trochus harvest on Aitutaki is a community affair, and normally lasts one week or less. A time-limited *rori* harvest might be run concurrently or, if this proved too onerous, staggered by six months.

Note that the *rori* harvest would probably take longer due to the sheer time-consuming nature of processing, but that fishermen out collecting trochus might save a great deal of effort by collecting *rori puakatoro* as well.

This might have significant benefits if a public holiday has to be declared for the duration of the harvest, as happened in 1992.

Note also that the short open season for trochus on Aitutaki has made it feasible to run a kind of individual transferrable quota system. Designed to ensure that at least some of the financial benefit derived from the communal trochus resource reaches the entire community, the total quota for the harvest (as determined by pre-survey) is split equally between every household on the island, resulting in certificates for a few kilograms of shell each.

These quotas can then be traded on the free market, and the Island Council (which handles all shell marketing) will only pay fishermen for shell that they can account for by their quota shares on hand.

Because Government officers are present full time at the few designated landing points, any illegal-sized shell, or shell over quota, can be returned to the reef, alive. Equal quotas are reissued from scratch every harvest.

Reply to the request for information published in Bulletin #4

Source: Dr Lyle Vail, Lizard Island Research Station, Cairns, Australia

A request for information on spawning behaviour of tropical holothurians was published in the Beche-de-mer Information Bulletin #4.

A list of observations compiled by Dr Lyle Vail (18/1/93) is presented below.

For two species, *Stichopus chloronotus* and *Holothuria coluber*, it gives the first observations on spawning. The details provided will be very useful for a general analysis.

We hope that other colleagues will have the chance to observe spawning and will send their observations and photos to: Maria Byrne, Histology F13, University of Sydney, NSW 2006, Australia, **or** Chantal Conand, Laboratoire de Biologie marine, Université de la Réunion, 97489 Saint-Denis Cedex, La Réunion, France.

These observations will included in the next bulletin.

Holothurian spawning – Lizard Island – 18/1/93

Observer	Anne Hoggett
Species	*Stichopus chloronotus*
Number	Four individuals spawning out of a group of about 50 animals in an area of about 50 m x 50 m. Anterior half of the body elevated when spawning with a slight swaying from side to side.
Locality	In front of Lizard Island
Date	4/11/90
Moon phase	One day after full moon
Time	18h30 (daylight saving time)
Habitat	Algae/seagrass patch
Observer	Lynda Axe
Species	*Bohadschia argus*
Number	One individual
Locality	North Reef, Lizard Island
Date	8/6/91
Moon phase	Two days after the last quarter
Observer	Campbell Davies, Gary Russ
Species	*Bohadschia graffeii*
Locality	Lizard Island
Behaviour	Anterior end raised
Date	11/11/92
Moon phase	1 day after full moon
Observer	Brigid Kerrigan
Species	*Holothuria coluber*
Locality	Watsons Bay, Lizard Island
Date	12/11/92
Moon phase	2 days after full moon
Time	16h00 (about 2.5 hours before sunset)
Depth	6–8 m

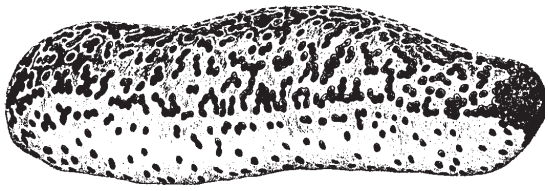
Holothurian spawning – Lizard Island – 18/1/93 (cont'd)

Observer	Anne Hoggett
Species	*Stichopus chloronotus*
Number	An aggregation of about 20 individuals was in an area about half a football field in size. Of these, 4–5 individuals were observed spawning; anterior half of body elevated, slight swaying from side to side.
Locality	In front of Lizard Island Research Station
Date	12/11/92
Moon phase	2 days after full moon
Time	17h00–18h00 (just before sunset)
Habitat	Reef flat, 1–2 m depth
Observer	Anne Hoggett
Species	*Bohadschia graffeii*
Number	1 only
Locality	North Direction Island, 5 nm from Lizard Island
Date	21/11/92
Moon phase	3 days before new moon
Time	15h30
Habitat	Reef slope, about 3 m depth

Beche-de-mer processing in New Caledonia in the 19th century
(in: The fishery resources of Pacific Island countries. Part 2. Holothurians, by Chantal Conand.
***FAO Fisheries Technical Paper,* No 272.2. Rome, FAO. 1989. 143 p.)**

B E C H E - D E - M E R

CORRESPONDENCE



Newly-formed company for the beche-de-mer export business

John E.P. Langemak from the Pacific Asian Export Co. introduces his company in the following letter sent to the South Pacific Commission.

We are a newly formed company which will be exporting beche-de-mer from Mexico and Central America to the Asian market. We have contracted with local fishermen to supply the product and have initially located three companies in Hong Kong which are very interested in purchasing from us.

From research done in the library at Scripps Institute of Oceanography, La Jolla, California, we came across to your Beche-de-mer Information Bulletin. *As we wish to conduct this venture in a responsible manner, it was deemed essential to contact your organisation.*

The species we will be marketing is Selenkothuria lubrica. *This species doesn't appear to be listed as an edible and marketable product in any publication we have read.*

However, the samples we sent to Hong Kong were enthusiastically received and two companies were familiar with this type of beche-de-mer. From reading various articles and talking with several companies in regards to beche-de-mer, we have a basic understanding of processing techniques and product value.

What we are now searching for is specific, detailed, step-by-step drying and processing instructions, current prices and fishing management guidelines to include: maximum percentage of population to be fished at a given time, maximum time period for harvesting a given area, time needed to repropagate, mating and spawning seasons, etc.

We are attempting to gather as much information as possible from all sources. If you are lacking information on beche-de-mer, America's Pacific Coastal Region, we would be very happy to share what we learn.

[Note from editor: Mr Langemak can be contacted at: Pacific Asian Export Co., 373 N. Sierra Ave., Solana Beach, CA 92075, USA. Tel: 619-259-1832. Fax: 619-481-1258]

Royal Hawaiian Sea Farms involved in research on sea cucumbers (cont'd)

Our readers will recall the correspondence from Dale Sarver to Garry Preston, SPC and Chantal Conand that we have published in the *Beche-de-mer Information Bulletin #4*. In this issue, Dale, Director of Research with Royal Hawaiian Sea Farms, summarises (in a letter sent to Hideyuki Tanaka) the work done by his company.

I read the excerpts from your correspondence with Mr Yeeting in the SPC Beche-de-mer Information Bulletin #4. *It was very interesting and I am anxious to learn more about the artificial culture of sea cucumbers. In the same volume there was some correspondence discussing the work Royal Hawaiian Sea Farms has been doing with* Stichopus horrens *and* S. japonicus *which I assume you have seen.*

In case not, I will summarise and update it a little for you. For the last year I have been developing culture techniques for the Hawaiian namako *by manipulating several physical and chemical parameters spawning of wild caught broodstock year round. While the Hawaiian species may exhibit some seasonality in maturation and spawning, it is to a much lesser extent than the Japanese species. While we have been able to remature and spawn animals after their initial spawning sessions, these second*

spawns have been of low quality. So, for the present time we are using only wild caught spawners.

I patterned our larval culture research after the techniques developed in Japan for their species. Using Isochrysis *as food under my rearing scheme anyway is not adequate. After experimenting with different combinations of many plankton species and management schemes we have come up with a procedure that seems reliable. We have had successful settlement of juveniles for the last 3 consecutive trials. In the last run we had survivals of over 90 per cent from ciliated embryos to doliolaria in 4 out of 6 vessels, and 72 per cent survival of those through to settled and feeding juveniles. Over 1,000 juveniles were produced in that laboratory-scale trial, and we hope to expand to larger-scale production soon.*

We have carried out some initial grow-out trials and find they can grow very fast under some culture conditions. Some of these trials have been with only naturally occurring microfauna as food, and some have included successful applications of supplemental food. These results are encouraging and we hope to continue this work next year.

I am presently writing up the results of our research up to date and preparing a proposal for further research, concentrating on intensive grow-out techniques. Since most of the research has been published in Japanese and Chinese, and I cannot read either, I feel a little in the dark about what has been done, especially regarding nurseries and adult grow-out. This is why I was so interested in the information you published in the Bulletin. *It will be a help in preparing my proposal. I would very much appreciate any additional information or papers you have on sea cucumber culture in English.*

As I indicated in the published letters to SPC, I am also trying to arrange shipments of S. japonicus *to Hawaii. I still have had little luck with obtaining live animals. I have written letters requesting assistance from many of the researchers in Japan with no answer. If you have any suggestions on where I could obtain some live specimens I would be grateful. If we get our research project funded I will go to Japan next year* [Note from editor: this letter was written in October' 92] *and hopefully bring back some pre-spawning adults. We have all the necessary permits to import them into Hawaii, and our business partner in Japan could assist us with the paperwork on that end.*

We intend to expand our research to some of the higher value tropical species next year also. One other question. The information I have from Japan discusses three types of namako, *the red, black and green. Are these all* S. japonicus*? Do they cross breed?*

[Note from editor: Dale Sarver can be contacted at: Royal Hawaiian Sea Farms, P.O. Box 3167, Kailua-Kona, Hawaii 96745. Tel: 808-329-5468. Fax: 808-326-3262]

Seahorses and pipefishes traded with beche-de-mer: a request for help

Dr Amanda Vincent, from the Department of Zoology of the University of Oxford, is presently working on pure and applied research on seahorses and pipefishes. She suspects that beche-de-mer and seahorses may face many of the same management and conservation concerns. In a letter sent to J.P. Gaudechoux (and reproduced below) Dr Vincent requests assistance from the members of the Special Interest Group.

Has anybody obtained incidental information about seahorses and/or their exploitation while looking at beche-de-mer? I am investigating the exploitation of seahorses and pipefishes as traditional medicines, aphrodisiacs, curios and aquarium fishes. A recent trip to the Philippines, Taiwan, Hong Kong and Guangzhou (China) revealed that the trade is substantial and its economic value may be considerable. By far the largest market is in dried seahorses for Chinese medicines.

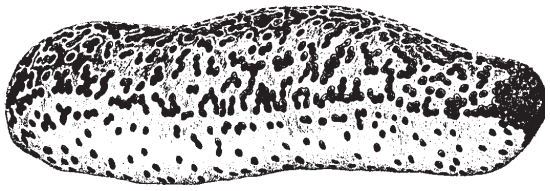
Dried seahorses and pipefishes are often traded in conjunction with beche-de-mer, since handling requirements and markets are similar. It appears that this trade may give rise to conservation concerns but more information is badly needed. I shall be grateful for any information, no matter how anecdotal or seemingly trivial.

As well, does anybody happen to have any preserved (alcohol or formalin) seahorse or pipefish specimens they no longer need? We are (a) trying to sort out the taxonomy of this family through molecular phylogeny work and (b) carrying out a co-evolution study of male parental care and female egg size. We need as many specimens of as many species as possible, with a particularly urgent need for animals which have only been preserved in 70% ethanol. We shall be most grateful for any specimens that can be spared. They should be sent to Dr Ingrid Ahnesjo, Department of Zoology, Villavagen 9, S-752 36 Uppsala, Sweden.

[Note from editor: Dr Amanda Vincent can be contacted at: Department of Zoology, South Park Road, Oxford OX1 3PS, England. Fax: 44-865-310447. E-mail: avincent@vax.oxford.ac.uk]

B E C H E - D E - M E R

Abstracts, Publications Workshops and Meetings



The biology and behavioural ecology of small juveniles of the holothurian species *Actinopyga echinites* (Jäger 1833)

An abstract of a thesis submitted by W.L. Wiedemeyer to the University of the Ryukyus, Okinawa, Japan in September 1992 is given below.

Several morphological, physiological and ecological experiments on the general biology of small juveniles (drained body weight = 0.09–17.34 g) of *Actinopyga echinites* (Echinodermata, Holothuroidea) were conducted between August 1991 and July 1992 on the reef flat near Bise Village, Okinawa, southern Japan (Figure 1).

Supplementary experiments were carried out at the laboratory. All experiments were methodically linked to each other and designed in order to evaluate the biological applicability of *A. echinites* to future stock enhancement projects intended for the species and for other commercially exploited tropical sea cucumbers of the coral reef zone if occasions arose.

The juveniles of *A. echinites* showed an average percentage of drained body weight within their fresh body weight of 48.25 per cent. Their internal and skeletal morphology differed considerably from the morphology of adult specimens. Two new types of skeletal spicules were discovered.

Individual growth of all spicule types monitored during a period of twelve months differed notably and shrinkage was observed for the two newly discovered types. The quantitative frequencies of the spicule types within the skeletons changed with increasing weights of the animals.

The juveniles of *A. echinites* displayed a strong habitat preference for plate-like substrate types

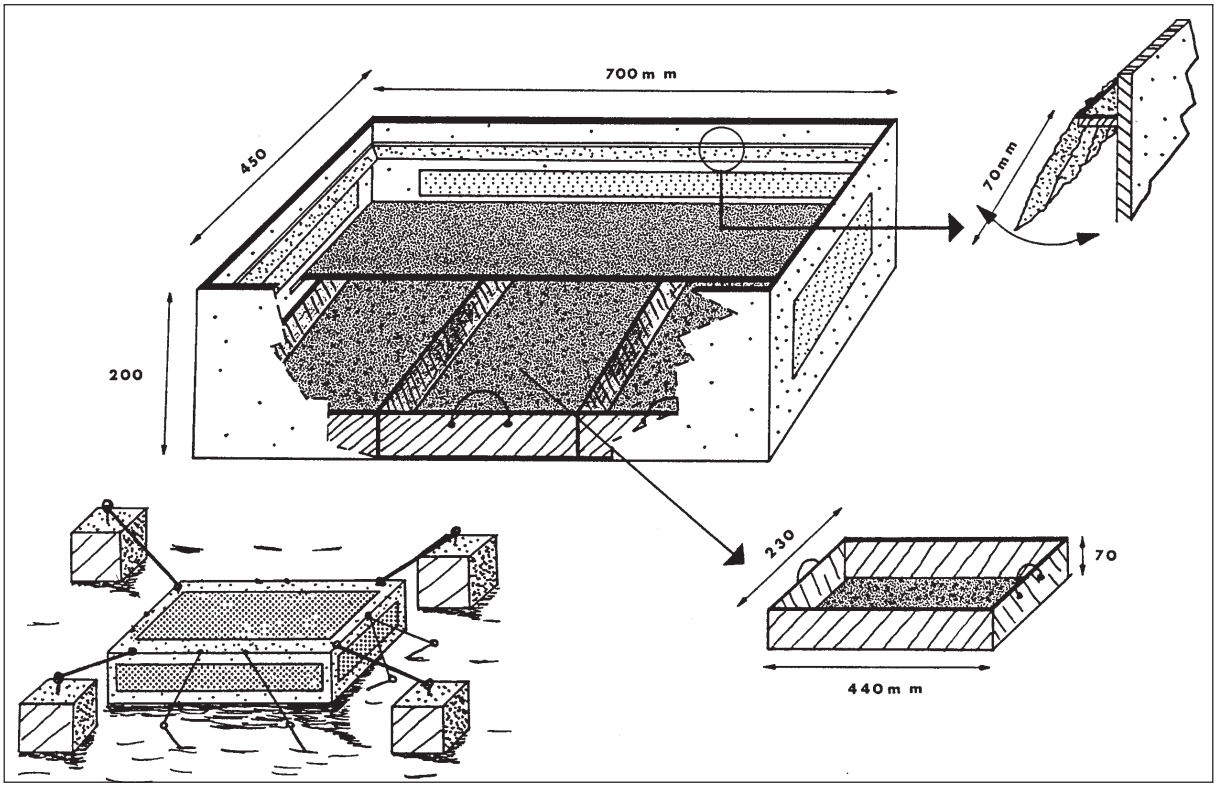


Figure 1: Design of the modified polypropylene boxes used during the field experiments

such as limestone or dead skeletons of *Acropora* spp. and exhibited continuous cryptic behaviour during 24 hours. The natural mortality of the animals (excluding predation effects) was low: 0.6 per cent per month during the first three months of the field experiments.

Although mortality reached a rate of 3.3 per cent during the rest of the experiments when predation effects were included, this was still considered to be a minor increase. The average percentage of predation effects within the total natural mortality was estimated as 76.8 per cent. In the field, *A. echinites* disclosed exponential growth with a 1,500 per cent weight increase during eleven months (Figure2).

At the same time, individuals kept at the laboratory under conditions which were very close to the natural environment in the field showed shrinkage of 54 per cent of their body weight. Juvenile *A.echinites* exhibited a maximum short-distance migration speed of 9 cm/h, which was 20 times slower than the speed observed in the adult animals (900 cm/h), when differences in total body length were taken into consideration.

The daily amount of sediment ingested by the juvenile *A. echinites* was estimated as 58.25 per cent of their individual drained body weight. The daily assimilated amount of organic material removed from the surrounding sediment was estimated as 0.54 per cent of the individual drained weights.

The author concludes that outdoor rearing of *A.echinites* juveniles and the releasing of the specimens to the field might be feasible. The results presented in this study provide basic information in order to enable the selection of adequate releasing areas and assessments of densities of juveniles to be installed during possible future stock enhancement projects.

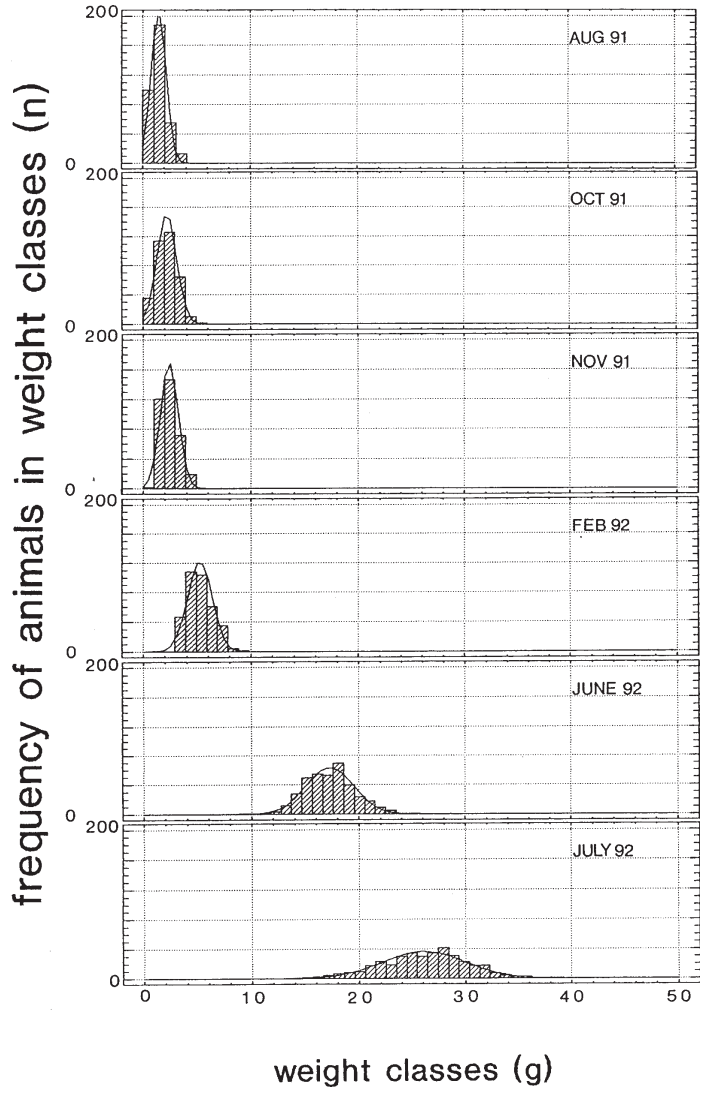


Figure 2: Frequency distribution of juvenile *A. echinites* within weight classes (g) during field experiments from August 1991 to August 1992. Fitted lines are ideal normal distributions. n = 360 animals for each plotted distribution.

Below are abstracts of papers presented at the 7th International Coral Reef Symposium in 1992 in Guam.

Wiedemeyer, W.L. (1992). Feeding behaviour of two tropical holothurians, *Holothuria (Metriatyla) scabra* (Jäger 1833) and *H. (Halodeima) atra* (Jäger 1833) from Okinawa, Japan

Digestive contents of *Holothuria scabra* and *H. atra* (n = 476 ind. each) were analysed on Okinawa, southern Japan from field surveys covering 24hour-periods. Specimens were collected at separate locations during the spawning and post-spawning seasons of 1991.

H. scabra fed during the night when burrowed. Small, medium and large individuals of both species had distinct feeding modes based on digestive speed, daily and seasonal feeding cycles, particle-size and chemical selectivity. *H. scabra* and *H. atra* showed different feeding strategies and behaviour which were specific for seasons and habitats. *H.scabra* reworked more sediment than *H. atra*. But with respect to thickness of the sediment layers at the survey areas, the effect of reworking of *H. atra* at areas of underlying hard substrates is considered more significant.

The amount (dry weight) of daily reworked sediment, as a percentage of the drained body weight of the individuals, was 31.0 per cent and 23.4 per cent in *H. scabra* and 46.5 per cent and 45.2 per cent in *H.atra* for spawning and post-spawning seasons, respectively. Daily assimilated organic matter (carbon / dry weight), as a percentage of the drained body weight of the individuals, was 0.29 per cent and 0.23 per cent in *H. scabra* and 0.18 per cent and 0.13 per cent in *H. atra* for spawning and post-spawning seasons, respectively. Assimilated organic matter per unit weight decreased with increasing body weight in both species, with the exception of reproducing individuals during the spawning seasons. Assimilation efficiency for organic matter was 75 per cent higher in *H. scabra* than in *H. atra*.

Buckley, R.M. & M.C. Gomez-Buckley (1992). Internal micro-tag identification systems for teleosts, holothurians and decapods

Successful extrinsic identification of organisms in ecological studies enables validation of biocenosis assumptions, estimation of population parameters and assessment of migrations, at relevant spatial and temporal scales.

The magnetic, binary-coded wire tag (CWT), alpha / numeric-coded Visible Implant (VI) tag, and fluorescent polymer (FP) tag, are bio-compatible internal micro-tags that (1) allow individual or batch recognition, (2) have low rates of loss, (3) do not invalidate biological normality, and (4) enable practical long-term recovery of information.

Retention of CWT in juveniles of five temperate reef, and three subtropical nearshore, fishes was 95–100 per cent up to 365 d; retention of VI tags in seven species was 0–85 per cent up to 365 d. Retention of FP tags in juveniles of two temperate reef fishes was 94 per cent at 70 d. Pilot study retention of FP tags in one sea cucumber and two shrimp species was 100 per cent up to 50 d. FP tags in juvenile *Sebastes* sp. have been recovered *in situ* during visual transects using ultra-violet dive lights.

Kerr, A.M. (1992). Effects of typhoon-generated waves on windward and leeward assemblages of holothuroids

In the Western Pacific, where typhoons are frequent, storm-associated waves were suspected of influencing the distributions of shallow-water holothuroids. I sampled holothuroids on a windward and leeward reef on Guam before and after Typhoon Russ.

Holothuria atra and *Actinopyga echinites*, which live on open, unsheltered substrata, and diurnally cryptic species were greatly reduced (66.1 per cent, 59.6 per cent and 55.6 per cent respectively) on the outer reef flat of the windward site. On the windward inner reef, *Actinopyga echinites* and cryptic species also decreased (47.2 per cent and 14.3 per cent). No species decreased on the leeward outer and inner reefs.

Rheophilic taxa along the reef margins at both sites were also unaffected by the typhoons. These data, the frequency of typhoons in the region (1 every 3.5 year on average) and the hypothesised longevity of many species (5–15 years), suggest that cyclonic storms may be important in structuring populations of holothuroids, particularly exposed, epibenthic forms, on windward reefs in the Western Pacific.

The new references abstracted below will be held in the SPC library and will be available on request.

If there are documents that you feel should be added to the database, please send us a copy, or, if this not possible, a photocopy of the cover page. Documents do not need to be formal publications–many of those held in the database are not – and we are keen to archive as much grey literature (internal reports, correspondence, unpublished data, etc.) as possible.

Thanks in advance for your help.

Kerr, A.M., E.M. Stoffel & Rosanna L. Yoon (1993). Abundance distribution of holothuroids (Echinodermata: Holothuroidea) on a windward and leeward fringing coral reef, Guam, Mariana Islands. *Bulletin of Marine Science*, 52(2): 780–791.

We used line transects to determine the abundance distribution of holothuroids on a windward (Pago) and leeward (Tumon) reef on Guam. In a total sample space of 11,134 m^2 between depths of 0 and 23 m, we recorded 20,283 holothuroids comprising 19 species.

Another five species were recorded as single individuals off the transects. *Holothuria atra* was the most abundant species recorded and comprised 92 per cent of the holothuroids counted at both sites.

The two next most abundant species were considerably less common: *Actinopyga echinites* and *H.leucospilota* were 3 per cent and 2 per cent of the enumerated fauna, respectively. Each of the remaining 20 species were 1 per cent or less of the total fauna. Species richness and a species' relative abundance between sites appeared related to overall reef exposure.

Species richness was slightly less for Pago (20) than for Tumon (22). Pago had much lower densities of the largest, epibenthic holothuroids common at Tumon: *Bohadschia argus*, *Stichopus chloronotus*, *Thelenota ananas* and *H. nobilis*. Conversely, abundances of cryptic holothuroids were similar between sites.

These observations suggested that storm-generated waves, which often devastate the windward reef at Pago, may strongly influence the holothuroid community there. Within-site species richness was associated with physiographic zones. The middle reef flats had the greatest number of species (20) of any reef zone, while reef slopes supported ten species.

The fewest number of species, four, occurred along the reef margin, and only two species, *Actinopyga mauritiana* and *H. cinerascens*, were found there in abundance.

Species abundances at smaller scales were less predictable. Pairwise product–moment correlation analyses of species abundances at Tumon showed that most distributions were independent of one another when enumerated within 10 m^2 and 2 m^2 quadrates.

Less often, there were weak but significant positive correlations. Weak but significant inverse correlations existed between *Holothuria atra* and three holothuroids found mainly on the reef front or reef slope: *A. mauritiana, H. nobilis* and *S. chloronotus.*

Each microhabitat supported more than one species, and species were often found in more than one microhabitat : rubble and sand bottoms and areas under rocks each supported 11 species, seven taxa were seen on sand, while three species were found in sand.

Macroalgae, turfaceous-algae-covered pavement, the surface of live coral and bare pavement had five, three, two and two species, respectively.

VandenSpiegel, D. & M. Jangoux (1993). Fine structure and behaviour of the so-called Cuvierian organs in the holothuroid genus *Actinopyga* (Echinodermata). *Acta Zoologica* (Stockholm) 74: 43–50.

Actinopygid Cuvierian tubules are few in number. They are made of a basal trunk from which arise 2-3branches. The trunk is smooth and hollow (proximally) or slightly swollen and solid (distally) and the branches consist of a central rachis to which attach many peripheral spherules.

The fine structure of the tubules is similar in the three investigated species of *Actinopyga* but differs considerably from that of non-actinopygid tubules. Basic behavioural differences occur also as actinopygid. Cuvierian tubules cannot elongate nor become sticky, and are not expelled by the individuals. It is concluded that actinopygid Cuvierian tubules do not fulfill a defensive function.

Vail, L. & Barry Russel (1990). Indonesian fishermen of Australia's Noth-West. *Australian Natural History*, 24: 211–220.

This article presents information about traditional Indonesian fishing activities, mostly sea-cucumber collection and trepang preparation on Ashmore Reef. The authors conclude 'the pressure of the marine resources have increased over the 10–15 years... and it is clear that some conservation measures are called for'.

List of beche-de-mer buyers

A list of beche-de-mer buyers was published in 1979 in the well-known SPC Handbook No 18 *Beche-de-mer of the Tropical Pacific*. This list is now out-of-date and the new version of the handbook is currently in preparation. However we have decided to publish an amended version of the list in the Bulletin to give people the chance to comment and suggest corrections and changes.

We look forward to receive any information on the contents of the address list.

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Welcome to new members

by J.P. Gaudechoux,
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The SPC Beche-de-mer Special Interest Group is growing. We have received additional completed questionnaires from the individuals listed below. The previous lists of members are available in the first four issues of *SPC Beche-de-mer Bulletin*.

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

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