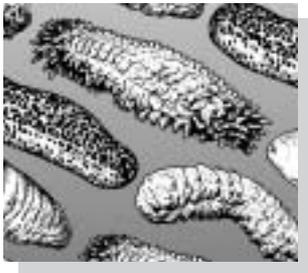


your attention to the very informative Virtual Echinoderms Newsletter. Issue no. 26 is available on the Web at www.nmnh.si.edu/iz/echinoderm.

An echinoderms forum was created after the International Conference in Dunedin. You can subscribe to it by contacting sabine.stohr@nrm.se or by sending an e-mail to listserv@nrm.se and including on the first line of the message SUBSCRIBE ECHINODERM-L, your surname and first name, but no other text.

The 11th International Echinoderm Conference will be held at the Ludwig-Maximilians-Universität, Munich, Germany, from 6–10 October 2003. More information can be found at: www.iec2003.uni-muenchen.de

Chantal Conand



new info
beche-de-mer

Overview of the beche-de-mer fishery in Milne Bay Province, Papua New Guinea

Jeff Kinch¹

Introduction

Milne Bay Province (MBP), at the far eastern tip of Papua New Guinea (PNG) (Fig. 1), has a population of approximately 205,000 people and an estimated 32 per cent of the country's total reef area (Munro 1989; Dazell and Wright 1986). MBP is the largest producer of beche-de-mer in PNG. Beche-de-mer is presently an artisanal fishery involving coastal and island communities, including fishermen, buyers who purchase processed beche-de-mer products from fishermen, and exporters (both licensed and illegal) who export the processed beche-de-mer to the international market.

Average annual income per household has been estimated at USD 130.00 (Kinch 2001a; Mitchell et al. 2001), with most communities relying mainly on beche-de-mer harvesting, fishing and subsistence agriculture for their cash income, food security and livelihoods. The income derived by coastal communities from the sale of beche-de-mer increased dramatically throughout the 1990s, and communities

are currently landing large amounts of beche-de-mer. This increase in production can be attributed to the decline in copra prices, the effects of drought in previous years, increased fishing for beche-de-mer in remote locations, a decline in the value of trochus and blacklip pearl oysters, and the establishment of new markets for previously low-value or non-commercial species. The diversity of beche-de-mer is now being altered in some areas due to this intensified and extensive exploitation, which represents a threat to community livelihood strategies, the fishery itself and the overall biodiversity of MBP's reef ecosystems.

Harvesting and processing

Traditional methods of harvesting beche-de-mer in MBP are either by hand or by free diving using spears or a small harpoon embedded in a lead weight. A typical dive day starts early in the morning with boats leaving for harvesting areas and outer reefs. With favourable weather conditions, clear sky, calm sea and non-turbid water, beche-de-

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mer is collected in water up to 30 metres deep. Boats are out for most of the day and actual dive time in the water may average between three and four hours. Dinghies are now beginning to take the place of sailing canoes, which represents an increase in household income due to the value of beche-de-mer and the need to range farther to locate fresh stocks. The use of lights is a common practice throughout MBP (Kinch pers. observ.). For example, in the Trobriand Islands most sandfish are caught at night using torches (Rawlinson pers. comm.). Hookah gear has been used in recent years by a local businessman and his associates.

Beche-de-mer is produced by a process of boiling, cleaning, drying and smoking (Conand 1990) (Fig. 2). The first stage of processing is pre-cleaning, which entails slamming the beche-de-mer down on the sand, expelling the air trapped inside the body, and inducing the beche-de-mer to eviscerate itself. While pre-cleaning, a large container of clean sea water is set to boil. This is usually done in discarded 200-L oil drums for a period of two to three hours. After boiling, the cooled, cooked beche-de-mer is taken to the sea where it is washed, and remnants of the intestines removed. It is then placed on drying racks to be smoked and/or sun dried. The drying racks are usually kept in a small, wooden

stick-framed building covered with woven coconut palm fronds that help concentrate heat and smoke. After the curing process, the beche-de-mer is then packed in copra sacks or plastic bags to await the exporters purchasing vessels, or sold direct or to trade stores.

History of commercial exploitation

Beche-de-mer was first harvested commercially in PNG in 1878 but it was probably exploited earlier than that (see Russell 1970; Shelley 1981; Conand 1990). During the late 1800s, MBP was visited by considerable numbers of foreign boats seeking pearl shell and beche-de-mer (Roe 1961). MBP inhabitants initially avoided these vessels because

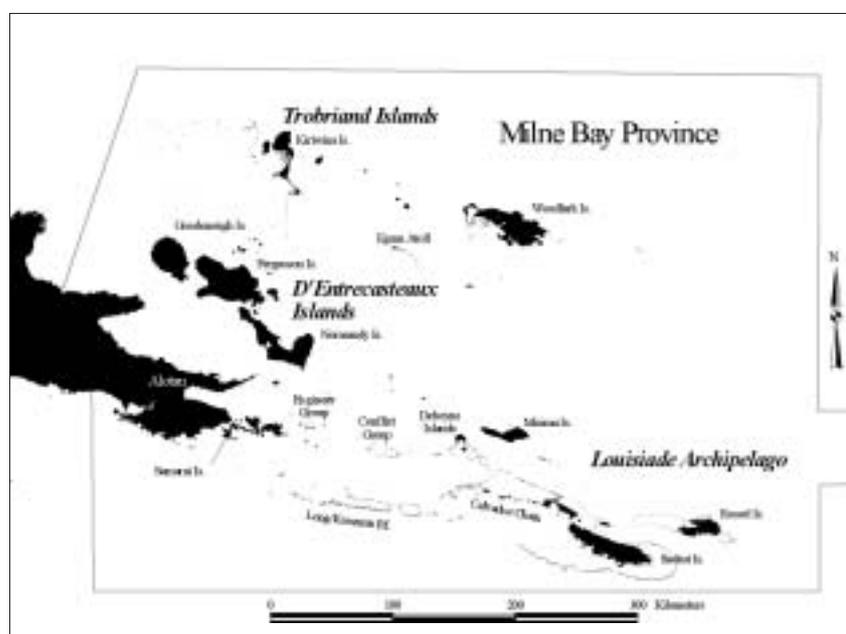


Figure 1. Milne Bay Province



Figures 2a. Beche-de-mer awaiting processing (photo: J. Kinch 1999)



Figure 2b. Boiling and processing beche-de-mer (photo: J. Kinch 1999)

they had a reputation for mistreating the islanders (Milne Bay Provincial Government 1981), and several incidences between villagers and beche-de-mer traders resulted in loss of life (see Murray 1912; Moore 1992; Kinch 1999). Chinese beche-de-mer traders were also among the first foreigners in MBP, particularly in the Engineer Group, bartering with Tubetube people for beche-de-mer, shells, and employing some men as both assistants and divers (MacIntyre 1983; Bromilow 1929).

Anecdotal evidence suggests that the exploitation of beche-de-mer in MBP declined in the latter half of the 19th century probably because of overfishing. The harvesting of beche-de-mer was also affected in the first half of the 20th century when the Chinese and Japanese markets were closed due to the Sino-Japanese War and World War II. Exports from MBP during the 1960s and 1970s was due to enterprising Chinese based in Samarai (DFMR n.d.), a plantation owner based at Nivani, and the former Samarai Fisheries Project (the forerunner of the Milne Bay Fishing Authority, see below). From Department of Primary Industries files located at Samarai, beche-de-mer exports from July 1969 to June 1970 were 58 tonnes at a value of AUD 7562. There were limited exports until the Bwanabwana Fishing Company (the forerunner of Kiwali Exports) began operations in the mid-1970s and MBP beche-de-mer fishery has operated from this time onwards.

The Milne Bay Fishing Authority

The Milne Bay Fishing Authority (MBFA) began operations in 1980 mainly as a fish buying operation, but it also purchased beche-de-mer, shells, clam muscle, shark fins and jaws, prawns, lobster and mud crabs. The premise behind the creation of MBFA under the Coastal Fisheries Development Plan was that there were sufficient stocks of fish and marine invertebrates in each established fishing station area to supply the needs of that station without adversely impacting the food needs of the village people or the long-term productivity of the reefs (Maurice Pratley and Associates 1989). High staff wages, absenteeism, misappropriation of funds, and a breakdown in organisational structure finally contributed to the demise of this programme in 1990, eventually costing around USD 12 million (Maurice Pratley and Associates 1989; ANZDEC 1995). Added to this was a lack of government protection from illegal fishing activities and buyers from other provinces, and no strong policing of government regulations. It was finally recommended that the MBFA operation be commercialised by involving private enterprises. In 1995, most of MBFA's assets, boats, staff and the manager were acquired by Nako Fisheries, the sister company of Kiwali Exports (see below).

Current industry players

Bwanabwana Fishing Company was the forerunner of Nako Fisheries and Kiwali Exports, which now operate under the company name Nako Marine Ltd. Previous to this they were all subsidiary companies of Masurina Ltd. Masurina's founders parted company in 2001 after a 26-year business relationship with one of the founders retaining the two marine resources companies.

Asiapac, the other main exporter started operations in 1992. It was the only other commercial buyer licensed for MBP and it purchased shell, beche-de-mer and sharkfin. Presently, Kiwali Exports and Asiapac dominate the industry. They have a fleet of buying vessels, compete against each other in pricing, and offer incentives and bonuses to fishermen for the right to buy their product.

The National Fisheries Authority (NFA) previously allowed for the provision of three exporter licenses in MBP. A company called Crome Investments was operating in the mid-1990s but ceased operations in 1996. Coral Sea Delights, based at Misima, purchased produce in 1998 and 1999. Recently, with the implementation of the National Beche-de-mer Management Plan several other companies have entered the scene. These include RFI Enterprises, Chou Traders and Tikay Maintenance Services.

Sandfish in the Trobriands

In 1987, Sandfish Enterprises Ltd was formed as a joint venture between a Trobriand Islands entrepreneur and some Asian investors. Mua Island in the Trobriands became the centre of *Holothuria scabra* (sandfish) production (Kailola with Lokani n.d.). The company used poorly paid local labour, and conducted operations in locations considered to be traditional fishing grounds. For a period of six months, from July to December 1987, the company produced 47.12 tonnes of sandfish (Mahara 1988) and it has been estimated that 96 tonnes of dried beche-de-mer was eventually exported (Crittin pers. comm.). The company ceased operations in 1990 and sandfish were reported to be severely depleted after this period of intense fishing (Tom'tavala 1990, 1992; Anon. 2000). In 1989, sandfish accounted for 70 per cent of the total beche-de-mer export for PNG (Lokani 1990) with the majority of this amount coming from MBP.

Exports

The main reason behind the present boom in exploitation and exports is linked to the removal of trade barriers to the People's Republic of China

during the latter 1980s (Lokani 1995; Conand 1990). Exports from MBP go via Hong Kong and Singapore. China's great rate of industrialisation and concurrent increase in wealth has vastly increased the demand for seafood, with significant impacts on prices paid. This may also explain the recent demand for species that were previously considered of little or no commercial value. Some

species of previously low-value beche-de-mer in MBP have shown substantial increases in prices, between approximately 1000 and 3000 per cent (Table 1).

Because beche-de-mer is an export driven industry, production should equate closely with export data. In liaison with NFA, the exporting companies and

Table 1. Purchasing price and increase for beche-de-mer – 1991 and 2001

Species	Size	Price in kina 1991 (October)	Price in kina 2001 (December)	Approximate price in USD 2001 (December)	% increase
<i>Holothuria scabra</i> (sandfish)	Large Grade 1	16.20	60.00 (120.00*)	20.00	270
	Medium Grade 1	12.60	40.00 (80.00*)	13.30	217
	Small Grade 1	10.80	30.00 (60.00*)	10.00	178
<i>H. fuscogilva</i> (white teatfish)	Large	7.20	60.00	20.00	733
	Medium		40.00	13.30	
	Small		35.00	10.00	-
<i>H. nobilis</i> (black teatfish)	Large	7.20	50.00	16.65	594
	Medium		40.00	13.30	-
	Small		30.00	10.00	-
<i>H. fuscopuntata</i> (elephant trunkfish)		-	7.00	2.30	-
<i>H. atra</i> (lollyfish)	Smooth/Large	3.60	5.00	1.65	39
	Smooth/Small		4.00	1.30	-
	Rough		4.00	1.30	-
<i>Thelenota ananas</i> (prickly redfish)	Large	4.50	40.00	13.30	788
	Small		30.00	10.00	-
<i>T. anax</i> (amberfish)		-	8.00	2.65	-
<i>Actinopyga mauritiana</i> (surf redfish)	Large	-	35.00	11.65	-
	Small		25.00	8.30	-
<i>A. miliaris</i> (blackfish)		2.70	40.00	13.30	1381
<i>A. lecanora</i> (stonefish)	Large	-	40.00	13.30	-
	Medium		30.00	10.00	-
	Small		20.00	6.65	-
<i>Stichopus chloronotus</i> (greenfish)	Large	3.60	45.00	15.00	1150
	Small		35.00	11.65	-
<i>S. hermanni</i> (curryfish)	Smooth	1.17	35.00	11.65	2891
	Rough		35.00	11.65	-
<i>Bohadschia argus</i> (tigerfish)		-	16.00	5.30	-
<i>B. vitiensis/B. marmorata</i> (brown sandfish)**		2.70	15.00	5.00	456
<i>B. similis</i> (chalkfish)		-	6.00	2.00	-

Price lists supplied by Kiwali Exports.

* Price for hot air-dried sandfish.

** As there is often confusion over what species brown sandfish actually is, this paper identifies both *Bohadschia vitensis* and *B. marmorata* as having the same common name.

the Planning Division of the Milne Bay Provincial Government have noted discrepancies in export figures, which gives cause for concern (Table 2). NFA's data sets are still under development and in some instances are incomplete. Also, the point of export is not always an indicator of harvest point because products exported from MBP also come from Tufi, in Oro Province, and Mailu, in Central Province (Anon. 2000). These data sets also do not include those animals that have been harvested and rejected at the point of sale and this wastage should also be considered when working out a suitable total allowable catch (TAC).

MBP has also seen a rise in the contribution it makes to the total PNG exports². In the early to mid-1990s this percentage fluctuated between 10 and 15 per cent but rose to nearly half of all exports from PNG in 2001 (Table 3). The increased production can also be related to declines in other provinces of PNG, and also to the opening up of previous unfished areas within MBP.

Resource decline and territorial disputes

Rural livelihoods are important to an estimated 90 per cent of the people in MBP (Kinch 2001a;

Table 2. Milne Bay beche-de-mer exports 1981 – 2001*

Year	Weight (kgs)	Value (kina)	Reference
1981	Approx 8,000	-	Kailola with Lokani n.d.
1984	2,070.00	5,796.00	Ito and Selemat 1985
1989	39,399.00	-	Kailola with Lokani n.d.
1990	58,207.00	-	Kailola with Lokani n.d.
1991	120,999.00	-	Milne Bay DPI (compiled from Kiwali purchasing figures)
1992	69,703.00	-	Kailola with Lokani n.d.
1993	47,783.86	276,376.02	NFA 1997; Lokani and Ada 1998
1994	32,489.90	-	Compiled from figures supplied by the exporting companies
1995	56,929.50	-	Compiled from figures supplied by the exporting companies
1996	65,455.00	683,203.73	NFA database
1997	46,263.40	-	Compiled from figures supplied by the exporting companies
1998	118,505.60	2,468,373.40	MBP Govt Derivation Grant Figures (compiled from customs' records)
1999	52,151.20	1,143,017.47	NFA database
2000	183,719.90	4,197,103.01	NFA database
2001	209,579.80	7,791,632.14	NFA database

Notes: This table is to be used as a guide only as the NFA database may be incomplete.

Before 1992, most beche-de-mer exports from MBP were shifted to Port Moresby for export.

* When several sources of data were available, the highest figure was used.

Table 3. Percentage of beche-de-mer supplied by MBP for the total PNG export: 1992–2000*

Year	MBP (kgs)	PNG (kgs)	% of BDM from MBP
1992	69,703.00	655,462.00	10.6
1993	47,783.86	499,489.46	9.6
1994	32,489.90	208,795.70	15.6
1995	56,929.50	444,747.00	12.8
1996	64,114.60	586,201.80	10.9
1997	46,263.40	505,402.40	9.1
1998	118,505.60	678,848.85	17.5
1999	52,151.20	394,682.45	13.2
2000	183,719.90	607,311.06	30.3
2001	209,579.80	482,281.40	43.4

Note: This table is to be used as a guide only as the NFA database may be incomplete.

* When several sources of data were available, the highest figure was used.

2. See Appendix A, on page 16, for a list of PNG's export figures for beche-de-mer from 1960 to 2000.

Mitchell et al. 2001). For many people in remote areas of PNG, beche-de-mer and the local fishing companies (through their buying programmes) offer the only source of cash. Unfortunately, this often leads to the not-too-judicious harvesting of marine resources. Many of the characteristics that make beche-de-mer economically important also make them vulnerable to overharvesting.

Experience in the past, and in several countries, has shown that excessive fishing can cause a large-scale export fishery such as beche-de-mer to no longer be economically viable. This has occurred elsewhere in PNG, notably with the continuing moratoriums on harvesting in the Manus and Western Provinces' fisheries as mentioned above. The economic and social problems caused by a decline in beche-de-mer stock levels in MBP would be considerable. NFA is faced with the difficult decision of whether to take further management measures — in an effort to make the fishery sustainable (albeit at a lower level of catch, and without any assurance of success) — or to accept the unsatisfactory 'boom and bust' cycle of harvesting and wait for a long-term recovery.

Linked to resource decline is the increase in territorial disputes that are now becoming commonplace all over MBP (see Maolai 2001). As resources decline, people manipulate clan and kin ties to gain access to other waters where remaining stocks are still to be found (Kinch pers. observ.). A number of works show that, in Melanesia at least, territoriality in coastal waters only comes into existence in response to the commencement of commercialisation of valuable resources such as trochus, beche-de-mer and pearl shell. In numerous cases this was deemed sufficient to aggravate disputes over tenure and resource rights (see Carrier 1981; Johannes 1982; Akimichi 1995; Polunin 1984; Wright 1985; Kinch 1999, 2000, 2001a). This is also true for MBP. As the commercial value for marine products has increased, so has the establishment of territoriality and arguments over exactly where traditional boundaries lie and who, by virtue of clan or village ties, has the right to fish within these boundaries. In response to this, some communities have started their own resource owners associations (see below), have established closed areas and have divided reef sections by clan ownership.

Stock research

The earliest stock assessments for MBP are noted by Lindholm (1978) who reports that McElroy, in 1971, made several stock assessments at Bubuleta (Killerton Islands), Samarai, the Trobriands and Goodenough Islands. In 1976, Lindholm, following up on this earlier work,

also conducted a survey of beche-de-mer stocks in the Trobriand and Goodenough Islands (Lindholm 1978). The overall density of beche-de-mer from this survey ranged from 300–350 animals/ha. According to Kailola with Lokani (no date) this stock assessment would have been of almost virgin stock.

Chesher (1980) conducted a marine resource inventory around the Samarai Islands, and along the barrier reef system that stretches from Ware to Bramble Haven. The average number of beche-de-mer was 31 animals/km at Sidea Island, 48 animals/km at Kosmann Reef, 79 animals/km at Steurs Islands and 106 animals/km on the Long Reef (Chesher 1980). Most of these beche-de-mer were *Thelenota ananas* (prickly redfish) with lesser sightings of *Holothuria nobilis* (black teatfish) and *H. fuscogilva* (white teatfish). At this time, the area from Ware to Jomard Entrance was not heavily fished, though Chesher (1980) notes that reefs around Ware, were already overfished.

A beche-de-mer and giant clam abundance survey was undertaken in 1997 by NFA in conjunction with the South Pacific Commission (SPC) to assess the exploitation of these species across MBP. Due to logistical problems and bad weather, the survey was conducted at only 63 sites in the Samarai and Engineer islands (SPC 1996). A total of 18 species were identified from the survey with densities ranging from 0.208 to 33.05 animals/ha (Lokani et al. 1997). The level of abundance recorded at this time was considered to be well below sustainable levels with the abundance of high value species being low.

In 2000, Conservation International (CI) conducted a marine biodiversity survey as part of its Marine Rapid Appraisal Program. This taxonomic survey of fish, corals and shellfish attempted to do a basic stock assessment of sedentary resources notably for beche-de-mer and giant clam. Fifty-seven sites were surveyed throughout MBP and species diversity and abundance of commercial-size beche-de-mer and all giant clams were recorded for each site. A total of 15 species representing four genera were recorded from 53 sites throughout MBP. The most commonly observed species (percentage of occurrence from transects are in parentheses) were: *Bohadschia argus* (tigerfish) (43.40%), *B. graeffei* (flowerfish) (39.62%), *Thelenota anax* (amberfish) (30.19%), *Holothuria atra* (lollyfish) (24.53%), and *Stichopus variegatus* (curryfish) (24.53%) (Allen et al. in press). The most abundant species recorded during the survey were *Thelenota anax*, *Bohadschia argus*, and *B. graeffei*, whose combined numbers comprised roughly half of the total count.

The CI survey noted the depletion of the higher value species and advocated the need for a further in-depth stock assessment. At the request of the Provincial Fisheries Management Committee in March 2001 (see below) a thorough stock assessment of MBP was made in October and November 2001 as a collaborative effort between the Commonwealth Science and Industry Research Organisation (CSIRO), NFA and CI. Specific objectives of the CSIRO/NFA/CI stock assessment were to:

- Assess the current state of holothurian resources in Milne Bay by visiting >1000 sites in the study area and record abundance, distribution, size frequency and biological data. Other benthic resources (e.g. clams) and habitat data were also collected during the survey;
- Calculate stock size estimates for the area, for each of the commercially important beche-de-mer species;
- Provide an indication of stock status for each of the commercially important species of beche-de-mer in the study area;
- Recommend and implement management strategies for the sustainable use of beche-de-mer in Milne Bay beginning in early 2002, and recommend efficient monitoring strategies to gauge their success;
- Provide sufficient training to PNG NFA staff to enable them to carry out/supervise beche-de-mer surveys in other areas of PNG.

The CSIRO/NFA/CI stock assessment employed rapid marine assessment techniques that have been developed, improved and applied by CSIRO for habitat surveys in the Torres Strait, Great Barrier Reef and Timor Box. The James Cook University research vessel, the RV *James Kirby* was used for the survey and a total of 1126 sites were visited over a six-week period (Fig. 3).



Figure 3a. Surveying beche-de-mer (photo: P. Seeto 2001)

Small teams of divers operating from dinghies located sample sites using portable GPS. On the reef top, divers swam along a 40-m transect and recorded resource and habitat information one metre either side of the transect line. Beche-de-mer and other benthic fauna of commercial or ecological interest were counted and, where possible, returned to the dinghy and measured. At each site, substrate was described in terms of the percentage of sand, rubble, consolidated rubble, pavement and live coral. The growth forms and dominant taxa of live corals were noted, and the percentage cover of all other conspicuous biota such as sea grass and algae were also recorded. On the reef edge, a diver swam along a 100-metre transect between in water 1 m to 20 m deep, recording resource and habitat variables similar to those recorded on the reef top. Video was also taken at representative sites, but was not used in the final analysis.

The results of the stock assessment show that even though there are still significant numbers of commercial beche-de-mer species left in MBP, their overall density of (21.24/ha) is lower than those for comparable fisheries in the Torres Straits and the northern Great Barrier Reef (160.40/ha) (Long et al. 1996) and similar to heavily depleted fisheries such as Timor Box (26.80/ha) (Skewes et al. 1999). Some Local Level Government (LLG) areas and species in MBP are showing signs of being heavily overfished and the current total allowable catch (TAC) of 140 metric tonnes is reaching the maximum level for sustainability. Another indicator of overfishing in MBP is the reduction in the proportion of catch of high value species from around 36 per cent in the early 1990s to around 15 per cent by 2002.

The beche-de-mer fishery in MBP is currently changing from a low-volume, high-value fishery to a high-volume, low-value fishery. *Holothuria nobilis*



Figure 3b. Villagers aboard the RV *James Kirby* (photo: CSIRO 2001)

were found in very low numbers and *H. fuscogilva* and *Thelenota ananas* are showing signs of harvesting pressure. *H. scabra* was not observed during sampling (Fig. 4). *H. atra* was the most abundant beche-de-mer species surveyed making up approximately half of all beche-de-mer stocks in MBP. It has been recommended that the TAC of high value species be reduced by half to 30 metric tonnes and that the *H. scabra* and *H. nobilis* be closed or have species specific TACs attached to them (Skewes et al. 2002).

Individual species had mean densities as follows: *Holothuria nobilis* at 0.18/ha, *H. fuscogilva* at 0.42/ha, *H. edulis* (pinkfish) at 2.15/ha, *H. atra* at 9.81/ha, *H. fuscopunctata* (elephant trunkfish) at 0.04/ha, *Bohadschia graeffei* (flowerfish) at 0.37/ha, *B. argus* at 1.33/ha, *B. marmorata* (brown sandfish) at 0.99/ha, *Stichopus chloronotus* at 3.81/ha, *S. hermani* (previously *variegatus*) (curryfish) at 0.09/ha, *Thelenota ananas* at 0.47/ha, *T. anax* (amberfish) at 0.63/ha, *Actinopyga miliaris* (blackfish) at 0.12/ha, *A. lecanora* (stonefish) at 0.02/ha, and *A. mauritiana* (surf redfish) at 0.12/ha (Skewes et al. 2002). High value species as per the National Beche-de-mer Management Plan mean density was 5.22/ha. When compared with other species in other areas

in PNG, the mean densities for the MBP beche-de-mer fishery definitely show signs of extreme fishing pressure (see Lokani 1991; Lokani and Chapau 1992; Lokani et al. 1992; Mobiha et al. 1993; Mobiha et al. 2000; Gisawa 2002).

Further follow up work is required if the beche-de-mer fishery in MBP is to remain viable. There have been no annual surveys done during closure and prior to opening to assess the inter-annual change in stock variability. Based on current information from the stock assessment, there is definite evidence of overfishing in certain areas of MBP and the TAC now requires review.

Management

In the early 20th century, attempts were made to manage beche-de-mer in the Trobriand Islands within MBP with an Act in the Colonial Administration. The *Pearl, Pearl Shell and Beche-de-mer Ordinance, 1911–1934*, prohibited the harvesting of pearl shell, trochus or beche-de-mer in between the high water mark and a parallel line 800 metres seaward of this (Territory of Papua 1934; Hyndman 1993; Tom'tavala 1990, 1992; Kinch 2001a). This was passed with the aim of

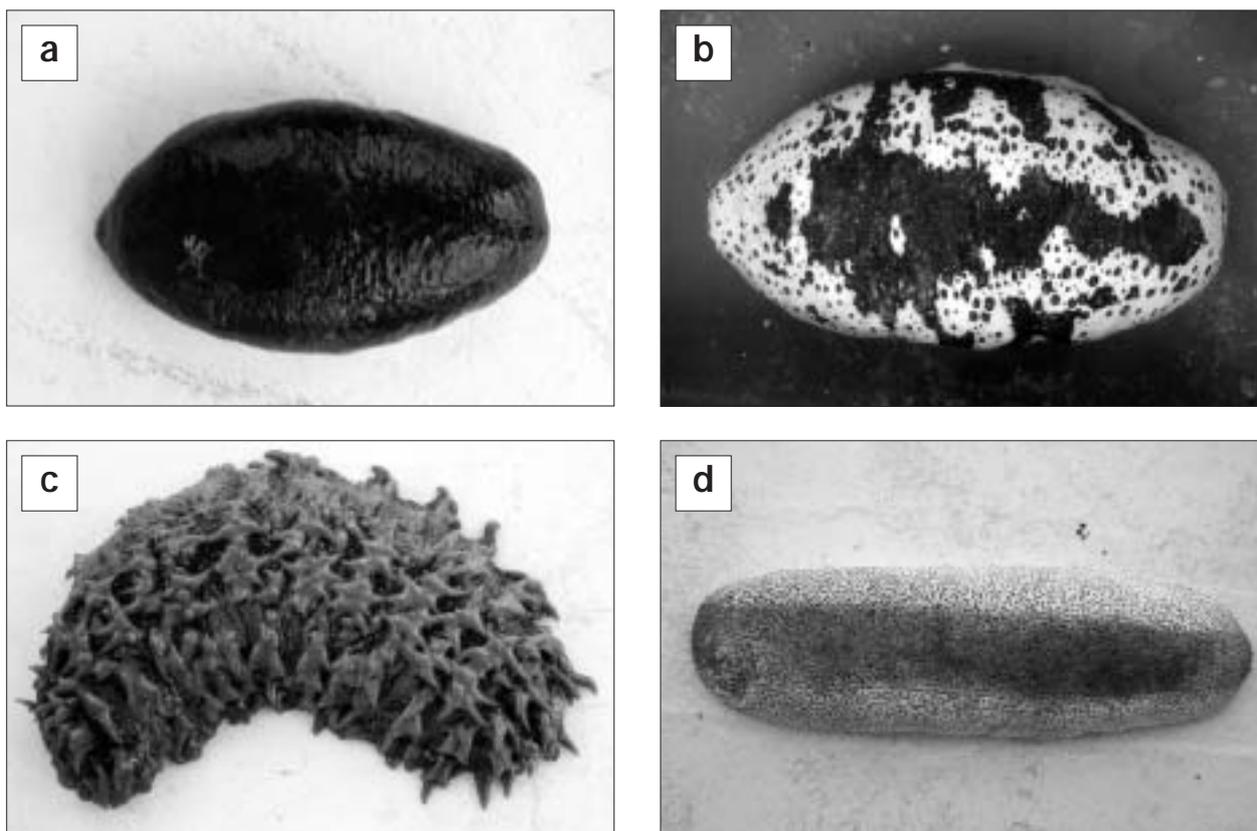


Figure 4. a. *Holothuria nobilis*, b. *H. fuscogilva*, c. *Thelenota ananas*, d. *H. scabra* (photos: CSIRO 2001)

protecting villagers' rights to make a living from their resources.

Today, the National Fisheries Authority has gazetted the National Beche-de-mer Management Plan 2001, for regulation and management of the industry and the implementation of Provincial Management and Advisory Committees (PMACs). This plan now over-rides the previous Milne Bay Beche-de-mer Management Plans 1998 and 2000.

One issue that needs to be addressed in MBP is the lack of information for fishers on minimum size limits, appropriate collection and processing techniques. Recommended wet lengths of beche-de-mer for collection are virtually unknown by fishers throughout MBP (see Kolkolo 1998; Kinch pers. observ.; Rawlinson pers. comm.). This has resulted in a loss of potential income and depletion of future stocks through the indiscriminate collection and subsequent rejection of undersized beche-de-mer. Also, a proportion of animals is rejected by purchasers due to decomposition caused by incomplete processing, drying and improper storage. In light of inadequate Provincial Fisheries Authority (PFA) resources, exporters and buyers should be involved in extension work and better processing techniques, as it is in their interest to sell Grade 1 product should be involved in extension work and better processing techniques, not only at the buying premises but actively in the villages. The author has produced and distributed education and awareness materials to villagers and conducted workshops on such issues (see Kinch 2001b).

Currently, the TAC for MBP stands at 140 metric tonnes up from 60 metric tonnes. A compulsory closed season occurs each year from 1 October to 15 December, or when this TAC is reached, and this is in line with the knowledge of spawning seasons in the western Pacific. These dates are taken from spawning research in other parts of the Pacific. The figure of 60 tonnes was based on export data that was assessed by NFA in 1997. An issue for NFA — who has responsibility for enforcing the TACs and the beche-de-mer fishery in MBP — is that the TAC has been continuously exceeded in recent years. For example, the TAC set for MBP in 2000 was 60 metric tonnes, but records show that nearly 184 metric tonnes were exported. In 2001, the TAC was set at 140 metric tonnes and nearly 210 metric tonnes was exported. All of this adds pressure on beche-de-mer stocks for future harvesting and is an obvious area for better enforcement of exporters.

Overall, enforcement of previous management plans has been poor in MBP. Previously, the National Fisheries Inspector was alleged to be corrupt (see Timothy 2000) and Provincial Fisheries

Inspectors, given new rights under the devolution of power under the Organic Law, are for a variety of reasons unable to do checks of field purchasing practices. Capacity building and training should be provided for these officers to be able to fulfil their functions adequately. There is also a need for greater transparency within the business sector that deals with exporting beche-de-mer.

Illegal activities

Illegal harvesting of beche-de-mer continues to be a problem in MBP despite NFA regulations. Harvesting in the closed season is particularly evident from the Engineer Group year after year (Jaymes 2000b, 2001a), and throughout the course of the stock assessment it was observed that most communities ignored the closure. It has also been reported that fishers sold to a local businessman who kept the processed beche-de-mer until the closure ended, and then sold to a major exporter.

Illegal buyers sponsored by foreign citizens in National Capital District were a problem in 2000 for MBP and there were consistent illegal exports of beche-de-mer products (see Post Courier 2000). This problem is still an issue and recently NFA stated that there was widespread trading of beche-de-mer in the provinces but that NFA was unable to control them (Dau 2001). Surveillance in the closed season by PFA is difficult due to financial constraints and vast distances. This is complicated by a lack of understanding of their rights under the Organic Law, as some previous national functions have been devolved to the provincial level. One major issue of smuggling activities is that there are no official records, which has serious implications for the enforcement of the TAC.

Finally, there are constant reports and allegations of a local businessman who uses hookah gear to harvest beche-de-mer. Under previous and current beche-de-mer management plans the use of underwater breathing apparatus (i.e. hookah or scuba) and the use of underwater lights or surface lights to harvest beche-de-mer at night is banned. Recently, two of the three hookah gears belonging to a local businessman were confiscated. The people caught using this equipment are now awaiting trial.

Resource management projects

To conserve the marine environment and to provide sustainable incomes, village livelihoods must maintain or enhance village capabilities and assets, and provide livelihoods opportunities for future generations. A variety of NGOs and donors, are attempting to assist communities to integrate conser-

vation, management and development at the local level. These include the Asian Development Bank's Coastal Fisheries Management and Development, the Australian Maritime College in collaboration with the National Research Institute, and the Milne Bay Community-Based Coastal and Marine Conservation Program (CMCP), which consists of multiple partners, including CI, the United Nations Development Program, the Global Environment Facility, and all levels of the provincial and national government.

Management regimes developed by communities, with or without the assistance of the above programmes, can be recognised by NFA under Section 30 of the Fisheries Management Act, 1998, though any traditional open seasons that are inconsistent with those set out under the National Management Plan for beche-de-mer are prohibited.

Traditional management

Throughout MBP, the practice of closing reefs or fishing grounds is/was carried out for a certain length of time following a death. After a period of several months to several years the area is reopened and people can once again access that area for harvesting. People are well aware of the benefits of such reef closure in resource regeneration and a modified version of this practice offers the most culturally appropriate way to introduce resource management in MBP.

Criticism levelled at closure systems are that they are not effective or efficient for fishery management. This is because each time the closure is lifted and there is a harvest, the removal of most or all of the spawning stock occurs. This means that all new recruits have to come from elsewhere, unless the closure has been left on for long enough that the population is actually starting to self-seed a bit (depending on local currents), and there is a population of (possibly cryptic) pre-recruits that is larger than before (Foale pers. comm.). Also, if there is a heavy economic pressure a closed season does not work well. There is a need for the CMCP to link modified traditional closures with awareness raising and extension work on quotas, and/or size limits. Once people understand the relationship between husbanding breeding stocks and increasing the rate of recruitment (and thus yields), then they can start to use closure systems effectively.

Resource owner associations

Numerous resource owners associations have been started over the last couple of years, expressly to address concerns for proper management of their

marine resources and to have a voice against the actions of exporters and buyers. The Woodlark Islanders decided to set up the Woodlark Island Fishermen's Association in June 2000 to protect against the overexploitation of the island's marine resources (Jaymes 2000a). The leadership of this organisation was also instrumental in the development of the Milne Bay Resource Owners Association (MBROA) in March 2001.

According to its constitution, MBROA plans to facilitate and conduct training programmes to educate its members to apply sustainable management to their resources and to acquire an export license to gain maximum benefits for the villager. MBROA's concerns were the failure of the government to assist the resource owners to develop their resources and to improve their livelihoods, and the prospect of the Milne Bay Provincial Government getting the third license for beche-de-mer export. MBROA stated that the government does not have effective control over the exporters whose prime interest was to make fast money (Jaymes 2001a). There was also a call to abolish the existing Fisheries Management Consultative Working Group (FMC) because of unfair representation. It was believed that the current members abused their responsibilities and exploited their island communities (MBROA 2001; also see below). MBROA is now in the process of registering itself as a formal organisation.

Other resource owner associations that have been developed with similar goals and objectives include the Engineer Islands Resource Owners Association, the Yealeamba Resource Owners Association, and the Deboyne Islands Development Association.

The Provincial Fishery Management Committee and industry concerns

The year 1998 saw the beginning of FMC, the forerunners of the Provincial Management and Advisory Committees (PMACs). The FMC for MBP formally sat at the end of 2000 and in 2001 (see below for issues). The National Management Plan now encourages the provinces in forming PMACs that will advise the National Management and Advisory Committees (NMAC) on provincial management arrangements.

A Beche-de-mer Management Consultative Workshop was held in September 2000 to re-evaluate the Milne Bay Beche-de-mer Management Plan 2000 by gauging views and submissions from stakeholders, developers and provincial authorities to ensure that the benefits of the beche-de-mer industry were shared in an equitable manner. At

another public meeting in December 2000, resource owners alleged that there was mass corruption in the newly appointed FMC as all members had interests tied up with one of the exporting companies. The people claimed that the board made decisions to protect their own interests and had left the islands undeveloped regardless of the long span of time spent in their mobile operations (Jaymes 2001b). It was also alleged that one of the exporting companies had substituted their own version of the management plan to the Provincial Executive Council (PEC) and had been distributing these to communities, particularly in the Engineer Group, which caused alarm amongst some resource owners.

At the second FMC meeting held in January 2001 (the first meeting being for the discussion of sitting fees) it was proposed by one of the Director of a major exporting company to impose a six per cent levy on beche-de-mer produced for each local level government (LLG). Each LLG was to be allowed four buyers. LLG functions would include establishing measures to settle disputes over ownership, monitoring and reporting unlicensed buyers, and reporting illegal fishing activities (Inuwai 2000). NFA later informed the FMC that it did not have the power to collect any such tax as the beche-de-mer fishery is covered by National legislation and functions and the idea was abandoned.

The third FMC meeting was held in March 2001. At this meeting it was proposed by the Director of one a major exporting companies and seconded by the Chairman that the stock assessment be organised immediately and the author took responsibility for this to happen. The same Director then moved that Milne Bay Properties, the business arm of the MB Provincial government pursue the avenue of obtaining an export license (Eastern Star 2001). Concerns were later raised with the PEC when it was alleged that Milne Bay Properties were to purchase 50 per cent shares of a company called Samarai-Murua Exports, which was held under the name of a local businessman who is associated with one of the major exporting companies. Later, the NFA stated that Milne Bay Properties would not get the license because government involvement in commercial enterprises has proven to be unsuccessful in the past and NFA would be reluctant to give a government owned entity an export license, and again the idea was abandoned.

A final beche-de-mer forum was later held in Alotau on in June 2001 just before the closure to discuss the seasonal closure and what the chairman was going to do to rectify the apparent misrepresentation in the makeup of FMC. Coinciding with the closure of the beche-de-mer season last

year, FMC was disbanded and new nominations should now be brought forward for membership of PMAC. PMAC did not sit in 2002.

Conclusion

Management of the beche-de-mer fishery in MBP is required in order to achieve sustainable levels because it provides the only realistic, self-generated source of cash to island and coastal communities. It is therefore important to establish sustainable management systems with supporting policy incentives to ensure that commercially valuable species do not become extinct. Because beche-de-mer stocks are under increasing pressure from overfishing, some immediate steps need to be taken to limit the effort exerted on the stocks as a loss of income and depletion of future stocks through the indiscriminate collection and subsequent rejection of undersized beche-de-mer will cause dire social problems.

Management strategies that could be tested include the following: having TACs set at the LLG level, species specific TACs or total closures for certain species with low abundance. Resources need to be allocated for awareness and capacity building at the village level for management of these valuable resources. This would include extension and training materials on processing and appropriate harvesting methods; village awareness of overfishing on resource sustainability; the possible incorporation of traditional closed seasons or areas (the best means of policing closed areas may be through village involvement) and limited entry. Effective monitoring is necessary to prevent overexploitation and depletion of beche-de-mer resources and further study is required on models of resource extraction. There is a need to continue stock assessments; monitor active fisheries and recovery rates; apply proper enforcement of recording of data; provide empowerment and support for fisheries inspectors and monitoring of overseas market. Finally, the potential for hatchery and re-seeding programs should be investigated. Undoubtedly, there are major requirements for immediate reform in order to establish a sustainable fishery and improvement of this important industry.

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Appendix A. PNG beche-de-mer exports 1960–2001*

Year	Quantity (kg)	Price in Kina	Reference
1960	1,623.00	-	Lindholm 1978
1961	2,400.00	-	Lindholm 1978
1962	4,448.00	-	Lindholm 1978
1963	12,845.00	-	Lindholm 1978
1964	6,295.00	-	Lindholm 1978
1965	4,092.00	-	Lindholm 1978
1966	4,413.00	-	Lindholm 1978
1967	10,468.00	-	Lindholm 1978
1968	11,183.00	-	Lindholm 1978
1969	12,401.00	-	Lindholm 1978
1970-71	6,527.00	-	Lindholm 1978
1971-72	3,872.00	-	Lindholm 1978
1972-73	9,869.00	-	Lindholm 1978
1973-74	4,068.00	7,041.00	DFMR n.d.
1974-75	1,214.00	2,590.00	Lindholm 1978; DFMR n.d.
1975-76	1,665.00	4,470.00	Lindholm 1978; DFMR n.d.
1977	5,325.00	13,297.00	Lindholm 1978
1978 (Jan-Apr)	5,903.00	-	Lindholm 1978
1979	1,300.00	4,000.00	DFMR 1979
1980	2,351.00	7,445.00	Wright 1986 cited in Kailola with Lokani n.d.
1981	11,090.00	25,966.00	Wright 1986 cited in Kailola with Lokani n.d.
1982	22,960.00	73,409.00	Wright 1986 cited in Kailola with Lokani n.d.
1983	7,630.00	23,938.97	Lokani and Kubohojam n.d.; Lokani 1990
1984	4,668.00	13,472.49	Lokani and Kubohojam n.d.; Kailola with Lokani n.d.; Lokani 1990
1985	19,491.00	58,192.00	Lokani and Kubohojam n.d.; Lokani 1990
1986	119,376.00	361,336	Kailola with Lokani n.d.
1987	192,055.00	591,009.22	Lokani and Kubohojam n.d.; Lokani 1990
1988	202,789.00	801,770.13	Lokani and Kubohojam n.d.; Lokani 1990
1989	194,896.00	1,146,584.85	Lokani 1990
1990	238,923.00	-	Lokani and Kubohojam n.d.
1991 (Jan-Aug)	626,047.50	4,637,807.43	Lokani and Kubohojam n.d.
1992	655,462.00	4,993,123.00	Myint 1996
1993	499,489.46	3,044,843.86	Myint 1996
1994	208,795.70	-	NFA database
1995	444,747.00	4,491,037.71	Myint 1996
1996	586,201.80	7,872,385.78	NFA database
1997	505,402.40	7,683,437.15	NFA database
1998	678,848.85	16,892,866.13	NFA database
1999	394,682.45	11,023,884.90	NFA database
2000	607,311.06	16,311,191.35	NFA database
2001	482,281.40	17,196,625.33	NFA database

Note: This table is to be used as a guide only. All data supplied by the NFA database may be incomplete as the database is still under development and all entries may not have been included yet.

* When several sources of data were available, the highest figure was used.