Fisheries, trade and utilization of sea cucumbers in Malaysia

Choo Poh-Sze

WorldFish Center, Penang, Malaysia

Abstract

Sea cucumber fisheries in Malaysia are exploited off the coastal waters around the coral reef regions in Sabah in East Malaysia. In Peninsular Malaysia, this resource is minimally exploited because more than 90 % of the coral reef islands in both the east and west coasts have been gazetted as marine parks or as fisheries prohibited areas, where fishing activities are prohibited in the vicinity. In Sabah, in the 1980s, landings of sea cucumber recorded an annual catch of about 400-500 tonnes (inclusive of sea urchins), while landings in the 1990s had fallen to an annual catch of around 100 tonnes. Species exploited for food include the sandfish *(Holothuria scabra),* black teatfish *(H. nobilis),* white teatfish *(H. fuscogilva),* elephant's trunkfish *(H. fuscopunctata), H. leucospilota,* orangefish *(Bohadschia graeffei),* brown sandfish *(Bohadschia marmorata)* and prickly redfish *(Thelenota ananas).* The sea cucumbers caught in Sabah, apart from being consumed locally, are exported mainly to Peninsular Malaysia, Sarawak, Singapore, Thailand, Hong Kong SAR (China), Taiwan (Province of China) and China PR. They are processed by boiling and evisceration, and are then exported in the dried or frozen form. Sea cucumbers are also imported into Sabah from neighbouring Indonesia and the Philippines, and may be re-exported after processing. However, since the 1990s, the volume of imports has decreased drastically.

In Peninsular Malaysia, sea cucumbers (locally known as "gamat") belonging to the *Stichopidae* family, mainly curry fish *(Stichopus hermanni* formerly known as *S. variegatus)* and warty sea cucumber *(S. horrens),* are exploited for their medicinal properties. In Pulau Langkawi on the west coast of Peninsular Malaysia in the State of Kedah, the processing industry has depleted the resources of *S. hermanni,* which is now an endangered if not an extinct species in the vicinity of the Langkawi Islands. *Stichopus horrens,* however, are still found in relative abundance in the reef flats of Pulau Pangkor, located on the west coast of Peninsular Malaysia in the state of Perak. The raw products are traditionally processed into gamat oil and gamat water, and recently into medicated balm, toothpaste and soap.

This paper describes the sea cucumber fisheries in Malaysia, the type of gear used, the abundance, localities where they are caught and ways for stock enhancement. Presently there is no fishing regulations aimed at preventing over-exploitation of sea cucumber stocks (except for regulations prohibiting fishing in marine parks). Suggestions for management measures to address overfished stocks are discussed. Sea cucumber trade, pharmaceutical or nutritional properties of the Malaysian species are also described.

Keywords: Landings, commercial species, exports, imports, processing, pharmaceutical properties, management

马来西亚的海参渔业和贸易

P. S. 朱

世界渔业中心，马来西亚

摘要

海参渔业是马来西亚东海岸沙巴州渔民的主要渔业生产项目之一。就整个马来西亚半岛而言，海参资源得到了很好的保护，其原因是马来西亚90%的珊瑚岛礁被规划为海洋公园，在该区域内严厉禁止任何渔业活动。在沙巴州，80年代，海参和海胆的年捕捞量是400—500吨，到了90年代下降到100吨左右。开发利用的食用海参种类有糙海参（*Holothuria scabra*）、黑乳参（*H. nobilis*）、黄乳参（*H. fuscogilva*）、奇乳海参（*H. fuscopunctata*）、玉足海参（*H. leucospilota*）、格皮氏海参（*Bohadschia graeffei*）、

图纹白尼参（*Bohadschia marmorata*），和梅花参（*Thelenota ananas*）。这些海参一部分销往沙捞越，大部分出口到新加坡、泰国、香港、台湾和中国大陆。加工方法也很简单，即去内脏、煮沸，部分晒成干品出口，也有成冻品出口。沙巴州也从邻国印度尼西亚和菲律宾进口，加工后再供出口。自从90年代以来进口量大幅度下降。

在马来半岛被叫做gamat的海参主要指刺参科（Stichopodidae）中的花刺参（*S. variegatus*）和糙刺参（*S. horrens*）具有药物开发价值。位于马来半岛西海岸吉打州的Pulau Langkawi海参加工业使得花刺参的资源遭到严重破坏，该种海参已被列为濒危动物。糙刺参的资源量在Perak州的Pulau Pangkor珊瑚礁区依然较为丰富。这类海参用传统的方法加工海参油、海参液，近来还被加工成海参软膏、牙膏和海参肥皂等名目繁多的产品。

本文还介绍了捕捞海参的渔具、资源量、渔场和资源增殖方法等。目前，除在海洋公园已制定有禁止捕捞的规定外，尚未制定有助于防止过度开发的渔业法规，仅在本文中提出若干建议供讨论。本文还介绍了马来西亚的海参贸易和马来西亚所产的海参的药用和营养性能等情况。

关键词：上岸量、商业种类、进出口、加工、药用性能、管理

Introduction

Malaysians value sea cucumbers for their medicinal benefits and also as culinary delicacies. Malays have traditionally utilized certain species of *Stichopus* (locally known as "gamat") for their medicinal properties and traditional medicines processed from gamat are used in wound healing, treatment of stomach ulcers and as a painkiller. The Chinese have long regarded sea cucumbers as a general health tonic, beneficial for treating tendonitis and arthritis, and as an aphrodisiac, among many other medicinal claims. The Chinese also consider sea cucumbers as culinary delicacies.

Globally, commercial species of sea cucumbers in many countries are overfished due to the ease in which sea cucumbers can be collected from shallow reef flats during low tide. In Malaysia, the lack of fishing regulations such as the minimum legal permitted size for harvesting, closed season and catch quota are also some reasons that contribute to the overfishing.

As a fishery, sea cucumber landings contribute only a small part of the total marine landings in Malaysia. Over-fishing of certain species of sea cucumbers has been observed in both Peninsular Malaysia and Sabah. This paper attempts to describe the fisheries, trade and utilization of sea cucumbers in Malaysia; it also discusses some of the management issues pertaining to over exploitation and ways for conservation of sea cucumbers in Malaysia.

Fisheries

Most of the commercial species of sea cucumbers utilized for medicinal purposes or as food are found in coral reef regions. Some of the edible but non-commercial species of sea cucumbers, however, are found in the vicinity of coastal mangrove mudflats; one such example is *Paracaudina* sp., locally known as "beronok", which is often served as a salad and consumed by coastal communities.

As a fishery, sea cucumber catches are relatively insignificant in terms of total tonnage and value compared to catches of prawns and fish landed in Malaysia. Except for some small scale, hand collection of sea cucumbers, there is no commercial scale sea cucumber fishery in Peninsular Malaysia and Sarawak. Sabah is the only state with a relatively important sea cucumber fishery.

Peninsular Malaysia

Although many commercial species of sea cucumbers are found in the coral reef regions in Peninsular Malaysia (see Forbes *et al.,* 1999), there is no commercial fishery mainly because most of the coral reef islands there have been gazetted as marine parks. In 1994, a total of 37 islands in both the east and west coasts were grouped into four island clusters (Payar Island in Kedah; Redang Island in Terengganu; Tioman Island in Pahang, Mersing Island in Johor)

and have been declared as marine parks where fishing or collection of aquatic organisms are not permitted. Poaching and fish blasting in marine parks are relatively rare compared to situations in Sabah. Apart from the marine parks, three areas in the west coast of Peninsular Malaysia have been declared Fisheries Prohibited Areas, two in Melaka and one in Negeri Sembilan.

Ungazetted coral areas that have no restriction on fishing include: the Sembilan group of islands and Pangkor Island in Perak; small patches of coral reef flats in Langkawi Island, Kedah; Kendi Island and Song Song Island in Penang. The Malaysian Government is currently studying the proposal to gazette the Sembilan Island groups as a marine park. This move is strongly supported by *Stolephorous* fishers in Pangkor Island who have experienced dwindling catches over the years and believe that the establishment of the Sembilan Islands Marine Park will help improve stock recruitment in the coastal waters of Pangkor.

There is a small commercial fishery consisting mainly of *Stichopus horrens* collected by hand by a fisher and his family from the north-western reef flats in Pangkor Island. The sea cucumbers collected are used for the preparation of traditional medicinal products like gamat water and gamat oil. The fishery here is small scale and generally regarded as sustainable. Preparation of gamat water involves draining the coelomic fluid from the gamat, which is then returned to the net cages holding them (see Baine and Choo, 1999). Animals are only harvested when there is a demand for gamat oil. Gamat are then collected from the reef flats and boiled in oil together with some herbs. Apart from *S. horrens,* Forbes *et al.* (1999) documented the presence *of Holothuria atra* and *H. fuscopunctata* in the Pangkor Island area.

The *S. hermanni* (formerly known as *S. variegatus)* fishery in Langkawi Island dates back to the mid 1900s but disappeared in the early 1990s due to overfishing for the traditional medicine industry. Sea cucumbers can still be seen in small numbers in some reef flat areas such as in the Datai and Tanjung Rhu areas. Species documented by Forbes et al. (1999) from Langkawi Island include *S. horrens, H. leucospilota* andH. *hilla.*

Sabah

The sea cucumber fishery in Sabah is important not because it contributes significantly to foreign exchange, but because it provides a livelihood for, and supplements the income of, the poor coastal communities, many of whom are artisanal fishers living in the Semporna, Sandakan, Kudat and the Kota Kinabalu areas. Large tracts of ungazetted coral reefs and reef flats are available for sea cucumber collection. In Sabah, eleven islands (Pulau Tiga Park with 3 islands, Pulau Tunku Abdual Rahman with 5 islands and Turtle Islands with 3 islands) are gazetted as marine parks and managed by Sabah Parks. However, even in these restricted areas, poaching, fish dynamiting and cyanide fishing continue to be a problem. The Sabah Government is in the process of gazetting 325 km^2 in Semporna as a marine park (http://www.tracc.org.my/Borneocoast/CZM_ISSUES/semporna_MP.html), while the Lankayan-Bilean Islands, off Sandakan, have been established as a conservation area under the Wildlife Conservation Act.

Most of the sea cucumbers landed in Sabah are collected by hand from shallow reef flats or by snorkelling or diving. Although the Annual Fisheries Statistics, Sabah, indicate that relatively few fishers are registered as collectors or those using miscellaneous gears (in 2000, the number of fishers recorded in Semporna was 77, Sandakan 0, Kudat 112 and Kota Kinabalu 28), the actual number of collectors could be at least five or six times these numbers. This is because the collection usually involves the whole family of the fishers, who wade in the reef flats to collect sea cucumbers during low tide. Fishing is carried out during the day or at night as long as the weather permits and the tides are low enough to allow the fishers to walk on the reefs. The number of fishing days to collect sea cucumbers average 20 days a month.

The wholesale value of processed sea cucumbers (beche-de-mer or locally known as "trepang" or "balat") constitutes only a small fraction of the total wholesale value of fisheries commodities. In 2000, Semporna landings constituted 2.61 % of the wholesale value in that district, 0.09 % in Sandakan, 0.04 % in Kudat and 0.18 % in Kota Kinabalu. In terms of the whole state, sea cucumbers constitute only 0.17 % of the total wholesale fisheries value.

Species

About 20 species of sea cucumbers are commercially fished. Compared to five years ago, the present landings comprise a significant increase in landings of the less valuable species commonly known as the 'worm' species. They include *Holothuria leucospilota* (local name "patola") and species known locally as "tri kantos", "quadro kantos", black beauty, broam beauty, hot dog *(Holothuria edulis),* "lubuyoh tadik" and "bantunan" *(Holothuria pardalis).* Figure 1 shows some of the common commercial species in Sabah and their local names.

Prices of sea cucumbers are related to the thickness of their body wall and their size. Species with a thick body wall (like teatfish) command higher prices than those with a thin body wall. For the 'worm' species, the 'large' category comprises 25-30 pieces to a kg, the 'medium category' 70-80 pieces per kg, the 'small category' 130-140 pieces per kg and extra small more than 180 pieces per kg. The wholesale price of some of the commercial species of beche-de-mer is shown in Table 1.

Figure 1. *Local names of commercial species of sea cucumber from Sabah. Top(L toR): boli-boli; kasut; gadol; talipan; bot-bot; legs; patola; leopard, black beauty. Bottom (L toR): susu; broam beauty (white); mother tadik; broam beauty (brown); powder; hotdog; patola; gadol; boli-boli; sandfish; tri kantos; tadik.*

Gear and Landings

Statistics on sea cucumber landings from Sabah in the last decade averaged around 100 tonnes (see Table 2); statistics between 1980 and 1990 recorded landings of around 400 tonnes inclusive of sea urchins. Sea cucumber landings recorded by the Food and Agriculture Organization (FAO) showed that there was a small fishery from Peninsular Malaysia (with Sabah accounting for a substantial amount of the catch) in the 1980s and early 1990s. No records were available from FAO after 1993; the Annual Fisheries Statistics, Malaysia does not document landings of sea cucumber implying that the fishery is insignificant compared to the more important resources like fish and prawn.

Table 1. *Wholesale price of some species of beche-de-mer from Sabah.*

Species	**Wholesale Price (US$/kg)**
Teatfish (*H. nobilis, H. fuscogilva*)	42.10 or 78.95 (retail)
Sandfish (*H. scabra*)	10.53 (small) or 18.42 (medium) or 36.84 (large)
Kasut (*H. fuscopunctata*)	6.58
Patola (*Holothuria leucospilota*)	5
Tri kantos	1.58
Bantunan	1.32
Broam beauty (white)	9.21
Broam beauty (brown)	4.74
Gadol (*Stichopus*sp.)	17.89 (small) or 21.05 (medium) or 23.68 (large)
Boli-boli (*Actinopyga miliaris*)	17.11
Talipan or timpul (*Thelenota ananas*)	17.11
Legs (*T. anax*)	3.68
Mother tadik (*Bohadschia*sp.)	7.37
Leopard (*Bohadschia* sp.)	9.21

Semporna, Sandakan, Kudat and Kota Kinabalu are important areas for sea cucumber fisheries. Since the mid 1990s, Semporna is the most important sea cucumber fishery area, with catches ranging from 29 % to 62 % of the total landings from Sabah (see Table 3).

Table 2. *Sea cucumber landings in Malaysia and Sabah (metric tonnes).*

	Landings (tonnes)	
Year	**Malaysia**	**Sabah**
1980		300
1981	168	300
1982	430	400

1983	435	400
1984	367	300
1985	1169	900
1986	687	500
1987	800	600
1988	616	400
1989	800	200
1990	800	400
1991	780	37
1992	800	90
1993		64
1994		142
1995		155
1996		105
1997		90
1998		123
1999		178
2000		159

Source: Data from FAO & Annual Fisheries Statistics, Sabah. 1980-1990 Sabah figures include also sea urchin.

Table 3. *Sea cucumber landings in the various districts in Sabah (metric tonnes).*

	Landings (tonnes)						
Year	**Semporna**	**Sandakan**	**Kudat**	**K. Marudu**	**K. Belud**	**K. Kinabalu**	**Total**
1991	0	35	1	0	0	1	37
1992	0	74	4	10	0	2	90
1993	0	57	0	1	0	6	63
1994	30	24	41	0	0	47	142
1995	55	21	46	0	0	33	155
1996	34.38	23.75	24.04	0	3.10	19.49	104.76
1997	25.69	19.29	19.02	0	0	26.01	90.01
1998	52.36	24.04	14.68	0	0	31.48	122.56
1999	79.65	24.47	21.88	0	0	51.80	177.80
2000	98.65	22.67	15.88	0	0	21.71	158.91

Source: Data from Annual Fisheries Statistics, Sabah.

May to August are the best months for sea cucumber collection because of the calm seas. January to March appears to be the worst time of the year for sea cucumber collection because of the rough weather caused by the Northeast monsoon (see Table 4).

Table 4. *Landings of sea cucumber in Sabah by months (metric tonnes).*

	Landings (tonnes)												
Year	**Jan**	**Feb**	**March**	**April**	May	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
1991	2	3	2	4	3	5	2	3	4	2	3	4	37
1992	5	5	4	7	6	8	12	11	9	6	10	7	90
1993	7	6	8	9	9	7	3	5	4	2	2	2	64
1994	5	5	8	4	6	17	43	11	11	9	8	15	142
1995	6	3	4	16	13	29	19	13	12	8	10	22	155
1996	8.22	13.03	6.54	10.52	8.44	12.53	7.28	9.02	8.35	6.00	7.07	7.76	104.76
1997	9.18	4.07	9.96	5.94	6.02	8.25	5.17	7.72	6.04	8.69	13.02	5.95	90.01
1998	6.68	7.88	5.55	10.10	12.57	11.90	13.73	13.19	13.03	13.47	7.21	7.25	122.56

1999	8.51	8.68	15.26	16.09	19.02	16.63	16.25	22.01	14.04	17.65	10.24	13.42	177.80
2000	7.45	10.60	14.54	11.58	17.24	13.65	12.98	14.17	16.01	13.31	12.28	15.10	158.91
Total	65.04	66.26	77.85	94.23	100.29	128.96	134.41	109.11	97.47	86.12	82.82	99.48	1142.04

Source: Data sourced from Annual Fisheries Statistics, Sabah.

Starting from the mid 1990s, the majority of the sea cucumbers were caught by coastal communities by hand picking them from shallow reef flats during low tide or by diving in the deeper regions (see Table 5). Teatfish, black fish, elephant's trunk fish and the bigger-sized sand fish are rarely found in the shallow reef flats due to over harvesting. They are often collected by coastal fishers of Filipino origin (some may be illegal immigrants) from the deeper areas by snorkelling or diving. In Kudat and Sandakan, sea cucumbers are collected also with the trawl gear. Most of the sea cucumbers harvested by trawl gear are collected by trawlers of 10-24.9 gross tonnage and 25-39.9 gross tonnage fishing in waters within 30 nautical miles of the coast.

Table 5. *Landings of sea cucumber in Sabah by gear group (metric tonnes).*

Year	Trawl	Hook/ Line	Pick/Dive	Total
1991	36		1	37
1992	84		6	90
1993	58		6	64
1994	29	27	86	142
1995	23		132	155
1996	27.09	0	77.67	104.76
1997	24.02	0	65.99	90.01
1998	33.12	0	89.44	122.56
1999	38.55	0	139.25	177.8
2000	37.97	0	120.94	158.91

Source: Data sourced from Annual Fisheries Statistics, Sabah.

Processing

There are several ways of processing sea cucumbers. Most sea cucumbers are processed into either the dried or frozen beche-de-mer. Methods employed by fishers generally yield beche-de-mer that are semi-processed and of low quality, and the end products are still moist and contain considerable amount of sand in the coelom. Fishers process sea cucumbers by putting them into a "kuali" (wok) on low heat without adding water. After the initial cooking, the sea cucumbers are transferred into a "kuali" of boiling water where some papaya *(Carica papaya)* leaves or lime (calcium carbonate) have been added and mixture is left to boil in order to soften the skin of the sea cucumbers. The sea cucumbers are then smoked or sun dried. The fishers will sell the semi-dried sea cucumbers to the middlemen even when they are not thoroughly dried since the fishers need cash to buy food and other necessities.

Middlemen, who procure fresh sea cucumbers from fishers, also process sea cucumbers as a cottage industry. The processed products are sold to wholesalers who will then export the beche-de-mer to various countries. The processors and middlemen living in Semporna in the floating village, where stilt houses extend right into the sea, appear well to do (with cable TV and well-furnished homes) compared to the fishers that supply them with sea cucumbers. The processors generally pay RM 6 for a large sized (when dried, it will be about 400 g in weight) black fish, RM 15 for a sandfish and RM 24 for a teatfish. The sea cucumbers are either processed immediately or they are kept in a container filled with brine. The body wall of the teatfish, or other species with a thick body wall, is vertically slit. This is not required for blackfish and sandfish. The sea cucumbers are then put into a "kuali" of boiling seawater where they are left to simmer for 1 1/2 hours over a slow fire. The sea cucumbers are boiled twice over a small flame and then dried under the sun.

If the sea cucumbers are previously preserved in brine, the salt is removed by washing the sea cucumbers with water before processing. They are then boiled over a slow flame for almost one day, and then dried in an oven at 120 °C until almost dried before transferring to dry under the sun or smoked over a fire. The dried sea cucumbers are then tossed in a kuali containing hot sand to remove the skin. After that they are boiled a second time, and the hard skin scraped off with a knife before they are dried again.

Frozen sea cucumbers are prepared by first boiling the animals for about *VA* hours. They are then transferred into plastic containers and covered with sand for two days. The sea cucumbers are then rubbed with sand to remove the skin. They are then boiled again over a slow flame until the body wall softens. The sea cucumbers are then left to cool before they are packed into plastic bags and put into the freezer.

Trade

Sea cucumbers are processed into beche-de-mer that are either chilled, fresh or frozen, or as other than these, which will include the dried or smoked variety. The chilled, fresh or frozen forms are exported mainly to Peninsular Malaysia and Singapore, while the main markets for the other than chilled, fresh, frozen products are Peninsular Malaysia, Singapore, Sarawak and Hong Kong SAR (China) (see Tables 6 and 7).

Table 6. *Beche-de-mer (chilled, fresh and frozen) exported from Sabah (metric tonnes).*

Year	Exports from Sabah (tonnes) to:									
	P. Malaysia	Sarawak	Singapore	Brunei	Japan	Hong Kong	Indonesia	Philippines	Total	US$
1984	3.26	1.47	0.40						5.13	14 081
1985	2.57		2.13						4.70	11 161
1986	1.43	0.12	0.22		0.20				1.97	5 318
1987	1.29		0.29						1.58	5 512
1988			0.02				0.21	3.58	3.81	1 486
1989			0.80					0.03	0.83	1 318
1990								0.12	0.12	20
1991	3.95								3.95	19 349
1992	1.87		0.55	0.25					2.67	11 021
1993	5.47	0.26	2.62						8.35	20 416
1994	3.56	0.67	4.29	0.30		0.20			9.02	22 168
1995	2.84	0.60	1.00						4.44	8 837
1996									0.00	0
1997									0.00	0
1998	1.05		0.40						1.45	7 500
1999	2.00								2.00	11 842
2000	0.55					1.30		2.55	4.40	9 763
Total	29.84	3.12	12.72	0.55	0.20	1.50	0.21	6.28	54.42	149 792

Source: Annual Report - Dept. Fisheries and Annual Fisheries Statistics, Sabah. From 1996 classified as trepangfitfor human consumption.

Compared to the 1980s, only a small amount of beche-de-mer were imported into Sabah in the 1990s (see Tables 8 and 9).

The SITC code used for identifying beche-de-mer can be very confusing. In the Annual Fisheries Statistics Sabah in the earlier part of 1990s, live, fresh and chilled sea cucumbers had the code number 36353110, frozen ones had the number 036393111, while other than fresh, chilled or frozen beche-de-mer had the code 036393911. From 1996 onwards, a new category, 'fit for human consumption' was given the code number 036393110; this category replaces the other than fresh, chilled or frozen category

Table 7. Beche-de-mer (other than chilled, fresh and frozen) exported from Sabah (metric tonnes).

Year	Exports from Sabah (tonnes) to:											
	P. Malay.	Sarawak	Singapore	Brunei	Hong Kong	Taiwan	Thailand	Philippines.	S. Korea	USA	Total	US$
1984	2.89	32.64	48.45								83.98	102 132
1985	51.54	137.19	62.80								251.53	158 355
1986	17.58	27.43	75.02	0.16	4.18						124.37	209 150

1987	13.51	31.66	70.20		58.21						173.58	345 501
1988	12.20	34.46	34.46	0.05	23.45	2.21					107.43	279 747
1989	19.57	17.98	26.19	0.10		0.12			0.50		64.46	147 934
1990	25.20	25.11	61.92	0.15	0.77	0.03		0.11	3.93		117.22	260 386
1991	43.25	9.79	3.85	0.14	9.35		1.34	0.43	0.35		73.50	300 551
1992	26.37	5.30	16.22	0.25				1.43			50.56	139 036
1993	21.47	11.82	2.17								35.46	69 566
1994	67.71	6.71	2.60	0.25	4.85						82.12	293 780
1995	45.76	16.15	6.58		0.55	3.42	0.30				72.76	300 686
1996	25.70	7.94	0.80		0.10		1.01	2.58	0.09		38.22	145 447
1997	28.53	9.69	3.83	0.78	7.10			0.30			50.23	231 754
1998	14.72	2.58	3.50	0.12	15.65	1.31		0.87		0.24	38.99	206 852
1999	30.24	0.61	0.09	0.36	12.22						53.13	267 510
2000	20.52	3.95	5.30	0.65	78.50						108.92	542 211
Total	466.76	381.01	423.98	3.01	214.93	7.09	2.65	5.72	4.87	0.24	1526.46	4 000 598

Source: Annual Report - Dept. Fisheries Sabah and Annual Fisheries Statistics, Sabah. From 1996 classified as trepang fit for human consumption.

Table 8. *Chilled, fresh and frozen beche-de-mer imported into Sabah (metric tonnes).*

	Imports into Sabah (tonnes) from:										
Year	**P. Malay.**	**Australia**	**Singapore**	**India**	**Japan**	**Hong Kong**	**Indonesia**	**Philippines**	**Taiwan**	**Total**	**US$**
1984			0.86							0.86	691
1985			0.36		0.01		0.06			0.43	448
1986			0.22	0.05			0.17			0.44	498
1987	0.15		0.12				0.03			0.30	313
1988							0.21	3.06		3.27	408
1989	0.29	0.02	1.13	0.54		0.10	0.08	2.74	0.01	4.91	2 907
1990	0									0	0
1991	0									0	0
1992	0									0	0
1993	0									0	0
1994	0									0	0
1995								0.20		0.20	154
1996								0.03		0.03	12
1997								0.04		0.04	11
1998	0									0	0
1999	0									0	0

2000								1.08		1.08	568
Total	0.44	0.02	2.69	0.59	0.01	0.10	0.55	7.15	0.01	11.56	6 010

Source: Annual Report - Dept. Fisheries and Annual Fisheries Statistics, Sabah. From 1996 classified as trepang fit for human consumption.

Table 9. *Main imports ofbeche-de-mer (other than fresh, chilled and frozen) in Sabah (metric tonnes).*

	Imports into Sabah (tonnes) from:						
Year	**Australia**	**Hong Kong**	**India**	**Indonesia**	**Philippines**	**Singapore**	**P. Malaysia**
1984	0.04	0.03	2.36	0.26	64.23	1.89	
1985		0.08	2.22	0.14	41.62	0.17	0.37
1986	0.07	0.14	1.49	0.29	38.19	0.43	
1987	0.01	0.08	0.61	0.31	7.65	0.43	0.86
1988	0.02	0.07	1.32	0.17	5.65	0.75	0.82
1989	0.02	0.10	0.54	0.08	2.74	1.13	0.29
1990	0.02	0.05	0.18	0.04	1.83		0.35
1991							
1992				0.08	0.16		0.35
1993					0.04		
1994					0.47		0.50
1995							
1996				3.50	0.03		
1997				0.50			
1998					0.70		1.22
1999			0.02				13.89
2000							4.38

Source: Annual Report - Dept. Fisheries and Annual Fisheries Statistics, Sabah. From 1996 classified as trepangfitfor human consumption.

Utilization

Sea cucumber, apart from being sought after as a food delicacy and as a traditional cure for many illnesses, are also exploited for their potential nutritional and pharmaceutical properties. Apart from the traditional gamat water and oil, sea cucumbers have been incorporated into products which include juice, balm, liniment oil, cream, toothpaste, gel facial wash, body lotion, facial wash and soap.

Sea cucumber is cholesterol-free. It is high in protein (55% of dry body weight) and contains 10-16% mucopolysaccharides (substances used for building cartilage) and saponins; it is helpful in reducing arthritic pain and arthralgia (due to the mucopolysaccharides content) and pharmacological studies indicate that the saponins of sea cucumber have anti-inflammatory and anticancer properties (Dharmananda, undated). Scientists from the University of Malaya working on *S. hermanni* reported on the painkilling, anti-inflammatory and anti-itching properties of this sea cucumber (Awaluddin, 2001).

Research carried out by Malaysian scientists indicated that three types of antimicrobial agents, namely atratoxin A, B_1 and B_2 were found *in H. atra,* and these agents exhibited high activity against various species of yeast and fungi, but bacterial species showed resistance against these agents (Ibrahim *et al.,* 1992). Shaharah *et al.* (1999) demonstrated that ethanol extracts from *H. atra* have antifungal properties effective against the yeasts, *Saccharomyces lypolytica* and *Candida lypolytica.* Studies carried out by Hawa *et al.* (1999) showed that the coelomic fluid of *S. badionotus, S. hermanni* and *B. mamorata vitiensis* demonstrated antioxidant activity.

Discussion

Except for the Marine Parks Act, which prohibits the collection of all aquatic organisms in the vicinity of the gazetted area, no other management measures are in place to specifically regulate the sea cucumber fishery. A lack of effective enforcement has resulted in activities like poaching, cyanide fishing and fish blasting which are still rampant in Sabah. The latter two activities have destroyed the reefs and affected the abundance of reef-related organisms. The situation in Sabah is rather delicate, since illegal fishers from neighbouring countries carry out many of these illegal activities. The indiscriminate dumping of garbage and sewage pollution in the Sandakan area has been attributed to illegal squatters

(Anon, 1998). Problems of illegal fishing and pollution will be difficult to solve if the bigger challenge of illegal immigration is not successfully resolved.

Other anthropogenic factors that destroy or degrade reefs include various activities related to ecotourism like anchoring boats on corals and treading on corals. The number of tourist arrivals exceeding the carrying capacity of the coral islands may lead to problems related to the disposal of solid wastes and sewage, thus posing a great pollution threat to the environment.

A study conducted by World Resources Institute in 2002 (quoted from Chou *et al.,* 2002) reported that out of the 4 006 km^2 of reef areas in Malaysia, 13 % of the reefs are classified under the Threat Index to be at low risk, 44 % medium risk and 38 % at high risk. A recent study on coral cover in the east coast of Peninsular Malaysia showed that an estimated 42.2 % of the sites studied were in fair condition, with some sites in good condition, and the percentage of recently killed coral was a relatively low at 5.3 % (Harborne *et al.,* 2000). A study conducted in June 2002 in some reefs off Kudat, Sabah found living coral ranging from 27.5 % to 71.3 % at the reef crests and from 10.6 to 60.6 % at reef slope depths between 3 and 6 m (Chou *et al.,* 2002).

A recent study carried out on the coral reefs off the east coast of Peninsular Malaysia showed that edible species of sea cucumbers were frequently seen [density/100m^2, with standard deviations in bracket: Redang Island - 4.7 (4.2); Tioman Island - 2.8 (2.6); Tinggi Island - 11.9 (17.8)] suggesting low fishing pressure (Harborne *et al.,* 2000). Studies conducted by researchers in Sabah indicated that invertebrates, including sea cucumber, are wantonly exploited, and that their numbers are greatly reduced or have disappeared from many reef areas. (http://www.tracc.org.my/Borneocoast/CORAL_REEFS/recent_reefsurveys_summary.html).

Although most fishers interviewed by the author reported a decrease in sea cucumber landings, none of them expressed the need for urgent conservation measures, indicating a general lack of awareness on the seriousness of the situation. This lack of urgency is also apparent among government planners and managers - due partly to the small scale of the sea cucumber fishery and its insignificance when compared to the other more abundant and valuable fisheries.

Measures such as the imposition of a closed season for a few months in each year or limiting fishing to a few days a month are some of the steps that the government can implement immediately. Research on the biology and ecology of the commercially important sea cucumber species will help managers to formulate regulations such as the minimum size for harvesting and closed season to be imposed during the spawning and breeding periods.

The loss in catch per month can be compensated by teaching the fishers how to process better quality beche-de-mer, which may subsequently fetch higher prices in the wholesale market. Research on value addition to processed sea cucumbers should also be given priority. The centuries old method of preparing beche-de-mer with so many rounds of boiling and drying, and again the many rounds of boiling and soaking before they are used for food preparation, would probably lead to the leaching of a considerable amount of valuable nutrients from the sea cucumbers. Processors should look into modern methods that would result in a more hygienic and wholesome sea cucumber product.

Stock enhancement of natural populations through the aquaculture of sea cucumber can also be explored. Presently, KO-NELAYAN (a fishers' association in Sabah) has initiated plans to culture and ranch sea cucumbers but so far they are concentrating on fattening wild sea cucumber stocks in pens located in Bum-Bum Island in Semporna, while they acquire the skills needed for culturing these organisms. Working in partnership with institutions such as the WorldFish Center, which has made considerable progress in the culture and stock enhancement of sand fish in the Solomon Islands, Viet Nam and New Caledonia can accelerate implementation of the culture and stock enhancement program (see Battaglene, 1999; Pitt and Duy, 2003).

Better success could be realized if the government works closely with the stakeholders to put in place co-management plans, which are derived from joint decisions between managers, fishers and processors. Managers must realize that the loss of the sea cucumber fishery will have a great impact on the poor artisanal fishers, who are dependent on sea cucumbers for their livelihood. Moreover sea cucumbers play an important role in the marine ecosystem as detritus and suspension feeders acting like the earthworms of the sea, and their role in the coral reef ecosystems must not be under estimated. We must ensure the sustainability of the sea cucumber fishery.

Conclusion

In Malaysia, a significant sea cucumber fishery exists only in the East Malaysian State of Sabah. Signs of overfishing of the more valuable species such as teat fish and sand fish are evident by the decrease in landings and the decrease in overall size of the animals landed. An increase in landings of the less valuable species such as the 'worm' species is noticeable. Threats to sea cucumber fishery include overfishing and degradation/destruction of aquatic habitats, especially coral reef habitats.

Except for the establishment of marine parks with the overall objectives of conserving corals and coral-reef related organisms, there are no other management plans specifically for the conservation of sea cucumbers. Poaching, cyanide fishing and fish blasting occur quite frequently, even in marine parks. Control of pollution and illegal fishing are made difficult by the problems posed by illegal immigrants who seek out a livelihood in fishing.

Conservation through the imposition of a minimum legal size for harvesting, a closed season for fishing, better enforcement of marine park regulations and stock enhancement through aquaculture are some of the measures that can

be implemented, and help to enhance recruitment and stock of sea cucumbers. Co-management involving the state and stakeholders can also increase the chances of success in implementing conservation plans.

Scientific research has proved that sea cucumbers have many nutritional and pharmaceutical values. The age-old method of processing beche-de-mer involves many cycles of boiling and drying, and nutrients may be lost during the processing process. Improved processing methods and value-addition in the preparation of sea cucumber products should therefore be given research priority.

Acknowledgements

I wish to thank Mr William Wong Yun Kwong, Mr Burhan Japar and Ms Edana Laison from KO-NELAYAN, Sabah for organizing my study visit to Sabah. I am grateful to Dr Meryl J. Williams and Prof Chantal Conand for their comments on the manuscript.

References

Anon. 1998. Chapter 9 Fisheries. *In: Sandakan Coastal Zone Profile.* The Integrated Coastal Zone Management Unit, Town and Regional Planning Department, Kota Kinabalu. (http://www.iczm.sabah.gov.my/Reports/Coastal%20Profile%20Sandakan/Ch09/).

Anon. 1990. *Annual Report of the Department of Fisheries Sabah 1984-1990.* Department of Fisheries, Kota Kinabalu, Sabah.

Anon. 2000. *Annual Fisheries Statistics 1991-2000.* Department of Fisheries Sabah, Kota Kinabalu, Sabah.

Awaluddin, A. 2001. Pharmaceuticals. *In: The Encyclopedia of Malaysia: The Seas.* p.18-119. Ong, J. E. and W. K. Gong (Eds.). Editions Didier Millet, Kuala Lumpur.

Baine, M. & Choo, P.S. 1999. Sea cucumber fisheries and trade in Malaysia. *In: The conservation of sea cucumbers in Malaysia- their taxonomy, ecology and trade: proceedings of an international conference.* Baine, M. (Ed.). p.49-63. Department of Agriculture, Kuala Lumpur, Malaysia. February 1999. Heriot-Watt University, Orkney, Scotland.

Battaglene, S.C. 1999. Culture of tropical sea cucumbers for the purposes of stock restoration and enhancement. *In: The conservation of sea cucumbers in Malaysia- their taxonomy, ecology and trade: proceedings of an international conference.* Baine, M. (Ed.). p.11-25. Department of Agriculture, Kuala Lumpur, Malaysia. February 1999. Heriot-Watt University, Orkney, Scotland.

Chou, L.M., Vo, S. T, Yeemin, T., Cabanban, A., Suharsono & Kessna, I. 2002. Status of Southeast Asia coral reefs. *In: Status of coral reefs of the world.* Wilkinson, C. (Ed.). p. 123-152. Australian Institute of Marine Science. Townsville, Australia.

Dharmananda, S. undated. Sea cucumber: food and medicine. *http://www.itmonline.org/arts/seacuke.htm.*

Forbes, R., Ilias, Z., Baine, M., Choo, P.S. & Wallbank, A. *A taxonomic key and field guide to the sea cucumbers of Malaysia.* Heriot-Watt University. Orkney, Scotland. 62pp.

Harborne, A., Fenner, D., Barnes, A., Bege, M., Harding, S. & Roxburgh, T. 2000. *Status report on the coral reefs of the east coast of Peninsula Malaysia. Coral Cay Conservation Ltd.* (Downloaded from www.reefbase.org).

Hawa, I., Zulaikah, M., Jamaludin, M., Zainal Abidin, A.A., Kaswandi, M.A. & Ridzwan, B H. 1999. The potential of the coelomic fluid in sea cucumber as an antioxidant. *Malaysian Journal of Nutrition,* 5:55-59.

Ibrahim, C.M., Darah, I., Khaw, A.G. & Satheesh, N. 1992. Aktiviti antimikrob oleh atratoksin daripada timun laut tempatan, *Holothuria atra* (Jaeger). *Prosiding Simposium Sumber Alam Kebangsaan Pertama,* 2:93-100.

Pitt, R. & Duy, N.D.Q. 2003. How to produce 100 tonnes of sandfish. *SPC Beche-de-mer Information Bulletin,* 18:15-18.

Shaharah, M.I., Ali, A.M., Abdul Manan, M.J., Ramli, S. & Salahuddin, J. 1998. Preliminary investigations on antimicrobial and cytotoxic properties of Malaysian seaweed *(Gracillaria changii)* and sea cucumber *(Holothuria atra).* In: *Proceeding Fisheries Research Conference 1998.* p. 124-130. Institut Penyelidikan Perikanan, Batu Maung, Penang.