

SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN MALAYSIA

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1. Introduction

Sea cucumbers or holothurians (class Holothuroidea, phylum Echinodermata) are important both ecologically and commercially in the production of beche-de-mer. In Malaysia, a number of sea cucumber species are exploited for export market and local consumption. These invertebrate resources have also contributed significantly to fishery and economy of a small portion of the Malaysian fishers as well as those involve in the processing, marketing, trade and other associated activities. The *Stichopus* group of sea cucumbers from local and imported sources is commonly processed into medicinal and health products such as oil, lotion, cream, tablets and soap. Existing sea cucumbers fishery in this country is centered in the coastal areas around the coral reef region in the Borneo part of Malaysia, particularly in the state of Sabah. The exploitation of this resource in Peninsular Malaysia is rather limited and is associated with the government's intervention through the establishment of marine parks and fisheries prohibited areas that prohibits fishing activities in its vicinity. At present, more than 90% of the coral reef islands located in both the east and west coasts of the peninsula have been gazetted for the protection of reef resources including the holothurians. Sea cucumbers are also

considered a delicacy in Malaysia and other ASEAN and Far East countries such as China and Japan. Because of high demand, the export and import of sea cucumbers and their products have been taking place for considerably long time. Recently, sea cucumber resource in Malaysia is in a declining state and this has raised concern by the government leading to some immediate actions being taken to reverse its decline through improving management and enhancing research and development.

2. Taxonomic Information

Some 44 species of sea cucumbers from five families are found in Malaysian waters. Nine species are recorded from the family of Stichopodidae while the rest which is represented by 27, 2, 1 and 5 species fall within the family of Holothuriidae, Phyllophoridae, Cucumariidae and Synaptidae, respectively. Their taxonomic classification and commercial value are given in **Table 1**. **Table 2** outlines distinguished morphological characteristics and distribution of each sea cucumber species. Although there are a number of established studies reporting the species presence, abundance and distribution, considerable knowledge gap still exists with respect to biological and ecological information.

Table 1. Summary table for sea cucumber species composition in Malaysia




Sea Cucumber Species	Family Name	Local Name	Commercial Value
<i>Stichopus chloronotus</i>	Stichopodidae		Low
<i>Stichopus horrens</i>	Stichopodidae	Talifan varieti hitam	High, Used in the production of traditional medicines
<i>Stichopus noctivagus</i>	Stichopodidae	-	None
<i>Stichopus variegatus</i>	Stichopodidae	Gamat biasa, Gamat pasir, Kebasik laut	Medium to low
<i>Stichopus hermanni</i>	Stichopodidae	-	N/A
<i>Stichopus vastus</i>	Stichopodidae	-	N/A
<i>Stichopus pseudohorrens</i>	Stichopodidae	-	N/A
<i>Thelenota ananas</i>	Stichopodidae	-	High
<i>Thelenota anax</i>	Stichopodidae	-	Low

⁵ Member of the Ad hoc Regional Working Group Sea Cucumber Fisheries and National Focal Point for Malaysia, Department of Fisheries

Sea Cucumber Species	Family Name	Local Name	Commercial Value
<i>Pearsonothuria graeffei</i>	Holothuriidae	-	Low
<i>Bohadschia marmorata</i>	Holothuriidae	Bat yandung, Bat andung, Trepang benang.	Low
<i>Bohadschia argus</i>	Holothuriidae	-	Low
<i>Bohadschia paradoxa</i>	Holothuriidae	-	Low
<i>Actinopyga obesa</i>	Holothuriidae	-	Low to medium
<i>Actinopyga lecanora</i>	Holothuriidae	-	Low
<i>Actinopyga mauratiana</i>	Holothuriidae	-	Low to medium
<i>Actinopyga miliaris</i>	Holothuriidae	-	Low to medium
<i>Holothuria (Acanthotrapeza) coluber</i>	Holothuriidae	-	Low
<i>Holothuria (Halodeima) atra</i>	Holothuriidae	Hitam	Low
<i>Holothuria (Halodeima) edulis</i>	Holothuriidae	Durun	Low
<i>Holothuria (Lessonothuria) pardalis</i>	Holothuriidae	-	None
<i>Holothuria (Lessonothuria) verrucosa</i>	Holothuriidae	-	None
<i>Holothuria (Stichothuria) coronopertusa</i>	Holothuriidae	-	None
<i>Holothuria (Mertensiothuria) leucospilota</i>	Holothuriidae	-	Low
<i>Holothuria (Mertensiothuria) parvicax</i>	Holothuriidae	-	None
<i>Holothuria (Metrartyla) martensi</i>	Holothuriidae	-	None
<i>Holothuria (Metrartyla) ocellata</i>	Holothuriidae	-	None
<i>Holothuria (Metrartyla) scabra var. versicolor</i>	Holothuriidae	Putih	High
<i>Holothuria (Microthele) nobilis</i>	Holothuriidae	-	High
<i>Holothuria (Microthele) fuscopunctata</i>	Holothuriidae	-	Low
<i>Holothuria (Microthele) fuscogilva</i>	Holothuriidae	-	High
<i>Holothuria (Thymiosycia) hilla</i>	Holothuriidae	-	None
<i>Holothuria (Thymiosycia) impatiens</i>	Holothuriidae	-	None
<i>Holothuria (Semperothuria) flavomaculata</i>	Holothuriidae	-	None
<i>Holothuria</i> species 1	Holothuriidae	-	None
<i>Labiodemas semperianum</i>	Holothuriidae	-	None
<i>Actinocucumis typicus</i>	Phyllophoridae	-	None
<i>Cladolabes schmeltzi</i>	Phyllophoridae	-	None
<i>Neothyonidium magnum</i>	Cucumariidae	-	None
<i>Euapta godeffroyi</i>	Synaptidae	-	None
<i>Opheodesoma glabra</i>	Synaptidae	-	None
<i>Synapta maculata</i>	Synaptidae	-	None
<i>Synaptula media</i>	Synaptidae	-	None
<i>Synaptula lamperti</i>	Synaptidae	-	None

Note: N/A – little has been reported of the commercial importance

Table 2. Biology of sea cucumbers in Malaysia

FAMILY: STICHOPODIDAE	
<p>Scientific Name: <i>Stichopus chloronotus</i> Common Name: Greenfish Local Name: Talifan varieti hitam</p> <p>Description: Body form is square in cross section. Prominent papillae along lateral margins. Colouration is black-green, with orange tips papillae. Body is firm but pliable. Smooth tegument. Tube feet arranged in three rows on flattened ventral surface. Maximum length: 30 cm.</p> <p>Distribution: Pulau Payar Group, Pulau Tioman, Pulau Redang groups, Pulau Perhentian, Pulau Tinggi groups and Pulau Mantanani</p>	
<p>Scientific Name: <i>Stichopus horrens</i> Common Name: None Local Name: Gamat</p> <p>Description: Body form is rectangular in cross section. Numerous papillae. Colouration varies from tan to red, often variegated with patches. Concentric rings around the base of papillae, apex being filamentous, visible during feeding only, otherwise withdrawn into body when at rest. Firm and smooth tegument. Maximum length: 30 cm.</p> <p>Distribution: Pulau Langkawi, Pulau Payar, Pulau Pangkor, Port Dickson, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups and Tunku Abdul Rahman Park</p>	
<p>Scientific Name: <i>Stichopus noctivagus</i> Common Name: None Local Name: None</p> <p>Description: Similar to <i>S. horrens</i> but has a more translucent, off-white body with brown striations and orange markings at the base of the tube feet.</p> <p>Distribution: Pulau Mantanani</p>	
<p>Scientific Name: <i>Stichopus variegatus</i> Common Name: Curryfish Local Name: Gamat biasa, Gamat pasir, Kebasik laut</p> <p>Description: Roughly square in cross section with convex upper surface. Body is stout, thick and firm. Tegument moderately rough. Low papillae. Colouration is off yellow with white circles around the papillae. Three distinct rows of orange-pink tube feet on flattened ventral surface. Maximum length: 40 cm.</p> <p>Distribution: Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Redang groups and Pulau Bohey Dulang</p>	

Scientific Name: *Stichopus hermanni*

Common Name: None

Local Name: None

Description: Appearance similar to *S. variegates*. Body is square in cross section with convex upper surface. Body is stout, thick and firm. Low black papillae. Smooth tegument. Colouration is uniform over entire upper surface and varies from grey to olive green. Three distinct rows of tube feet on flattened ventral surface, colour tend to be slightly lighter than the rest of the body. Maximum length: 40 cm.



Distribution: Pulau Segentang, Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Tunku Abdul Rahman Park and Pulau Bohey Dulang

Scientific Name: *Stichopus vastus*

Common Name: None

Local Name: None

Description: Roughly square in cross section, upper surface heavily convoluted. Low papillae. Body is stout, thick and firm. Smooth tegument. Colouration may be any of various shades of grey to an off yellow. May also have reticulated black "Tiger" pattern covering entire dorsal surface. Three distinct rows of pink tube feet on flattened ventral surface.



Distribution: Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Tunku Abdul Rahman Park and Pulau Bohey Dulang

Scientific Name: *Stichopus pseudohorrens*

Common Name: None

Local Name: None

Description: Dorsal surface domed with flattened ventral surface. Papillae well developed on dorsal and lateral surfaces measuring 1.5-2.0 cm in length, not divided. Colouration is light brown with white patches. Mouth is ventral, the anus terminal. Maximum length: 50 cm.



Distribution: Pulau Bohey Dulang

Scientific Name: *Thelenota ananas*

Common Name: Prickly Redfish

Local Name: None

Description: Body is roughly square in cross section. Numerous large crowned papillae over entire upper body surface. Colouration is reddish-orange, papillae slightly darker than body surface. Flat underside is covered in numerous large tube feet. Maximum length: 70 cm.



Distribution: Pulau Tioman, Pulau Redang groups, Pulau Mengalum, Pulau Bohey Dulang and Pulau Sipadan

Scientific Name: *Thelenota anax*

Common Name: Amberfish

Local Name: None

Description: Quadrangular in cross section with rounded upper surface, covered with rounded tubules giving it a "Warty" appearance. Numerous tube feet on flat lower surface. Colouration is cream with scattered orange-red blotches. Maximum length: 80 cm.

Distribution: Tunku Abdul Rahman Park, Pulau Mantanani, Sabah Turtle Islands and Pulau Bohey Dulang



FAMILY: HOLOTHURIIDAE

Scientific Name: *Pearsonothuria graeffei*

Common Name: Orange Fish

Local Name: None

Description: Body is cylindrical in cross section. Colouration is pale cream with brown and black patches. Large low papillae with white tips. Three rows of tube feet. Maximum length: 50 cm.

Distribution: Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Pulau Mantanani, Sabah Turtle Islands and Semporna area



Scientific Name: *Bohadschia marmorata*

Common Name: Chalkfish, Brown Sandfish

Local Name: Bat yandung, Bat andung, Trepang benang.

Description: Cylindrical in cross-section, with thick body wall. Numerous papillae, each with a dark ring around its base. Mouth is surrounded by twenty tentacles. Anus is slightly dorsal and has five papillae. Cuvierian tubules are readily ejected. Colouration is light yellowish but may have darker patches. Maximum length: 40 cm.

Distribution: Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Pulau Bohey Dulang, Pulau Mengalum, Pulau Sipadan, Pulau Mantanani, Kudat and Sabah Turtle Islands



Scientific Name: *Bohadschia argus*

Common Name: Leopard Fish

Local Name: None

Description: Cylindrical in cross-section. Generally, upper surface is grey or grey-brown, usually with striking pattern of spots ringed with white, and lower surface is light yellow-brown. Some individuals are uniform brown with a few papillae with distinctive white ring. Mouth is ventral with twenty tentacles. Anus is slightly dorsal with five papillae. Cuvierian tubules are readily ejected. Maximum length: 40 cm.

Distribution: Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Pulau Mengalum, Pulau Mantanani, Tunku Abdul Rahman Park, Kudat, Sabah Turtle Islands and Pulau Sipadan



Scientific Name: *Bohadschia paradoxa*

Common Name: None

Local Name: None

Description: Body form and size similar to *B. marmorata* but dark brown in colour and darker circles surrounding shorter papillae.

Distribution: Pulau Tinggi and Pulau Redang groups



Scientific Name: *Actinopyga obesa*

Common Name: None

Local Name: None

Description: Body is generally wider in the middle and tapering at both ends. Rough tegument with numerous papillae, often covered with powdering of sand. 20 tentacles surrounding mouth and 5 anal teeth on anus. 3 rows of tube feet on ventral surface. Colouration is reddish brown to yellowish brown with lighter underside. Appearance is similar to *A. echinites*. Maximum length: 30 cm.

Distribution: Pulau Tioman



Scientific Name: *Actinopyga lecanora*

Common Name: Stonefish

Local Name: None

Description: Body is cylindrical, usually attenuated at posterior end. Thick and firm tegument with thin elongated papillae sparsely covering upper surface. 20 tentacles surrounding mouth, 5 anal teeth on anus. Colouration is light grey to dark brown with light speckling over most of body, usually dense at posterior. Maximum length: 40 cm.

Distribution: Pulau Tinggi, Pulau Tioman and Pulau Redang groups



<p>Scientific Name: <i>Actinopyga mauratiana</i> Common Name: Surf Redfish Local Name: None</p> <p>Description: Body is almost cylindrical with numerous large tube feet on flattened underside. Thick and firm tegument with thin elongated papillae sparsely covering upper surface. 25 or more tentacles surrounding mouth and 5 anal teeth on anus. Colouration is mottled chestnut brown with white spots around posterior end. Maximum length: 30 cm.</p> <p>Distribution: Pulau Mantanani</p>	
<p>Scientific Name: <i>Actinopyga miliaris</i> Common Name: Blackfish Local Name: None</p> <p>Description: Cylindrical body. Small soft papillae covering rough tegument. 3 rows of tube feet on ventral surface. 20 tentacles surrounding mouth and 5 anal teeth. Colouration is black, sometimes with dark brown underside. Maximum length: 30 cm.</p> <p>Distribution: Pulau Perhentian and Pulau Redang groups</p>	
<p>Scientific Name: <i>Holothuria (Acanthotrapeza) coluber</i> Common Name: None Local Name: None</p> <p>Description: Elongated and cylindrical in cross-section. Numerous papillae on black upper surface and yellow tube feet on yellow ventral surface. Tough and firm tegument. 20 tentacles surrounding mouth.</p> <p>Distribution: Pulau Tioman, Pulau Tinggi, Pulau Perhentian groups, Sabah Turtle Islands, Pulau Bohey Dulang and Kudat area</p>	
<p>Scientific Name: <i>Holothuria (Halodeima) atra</i> Common Name: Lolly Fish Local Name: Hitam</p> <p>Description: Uniformly black and cylindrical with rounded ends. Smooth tegument, pliable body wall. Small specimens often covered in sand with patches of skin showing through. Large specimens generally seen without covering or with thick covering on upper surface. When rubbed, it gives off a purple/red dye, the toxin holothurin.</p> <p>Distribution: Pulau Payar, Pulau Pangkor, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Tunku'Abdul Rahman Park, Pulau Mantanani, Kudat and Pulau Sipadan</p>	

Scientific Name: *Holothuria (Halodeima) edulis*

Common Name: Pinkfish

Local Name: Durun

Description: Body is cylindrical in cross section with rounded ends. Smooth tegument. Pliable body wall. Colouration is dark red/black on upper surface and pink on underside. Maximum length: 30 cm.

Distribution: Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Port Dickson, Tunku Abdul Rahman Park, Pulau Mantanani, Kudat, Sabah Turtle Islands, Semporna area and Pulau Sipadan



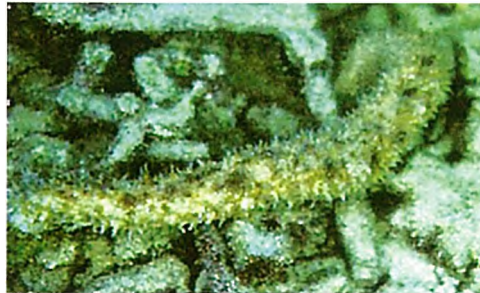
Scientific Name: *Holothuria (Lessonothuria) pardalis*

Common Name: None

Local Name: None

Description: Body is cylindrical in cross section and tapering at both ends. Smooth tegument. Thin and pliable body wall. Colouration is mottled light brown-grey and white, with undersurface usually lighter than upper surface. Maximum length: 10 cm.

Distribution: Pulau Payar, Pulau Tinggi group and Sabah Turtle Islands



Scientific Name: *Holothuria (Lessonothuria) verrucosa*

Common Name: None

Local Name: None

Description: Body is thick and cylindrical in cross section, tapering slightly at posterior end. Smooth tegument, covered with numerous papillae, those on upper surface usually longer and orange tipped. Colouration is uniform chocolate brown. Maximum length: 40 cm.

Distribution: Sabah Turtle Islands



Scientific Name: *Holothuria (Stichothuria) coronopertusa*

Common Name: None

Local Name: None

Description: Dark brown to black dorsal surface, with numerous conical papillae distributed evenly over dorsal and lateral surfaces. Slightly flattened ventral surface, maroon in colour, uniformly covered with small podia. 20 tentacles on slightly ventral mouth, surrounded by a collar of long papillae. Five groups of papillae surrounding terminal anus. Tegument has a loose appearance. Maximum length: 45 cm.

Distribution: Pulau Tioman



<p>Scientific Name: <i>Holothuria (Mertensiothuria) leucospilota</i> Common Name: None Local Name: None</p> <p>Description: Body is uniformly black, elongated and cylindrical in cross section. Smooth tegument, pliable and covered with numerous soft papillae. 20 elongated black tentacles surrounding mouth. Cuvierian tubules are fine white threads, readily ejected when disturbed.</p> <p>Distribution: Langkawi, Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Besar, Kudat, Tunku Abdul Rahman Park and Turtle Islands</p>	
<p>Scientific Name: <i>Holothuria (Mertensiothuria) parvicax</i> Common Name: None Local Name: None</p> <p>Description: Body is hemicylindrical in cross section, flattened below and tapering slightly at ends. Soft and pliable tegument. Mottled colouration of grey/brown on upper surface with white ringed red-brown papillae, under surface is light grey to white with dark spots on tube feet. Thick and translucent cuvierian tubules are readily ejected. Maximum length: 20 cm.</p> <p>Distribution: Pulau Tinggi, Pulau Redang groups, Pulau Mantanani, Sabah Turtle Islands and Pulau Bohey Dulang</p>	
<p>Scientific Name: <i>Holothuria (Metrartyla) martensi</i> Common Name: None Local Name: None</p> <p>Description: Colouration is grey/brown with double row of dark spots on upper surface. Rough tegument with numerous papillae over dorsal and lateral surfaces. Flattened ventral surface. Produces thin white cuvierian tubules when disturbed. Mouth is ventral and anus is terminal.</p> <p>Distribution: Pulau Payar</p>	
<p>Scientific Name: <i>Holothuria (Metrartyla) ocellata</i> Common Name: None Local Name: None</p> <p>Description: Colouration is white with brown speckling and characteristic white-ringed spots surrounding dorsal papillae. Rough tegument. A row of prominent papillae along lateral-ventral margin. Flattened ventral surface with white border, the rest is brown speckled with white-ringed spots. Mouth is ventral and anus is terminal.</p> <p>Distribution: Pulau Payar</p>	

Scientific Name: *Holothuria (Metriatyla) scabra* var. *versicolor*

Common Name: Sandfish

Local Name: Putih

Description: Body is oval in cross section with flat lower surface. Stout with firm to pliable body wall. Smooth tegument. Variable colouration but generally grey upper surface with dark transverse wrinkles and creamy lower surface. Maximum length: 30 cm.

Distribution: Tunku Abdul Rahman Park



Scientific Name: *Holothuria (Microthele) nobilis*

Common Name: Black Teatfish

Local Name: None

Description: Body is flattened and oval in cross section, stout, firm and ridged. Six to eight prominent papillae. Five anal teeth. Cuvarian tubules translucent when ejected. Colouration is uniform black, often covered with fine layer of sand. Small specimens have cream or orange flecks. Maximum length: 40 cm.

Distribution: Pulau Mengalum



Scientific Name: *Holothuria (Microthele) fuscopunctata*

Common Name: Elephant's Trunk Fish

Local Name: None

Description: Convex upper surface. Underside slightly flattened. Stout and firm body with smooth tegument. Prominent wrinkles on upper surface. Notch in body indicates position of anus. Colouration is generally dark orange to rusty brown on upper surface with pale grey sides and undersides. Maximum length: 35 cm.

Distribution: Pulau Pangkor



Scientific Name: *Holothuria (Microthele) fuscogilva*

Common Name: White Teatfish

Local Name: None

Description: Shape similar to *H. nobilis*. Body is flattened oval in cross section. Six to eight prominent papillae along each side of body. Five anal teeth. Colouration ranges from yellowish white to grey brown. Often covered in fine layer of sand.

Distribution: Pulau Mantanani



Scientific Name: *Holothuria (Thymiosycia) hilla*

Common Name: None



Local Name: None


Description: Body is cylindrical in cross section, tapers at both ends, giving an elongated thin appearance. Smooth and loose tegument. Colouration is uniform brown. Prominent white conical papillae all over body. When stressed, entire body contracts to about a third of its length and papillae retracted. Maximum length: 20 cm.


Distribution: Pulau Tinggi, Pulau Tioman group, Langkawi, Pulau Mengalum, Pulau Mantanani and Sabah Turtle Islands



<p>Scientific Name: <i>Holothuria (Thymiosycia) impatiens</i> Common Name: None Local Name: None</p> <p>Description: Body is cylindrical, tapering at both ends. Firm but pliable body. Tough tegument. Prominent papillae all over body. Cuvierian tubules sometimes ejected. Colouration is variable, but most have variegated pink and brown colour with variable light and dark bands on upper surface. Lower surface tends to be paler. Colour may alternatively be uniform beige. Maximum length: 20 cm.</p> <p>Distribution: Pulau Tinggi group</p>	
<p>Scientific Name: <i>Holothuria (Semperothuria) flavomaculata</i> Common Name: None Local Name: None</p> <p>Description: Cylindrical body, tapering abruptly at the posterior and gradually towards the mouth. 20 yellowish tentacles surrounding mouth. Colouration is red-brown to mauve with yellow tube feet. Smooth, soft and thick tegument.</p> <p>Distribution: Pulau Tinggi group</p>	
<p>Scientific Name: <i>Holothuria</i> species 1 Common Name: None Local Name: None</p> <p>Description: Cylindrical in shape, tapering slightly at the posterior. Mouth and anus are terminal. Smooth tegument. Colouration is dark blue to black with prominent maroon-tipped papillae and black with light brown edged tentacles. When disturbed, cuvierian tubules are ejected, and animal may eviscerate.</p> <p>Distribution: Semporna</p>	
<p>Scientific Name: <i>Labidodemas semperianum</i> Common Name: None Local Name: None</p> <p>Description: Cylindrical body, tapering more at posterior than at anterior. Colouration is uniform white with purple anterior end. Prominent white papillae arranged in rows.</p> <p>Distribution: Kudat</p>	

FAMILY: PHYLLOPHORIDAE	
<p>Scientific Name: <i>Actinocucumis typicus</i></p> <p>Common Name: None</p> <p>Local Name: None</p> <p>Description: Body is roughly square in cross section, tapering at both ends. Prominent papillae along ambulacra. Tough tegument. Rigid body. Twenty tentacles surrounding mouth. Colouration is uniform, varying from red brown to purple.</p> <p>Distribution: Pulau Mantanani</p>	
FAMILY: PHYLLOPHORIDAE	
<p>Scientific Name: <i>Cladolabes schmeltzi</i></p> <p>Common Name: None</p> <p>Local Name: None</p> <p>Description: Body is cylindrical in cross section and tapers at both ends. Smooth tegument. Firm body. Tube feet cover entire body.</p> <p>Distribution: Pulau Mantanani</p>	

FAMILY: CUCUMARIIDAE	
<p>Scientific Name: <i>Neothyonidium magnum</i></p> <p>Common Name: None</p> <p>Local Name: None</p> <p>Description: Body divided into two distinct regions. Massive tentacular crown usually the only part visible, body buried in sediment. Colouration is creamy white, tentacles and visible tube feet are dark brown to black. Tentacles may be 15 cm long.</p> <p>Distribution: Pulau Bohey Dulang</p>	

FAMILY: SYNAPTIDAE	
<p>Scientific Name: <i>Euapta godeffroyi</i></p> <p>Common Name: None</p> <p>Local Name: None</p> <p>Description: Cylindrical and translucent body, with mottled cream white and grey, brown or green longitudinal stripes with darker bands in enlarged "beaded" areas of the skin. Fifteen cream colour tentacles. Maximum length: 1.5 m.</p> <p>Distribution: Port Dickson and Tunku Abdul Rahman Park</p>	

<p>Scientific Name: <i>Opheodesoma glabra</i> Common Name: None Local Name: None</p> <p>Description: Relatively large. Colouration is deep brown to grey with some white flecking. 15 tentacles.</p> <p>Distribution: Tunku Abdul Rahman Park</p>	
<p>Scientific Name: <i>Synapta maculata</i> Common Name: None Local Name: None</p> <p>Description: Cylindrical body, lacks tube feet. Colouration is variable, from yellow brown to tan with longitudinal stripes and large dark patches in enlarged "beaded" areas of the skin. Fifteen tentacles surrounding mouth, tan in colour with white lines along margins of the pinnae. May exceed 2 m in length.</p> <p>Distribution: Sabah Turtle Islands and Pulau Bohey Dulang</p>	
<p>Scientific Name: <i>Synaptula media</i> Common Name: None Local Name: None</p> <p>Description: Cylindrical body, lacks tube feet. Colouration is chocolate brown with white lines and dashes along length of body. Cream coloured tentacles with fine brown lines. Maximum length: 5 cm.</p> <p>Distribution: Pulau Payar and Pulau Redang groups</p>	
<p>Scientific Name: <i>Synaptula lamperti</i> Common Name: None Local Name: None</p> <p>Description: Body is cylindrical. Lacks tube feet. Colouration of body and tentacles are opaque white with dark longitudinal stripes. Maximum length: 5 cm.</p> <p>Distribution: Pulau Payar, Pulau Sengilan, Pulau Tinggi, Pulau Tioman, Pulau Redang groups, Pulau Bohey Dulang and Pulau Sipadan</p>	

3. Production and Utilization

3.1 Sea Cucumber Fisheries

Sea cucumber fishery in Malaysia is a traditional in nature. There is no commercial scale of sea cucumber fishery in the peninsula and Sarawak but it is relatively important in the state of Sabah. Sea cucumbers are commonly collected by hand by fishers or their families. Beside manual method, snorkelling and diving are also used to harvest sea cucumbers in Sabah. In Kudat and Sandakan of Sabah, a portion of catches is derived from trawl gears that operating for fish and prawn fisheries. In Pangkor Island, Perak, one fisher and his family member (the only one in this state that harvest sea cucumbers) collect sea cucumbers at low tide and deposit the catch in a submerged cage in the sea close to his house. At one time he has gathered a maximum 1000 individual sea cucumbers before selling them to buyers (Baine and Choo, 1999). Up till today, the production of all commercial sea cucumbers in Malaysia is contributed from natural populations.

The main fishing areas for sea cucumbers are concentrated in coral reef region and some of the edible but not commercially significance species such as *Paracaudina* sp. or locally known as 'beronok' are found in the mudflat of coastal mangrove areas. The contribution of sea cucumber catches is insignificant in terms of tonnage and value compared to catches of commercial fish and prawns landed in Malaysia. The presence of non commercial scale sea cucumber fishery in the peninsula and Sarawak is simply because most of the coral reef islands in Peninsular Malaysia have been gazetted as Marine Parks. Four group of island clusters (Redang Islands in Terengganu, Tioman Island in Pahang, off-Mersing Islands in Johor and Payar Island in Kedah) comprise of 37 islands altogether were gazetted as Fisheries Protected Areas in 1987, then legally declared as Marine Parks in 1994. This management intervention allows no fishing and collection of aquatic organisms in these areas. In addition, four areas in the waters of the west coast of the peninsula (Pulau Besar and Tanjung Tuan in Melaka, and Tanjung Tuan 1 and Tanjung Tuan 2 in Negeri Sembilan) have also been declared Fisheries Protected Areas in 1994. This consequently limits the space and activity for harvesting sea cucumbers.

The areas left for sea cucumber harvest include the ungazetted Sembilan group of islands and Pangkor Island in Perak, and Langkawi Island, Kendi Island and Songsong Island in Kedah - all is in the west coast of Peninsular Malaysia. The sea cucumber fishery in the ungazetted islands on the east coast is almost non existence. The fishing areas in Sabah concentrate in Semporna, Sandakan, Kudat and Kota Kinabalu. There are relatively large areas of ungazetted coral reefs and reef flats available for sea cucumber fishery. The islands of Pulau Tiga Parks (3 islands), Pulau Tunku Abdul Rahman (5 islands) and Turtle Islands Park (3 islands) have been gazetted as Marine Parks and managed by the Sabah Parks Authority, while the Lankayan-Bilean Islands (off Sandakan) have been declared a conservation area under the Wildlife Conservation Act. Due to an inadequacy in the enforcement capacity and issue of illegal immigrants, the problems of poaching, dynamite and cyanide fishing even in the restricted areas still occur in the Borneo part of Malaysia.

Fishing season for sea cucumbers is all the year around. May to August is the best months for sea cucumber collection because of the calm seas. January to March appears to be the worst time because of the unfavourable weather caused by the Northeast monsoon. Fishing season is well represented by monthly landing data from Sabah that also indicates months in the middle of the year as the peak collection period (**Figure 1**). Fishing is carried out during the day or at night as long as the weather permits and the tide are low enough to allow fishers to walk on the reef. In Sabah, the numbers of registered fishers were 77 in Semporna, 0 in Sandakan, 112 in Kudat and 28 in Kota Kinabalu for the year 2000. However, these figures may not reflect the actual numbers of sea cucumber collectors. Taking into consideration that sea cucumbers are collected by family members of the fishers, the actual numbers of collectors may reach 5-6 times higher (Choo, 2004). In the peninsula, as the fishery is relatively insignificant, there are only a few regular sea cucumber fishers. In Pulau Pangkor, there is only one fisher collecting the animals occasionally with the help from his grandson. While in Pulau Langkawi, fishing is reported to be carried out by some part time and occasional fishers. The number of fishing days for sea cucumber collection in Malaysia average 20 days a month.

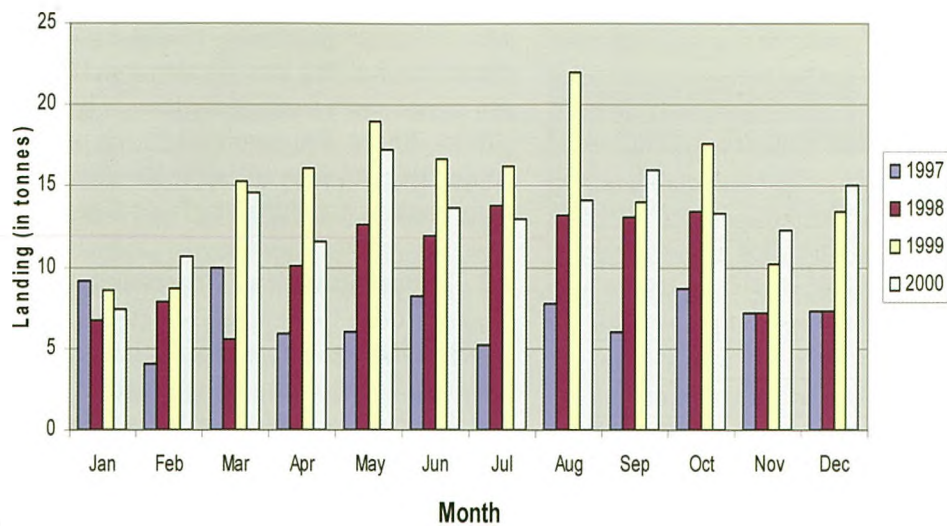


Figure 1. Seasonal landing of sea cucumbers in Sabah, Malaysia (based on landing data for 1997-2000)

With respect to catches of sea cucumbers in Malaysia, there are about 20 species commercially fished. Compared to five years ago, the present landings comprise a significant increase in catches 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*). Some of the common commercial species in Sabah and their local names are given in **Figure 2** and **Table 3**. The annual landing of sea cucumbers in Malaysia

does not appear in the Malaysian Fisheries Statistics because its figures are insignificant compared to the landings of fish and prawns. Sea cucumber landings in Malaysia are mainly contributed from Sabah. The FAO Fisheries Statistics for 1980s and 1990s also showed that there was a small fishery for sea cucumbers in Peninsular Malaysia. Statistics of sea cucumber landings from Sabah during the 1980-2000 periods averaged approximately 100 tonnes annually (**Table 4**). The Sabah Annual Fisheries Statistics also separate sea cucumber landings by fishing gear group (**Table 5**) showing that Pick/Dive as a major method of fishing sea cucumbers.



Figure 2. Local names of commercial species of sea cucumbers from Sabah. Top (left to right): boli-boli; kasut; gadol; talipan; bot-bot; legs; patola; leopard, black beauty. Bottom (left to right): susu; broam beauty (white); mother tadik; broam beauty (brown); powder; hotdog; patola; gadol; boli-boli; sandfish; tri kantos; tadik.

Table 4. Annual landings of sea cucumbers in Malaysia and Sabah for 1980 - 2000.

Year	Landings (in metric tonnes)	
	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 and Annual Fisheries Statistics, Sabah. The Sabah figures for 1980-1990 include sea urchins

Table 5. Annual landings of sea cucumbers in Sabah for 1991 - 2000.

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	89.55	122.56
1999	38.55	0	139.25	177.8
2000	37.97	0	120.94	158.91

Values of sea cucumbers are related to the thickness of their body walls and sizes. 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 kilogram, 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. (Choo, 2004). The wholesale price of some of the commercial species of beche-de-mer products and their markets are shown in Table 6 below.

3.2 Local Usage and Processing

Holothurian resources in Malaysia are utilised for both local consumption and export market. The local consumption of these resources circles around the production of medicinal and nutritional products as well as culinary delicacies. The Malay community has traditionally used certain species of *Stichopus* or locally known as 'gamat' for their medicinal properties. Traditionally processed of gamat products have long been used in treating stomach ulcers, wound healing and as a pain killer. Darmananda (undated) reported that sea cucumber is cholesterol-free, high in protein (55% of dry body weight) and contains 10-16% mucopolysaccharides and saponins which are helpful in reducing arthritis and arthralgia, and anti-inflammatory and anti-cancer properties, respectively. *Stichopus hermanni* was reported to provide painkilling, anti-inflammatory and anti-itching properties (Awaluddin, 2001). Current studies in Malaysia indicated that the *Hothuria atra* contains three types of antimicrobial agents (atratoxin A, B1 and B2) which exhibit high activity against various species of yeast and fungi, but no activities against bacterial species (Ibrahim *et al.*, 1992). The ethanol-extract from *H. atra* has shown antifungal properties effective against the yeasts *Saccharomyces lypolytica* and *Candida lypolytica* (Shaharah *et al.*, 1998). Another study conducted by Hawa *et al.* (1999) proved that the coelomic fluid of *S. badionotus*, *S. hermanni* and *B. marmorata* has antioxidant property. The centre for the production of traditional gamat-based products is Pulau Langkawi, Kedah in the Peninsular Malaysia. The Chinese have long regarded the holothurian species as a general tonic useful for treating tendonitis, arthritis and other disorders, and as an aphrodisiac. The Chinese also consume sea cucumbers as food delicacies. Latest development shows that *Stichopus* (gamat) are popularly used in Malaysia in producing health and nutritional products in various forms such as lotions, tablets, oils and creams, which are found most in departmental stores and pharmacies.

The techniques and ingredients used in the processing of sea cucumbers in this country differ and depending on the purposes and products people wanted to produce. Gamat water, one of the traditional medicine products is processed by people in Pulau Langkawi by draining the coelomic fluid from the *Stichopus* (gamat) species. The animals are then returned to the net cage holding them for subsequent use (Baine and Choo, 1999). Gamat oil is made of *Stichopus* species from wild and holding cages by boiling them in oil together with some herbs. The other sea cucumber products that produced through high technology-based industries offer limited information accessibility as many operators consider them a business secret. Among them include products such as juice, balm, liniment oil, cream, toothpaste, gel facial wash, body lotion and soap. Through some processes in the kitchens, the *Holothuria* spp. are cooked by Chinese for making assorted soups and food delicacies, while some Malays turn this sea cucumber especially *Acaudia* spp. into a food locally called as 'kerabu' and serve during lunch and dinner.

There are several methods of processing sea cucumbers for export market. The post-processed products of sea cucumbers, also called as beche-de-mer are commonly be in form of either chilled, dried, frozen, salted, in brine, smoked or boiled. Processing of the product begins with the heating of sea cucumbers in a wok on low heat without adding water. Then it is transferred into another wok containing boiling water mixed with papaya leaves or lime to soften the skin of sea cucumbers. The mixture is left to boil for some times before being smoked or sun dried. The beche-de-mer produced by fishers is generally that of semi-processed and of low quality due to the presence of sand in the coelom and some level of moist (Choo, 2004). Besides fishers, the middlemen and processors also produce beche-de-mer in a slightly different way. Products yielded by the later two groups are of better quality and fetch higher prices. The supplied sea cucumbers are either processed immediately or being kept in container filled with brine. Tick body wall species such as the teatfish is vertically slit. On the other hand, thin body wall species such as the blackfish and sandfish do not require this process. The next step is to place them into a wok containing boiling seawater where they are left to simmer for about 1 1/2 hours over a slow heat. Sea

cucumbers are boiled twice over a small fire and then dried under the sun. For the brine-preserved sea cucumbers, the salt is removed beforehand by washing them with water prior to 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 wok 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 1 1/2 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 (Choo, 2004). Regardless of types of the end products, the boiling and drying of sea cucumbers in the processing stages seem to reduce their nutrient contents and final quality of the products.

3.3 Marketing

The market destination of sea cucumbers involves both domestic and international (**Table 6**). A small portion of fresh sea cucumbers are partly sold at some local fish markets for consumption (commonly ends up in individual houses and restaurants) especially in the Chinese populated areas in Malaysia. The domestic market also includes those purchased by the processors from the fishermen or middlemen for producing traditional medicines and the other health and related products. The volume that goes to local markets and restaurants is hardly quantified. Major portion of these resources is exported in various forms such as frozen, dried, salted and smoked. However, the most significant product is the dried body wall known beche-de-mer (**Table 6**). The local market value of sea cucumber products varies depending on, among others, the species, size and product form. The prices of dried sea cucumber products range between USD1.3 per kg and USD79 per kg (**Table 6**). The distribution chain of sea cucumber products depends again on its destination either domestic or international. In the domestic market system it begins with fishers who collect the sea cucumbers and sell them fresh either directly to the restaurant owners or to the

Table 6. Summary for consumption and marketing of sea cucumbers in Malaysia

Sea Cucumber Species	Family Name	Product form	Locally Consumed (C), Discarded (D), Traded (T)	Local Price (US\$/kg)	Market Destination
<i>H. nobilis</i> , <i>H. fuscogilva</i>	Holothuriidae	Dried	C and T	42.10 or 78.95 (retail)	Domestic and International market
<i>H. scabra</i>	Holothuriidae	Dried	C and T	10.53 (small) or 18.42 (medium) or 36.84 (large)	Domestic and International market
<i>H. fuscopunctata</i>	Holothuriidae	Dried	C and T	6.58	Domestic and International market
<i>H. leucospilota</i> (Patola)	Holothuriidae	Dried	C and T	5	Domestic and International market
(Tri kantos)	Holothuriidae	Dried	C and T	1.58	Domestic and International market
<i>Holothuria pardalis</i> (Bantunan)	Holothuriidae	Dried	C and T	1.32	Domestic and International market
(Broam beauty - white)	Holothuriidae	Dried	C and T	9.21	Domestic and International market
(Broam beauty - brown)	Holothuriidae	Dried	C and T	4.74	Domestic and International market
<i>Stichopus</i> sp.	Stichopodidae	Dried	C and T	17.89 (small) or 21.05 (medium) or 23.68 (large)	Domestic and International market
<i>Actinopyga miliaris</i>	Holothuriidae	Dried	C and T	17.11	Domestic and International market
<i>Thelenota ananas</i> (Talipan or Timpul)	Stichopodidae	Dried	C and T	17.11	Domestic and International market
<i>T. anax</i>	Stichopodidae	Dried	C and T	3.68	Domestic and International market
<i>Bohadschia</i> sp.	Holothuriidae	Dried	C and T	7.37 9.21	Domestic and International market

middlemen and/or retailers before reaching the consumers. The international market flow is from fishers to middlemen to processors or producers to exporters to importers then finally to consumers. Baine and Choo (1999) pointed out that in Malaysia the situation is complex, as the country appears simultaneously to be a producer, exporter, importer, and consumer and the products appears under different categories (live, fresh or chilled and frozen).

4. Trade

Sea cucumber products that are traded from and into Malaysia (mainly through Sabah) are generally categorised into chilled, fresh or frozen, or as other than these, which include dried, smoked or in brine. The former group of products (i.e., chilled, fresh or frozen) are exported mainly to Peninsular Malaysia and Singapore (**Table 7**), while the later group of products (i.e., other than chilled, fresh, frozen),

its main markets are the Peninsular Malaysia, Singapore, Sarawak and Hong Kong SAR (China) (**Tables 8**). Table 7 and 8 also indicate the values (in US\$) of total export of beche-de-mer from Malaysia for the period 1984-2000. The imported products for both categories into this country are mainly sourced from the Philippines (**Table 9** and **10**). The international trade of sea cucumbers is dominated by the Southeast Asian and Far East Countries whereby nearly 90% of sea cucumbers harvested globally is consumed in these regions. (Ferdouse, 2004). Malaysia is considered the third important country in terms of the world imports of sea cucumbers for fresh, frozen, dried, salted and in brine products.

The trade statistic for sea cucumbers is only available since 1984 and has been considered as too brief with no species or sub-group specific and requires re-evaluation. There is some confusion with respect to the SITC code used for identifying

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

year	Exports from Sabah (tonnes) to:									
	Pen. Malaysia	Sarawak	Singapore	Brunei	Japan	Hong Kong	Indonesia	Philippines	Total	US\$
1984	3.26	1.47	0.4						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	0.6	1.00						4.44	8 837
1996									0	0
1997									0	0
1998	1.05		0.40						1.45	7 500
1999	2								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 trepang fit for human consumption.

Table 8. Beche-de-mer (other than chilled, fresh and frozen) exported from Sabah (metric tonnes)

year	Exports from Sabah (tonnes) to:											
	Pen. Malaysia	Sarawak	Singapore	Brunei	Hong Kong	Taiwan	Thailand	Philippines	South Korea	USA	Total	US\$
1984	2.89	32.64	48.45								83.98	102 132
1985	51.54	137.19	62.8								251.53	158 355
1986	17.58	27.43	75.02	0.16	4.18						124.37	209 150
1987	13.51	31.66	70.2		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	9.790	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	2.6	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	0.8		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	3.5	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	5.3	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 9. Chilled, fresh and frozen beche-de-mer imported into Sabah (metric tonnes).

year	Imports into Sabah (tonnes) from:										
	Pen. Malaysia	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			0.3	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 10. Main imports of beche-de-mer (other than fresh, chilled and frozen) in Sabah (metric tonnes).

year	Imports into Sabah (tonnes) from:						
	Australia	Hong Kong	India	Indonesia	Philippines	Singapore	Pen. 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	0.1	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		0.5
1995							
1996				3.5	0.03		
1997				0.5			
1998					0.7		1.22
1999			0.02				13.89
2000							4.38

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

beche-de-mer in the existing statistics. In the Annual Fisheries Statistics of 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 (Choo, 2004).

5. Conclusion and Recommendations

Fisheries – the sea cucumber fishing has been totally banned in Marine Parks and protected areas. Its population status in these areas is relatively stable. Species numbers are observed high and size range is narrow suggesting that the populations are still healthy. The fishery in Pulau Langkawi is somewhat active due to high demand in traditional gamat industry. The population of *Stichopus* in the vicinity of this island has seriously depleted. In Pulau Pangkor, one fisher and his family have been collecting sea cucumbers and there are still relatively high numbers of juveniles suggesting the fishing effort had little impact. In Sabah, signs of overfishing of the more valuable species such as teat fish and sand fish are evident by the decline trends in landings and the decrease in overall size of the animals landed. In Sarawak, there is limited data and information pertaining to the population status but general observation indicates that fishing is minimal suggesting the overfishing does not occur. The intense fishing of sea cucumbers in any one particular area may cause a serious decline to its population. Consequently, the problem can spread to nearby populations within and cross-country as people would search for new sources of sea cucumbers to fulfill the demand. There are cases of finfishers, due to limited enforcement capacity, encroaching on marine parks as there are bountiful of resources in these areas. Similar thing may happen with respect to sea cucumber resources in the future if appropriate management measures are not immediately taken.

Utilisation – an observation on the existing processing techniques has led to a general conclusion that the product quality needs to be improved. This would unquestionably direct to

an increase in market value. Improved processing techniques can help increase earnings that may alleviate additional pressure on sea cucumber stocks because the same earnings can be achieved with less catch and/or effort. There is an issue of imbalance among earnings of fishers, processors and traders. The possible solution is through catch regulation with the employment of taxation as an initiative to readdress the imbalance. If the sea cucumber industry works in a more equitable nature and aided through legal codification, then fishers seem to be more acceptable to co-management.

Trade – the monitoring and understanding sea cucumber market is one of the key factors in resource management. This however, is not taking place at present in Malaysia within the perspective of sea cucumber fisheries and management. In some countries, the provision of size limit and its monitoring have been reported effective in controlling resource exploitation. If the species of interest is found too small in the market then the fishing season is closed and vice versa. By monitoring the market price the authorities can also control resource exploitation. For instance, if the market is low, then the fishing of targeted species is banned. The regulation had been imposed on sea urchin fishery in Japan with some success. The trade statistics are generally not sufficient. The situation in Malaysia is complicated as the country being simultaneously an importer, exporter, producer and consumer. There is a need to collect and standardize the statistics at the different levels of the holothurian system.

Recommendations – there is a critical need to establish and implement management plans towards sustainability to ensure the breeding populations of all sea cucumber species are maintained. Knowledge gap needs to be bridged immediately through strategic research and monitoring. The management should be an integrated in nature and taking into account all stakeholders within and surround the sea cucumber system. The fisheries, market and trade statistics need to be improved. Actions are required in enhancing the management sustainability through financial capacity, human resource development and participation of the community, among others.

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Bibliography

- Awaludin, A. 2001. Pharmaceuticals. In: *The Encyclopedia of Malaysia. The Seas*, p18-119. Ong, J.E. and W.K. Gong (eds.) Editions Didier Millet, Kuala Lumpur.
- Baine, M. and Choo, P.S. 1999. Sea cucumber fishery 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), p49-63. Department of Agriculture, Kuala Lumpur, Malaysia. February 1999. Heriot-Watt University, Orkney, Scotland.
- Choo, P.S. 2004. Fisheries, trade and utilization of sea cucumbers in Malaysia. In: *Advances in sea cucumber aquaculture and management*. Conand, C., Purcell, S., Uthicke, S., Hamel, J-F, and Mercier, A. (eds.), p57-68. FAO, Rome.
- Darmananda, S. undated. Sea cucumber: food and medicine. [http://www. itmonline.org/arts/ seacuke.htm](http://www.itmonline.org/arts/seacuke.htm).
- Fedouse, F. 2004. World markets and trade flows of sea cucumber/beche-de-mer. In: *Advances in sea cucumber aquaculture and management*. Conand, C., Purcell, S., Uthicke, S., Hamel, J-F, and Mercier, A. (eds.), p101-117. FAO, Rome.
- Forbes, R., Ilias, Z., Baine, M., Choo, P.S. and Wallbank, A. 1999. A taxonomic key and field guide to the Sea Cucumbers of Malaysia. Heriot-Watt University, Orkney, Scotland. 62pp.
- Hawa, I., Zulaikah, M., Jamaludin, M., Zainal Abidin, A.A., Kaswandi M.A. and 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. and Satheesh, N. 1992. Aktiviti antimikrob oleh atratoksin daripada timun laut tempatan, *Holothuria atra* (Jaeger). Prosiding Simposium Sumber Alam Kebangsaan Pertama, 2: 93-100.
- Shaharah, M.I., Ali, A.M., Abdul Manan, M.J., Ramli, S. and Salahuddin, J. 1998. Preliminary investigation on antimicrobial and cytotoxic properties of Malaysia seaweed (*Gracillaria changii*) and sea cucumber (*Holothuria atra*). Prosidings of Fisheries Research Conference 1998, p124-130. Institut penyelidikan Perikanan, Bat Maung, Penang, Malaysia.