Report of the Regional Study on Sea Cucumber Fisheries, Utilization and Trade in Southeast Asia 2007-2008

THE SECRETARIAT
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

REPORT ON

THE REGIONAL STUDY ON SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN SOUTHEAST ASIA

2007-2008

SOUTHEAST ASAIN FISHERIES DEVELOPMENT CENTER

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PREPARATION AND DISTRIBUTION OF THIS DOCUMENT

Report of the Regional Study on Sea Cucumber Fisheries, Utilization, and Trade in Southeast Asia (2007-2008), in collaboration with the Association of Southeast Asian Nations (ASEAN). The document is distributed to the ASEAN-SEAFDEC Member Countries, SEAFDEC Departments and concerned institutions.

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We also want to thank members of the Ad Hoc Regional Working Group on Sea Cucumber Fisheries including Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Vietnam. Without your efforts, this report could not be accomplished.

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Finally, the Secretariat would like to address again that all the above individuals deserve our gratitude for helping in various ways to complete this regional study. With our compliments!

SEAFDEC Secretariat
December 2008

TABLE OF CONTENT

Executive Summary

The present trend towards overfishing of sea cucumbers in diverse geographical areas to supply international market demand has become an urgent concern in the international community. There is also an attempt to conserve and manage sea cucumber in commercial species by various international organizations.

Nonetheless, inadequate attention is given to the management of these species since its fisheries status is not very well known. The ASEAN-SEAFDEC Member Countries therefore agreed to conduct the 'Regional Study on Sea Cucumber Fisheries, Utilization, and Trade' and established the 'Ad-hoc Regional Working Group on Sea Cucumbers Fisheries' in July 2007.

Outcomes of the Regional Study show that more than 135 species of sea cucumber were found in Southeast Asia during the desk study. Sea cucumbers are generally harvested by local fishermen using simple or traditional methods. Sea cucumbers are mostly utilized for both local consumption and export market particularly the Chinese market. Sea cucumbers are sold in various forms, e.g. fresh, dried, and advanced processed products for consumption as culinary delicacies as well as medical and nutritional products. However, data and information related to trade in sea cucumbers may have been underestimated and/or overestimated at national levels due to various reasons, i.e. it is the target species, having high demand for export, could be traded at border-to-border, etc.

There are a number of common problems in data and information collection including statistical records do not reflect the actual sea cucumber fisheries; existing research capacity limit the appropriate data collection including biological data, resource status, its habitat, trade status and fisheries; existing taxonomical knowledge limit the appropriate identification of sea cucumber species; and lack of trained staff. These identified problem areas should be strengthened.

Sea cucumbers clearly represent an economically important fisheries resource and alternative livelihoods for local communities in the ASEAN region, therefore listing of sea cucumbers under any Convention of International Trade in Endangered Species (CITES) appendices should not be made without best scientific information. Instead, there should be management measures of sea cucumbers in place in an effective and efficient manner. In doing so, it should be accommodated into a national fisheries management framework where exists.

In addition, enhancement of commercial stock should be promoted through the development of aquaculture techniques and restocking program. Each Member Country should recognize and distinguish the economically important species and identify ways for the stock enhancement program of such species.

I. Background and Rationale

I. BACKGROUND AND RATIONALE

1.1 Introduction

Taking into account of a trend towards overfishing on sea cucumbers in commercial species especially in the Families Holothuriidae and Stichopodidae to furnish an international market demand, the issue, started from 2002, has become famous and seriously discussed among the international trade and conservation communities, specifically at the Convention on International Trade in Endanger Species (CITES). Subsidiary CITES-related meetings have shown the tendency of inclusion of sea cucumbers in commercial species into their Appendices.

Based on the global concerns on diminishing of sea cucumber resources, the ASEAN-SEAFDEC Member Countries first time gathered at the Preparatory Meeting on Environmental Related Tasks, which was organized in October 2005 in Bangkok, Thailand in order to discuss on the issue. The recommendations from such meeting were submitted to the 8th Meeting of ASEAN-SEAFDEC Fisheries Consultative Group (FCG) and the 38th Meeting of SEAFDEC Council, which were taken place in Brunei Darussalam in April 2006. The two Meetings provided regional policy directives and supported SEAFDEC in collaboration with the Member Countries on the following aspects:

- Conduct of a regional comprehensive study on existing available data and information on sea cucumbers;
- The Secretariat to coordinate with Department of Marine and Coastal Resources, Thailand when conducting the regional study on sea cucumbers;
- The management of sea cucumber resources should be the purview of the national fisheries competent agency

The above regional policy directives were addressed again at the ASEAN-SEAFDEC Regional Technical Consultation (RTC) on International Fisheries Related Issues held on 18 September 2006, in Phuket Thailand. The Consultation again reaffirmed to conduct the regional study on sea cucumbers fisheries, utilization and trade and also requested SEAFDEC Secretariat in collaboration with the Departments and the ASEAN-SEAFDEC Member Countries to establish the Regional Expert Group on Sea Cucumbers to facilitate the compilation of existing available data and information on sea cucumbers. The Regional Expert Group on Sea Cucumbers will be mobilized for planning and coordination work on sea cucumber status, resources utilization, management and trade in order to assess possibility in the development of country's initiative or action plan and policy recommendation.

1.2 Regional Working Mechanisms and Collaborative Arrangement

So far, there have been very limited studies and collection of information on both the biology and production of sea cucumbers in the Southeast Asian countries. Sea cucumbers nonetheless clearly represent an important fisheries; lack of attention to the management of these species; and their fisheries status is unknown. Therefore, it is important that the region should conduct a study reflecting characteristics of sea cucumbers fisheries, utilization and trade in Southeast Asia.

In order to pave the way for the Member Countries in collecting information related to sea cucumbers fisheries, utilization and trade, SEAFDEC developed a framework for a desk study and established the regional working mechanism for the regional study. Following a framework developed by SEAFDEC, the regional study was conducted by the experts from respective ASEAN Member Countries based on data and information available in their countries. The Experts were also appointed as the members of an 'Ad-hoc Regional Working Group on Sea Cucumber Fisheries' in Southeast Asia.

In this connection, there are eight ASEAN member countries agreed to collect secondary data and information available in their countries, namely Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam. Lao PDR, a landlocked country, and Singapore, without any significant fishery, did not participate to the study.

ASEAN Member Countries:

The regional study was conducted by the National Focal Points, who were nominated by the participating countries. The National Focal Point is responsible for the conduct of national compilation

of necessary information for the regional study on data and information collection of sea cucumber fisheries, utilization and trade and ensures the regular communication with SEAFDEC on issues related to sea cucumbers and the regional study. They were also appointed as a member of 'Ad-hoc Regional Working Group on Sea Cucumber Fisheries', which is tasked to develop regional policy for conservation and management of sea cucumbers and to attend relevant regional meetings as requested by SEAFDEC. The membership of this Working Group will be valid toward the convening of CoP15 CITES.

SEAFDEC:

The Secretariat of SEAFDEC plays coordination role among the member of Ad-hoc Regional Working Group on Sea Cucumber and also the Department of Marine and Coastal Resources, Thailand as suggested by the Council. SEAFDEC is also in-charge of monitoring the progress of sea cucumbers conservation and management at the international level particularly in relation with the FAO and CITES. SEAFDEC Secretariat is responsible for compiling and making synthesis of the national reports as a basis for regional discussion on coordinated positions. Other SEAFDEC Departments also provide necessary information related to sea cucumbers.

Members of the Regional Fisheries Policy Network (RFPN):

For the coordination and facilitation of proposed activities with each participating ASEAN Member Country

1.3 Objective of the Regional Study

To compile necessary information by delineating the status of sea cucumbers in the ASEAN region in order for SEAFDEC and its member countries to address possible issues raised in relation to sea cucumbers at the international fora particularly CITES.

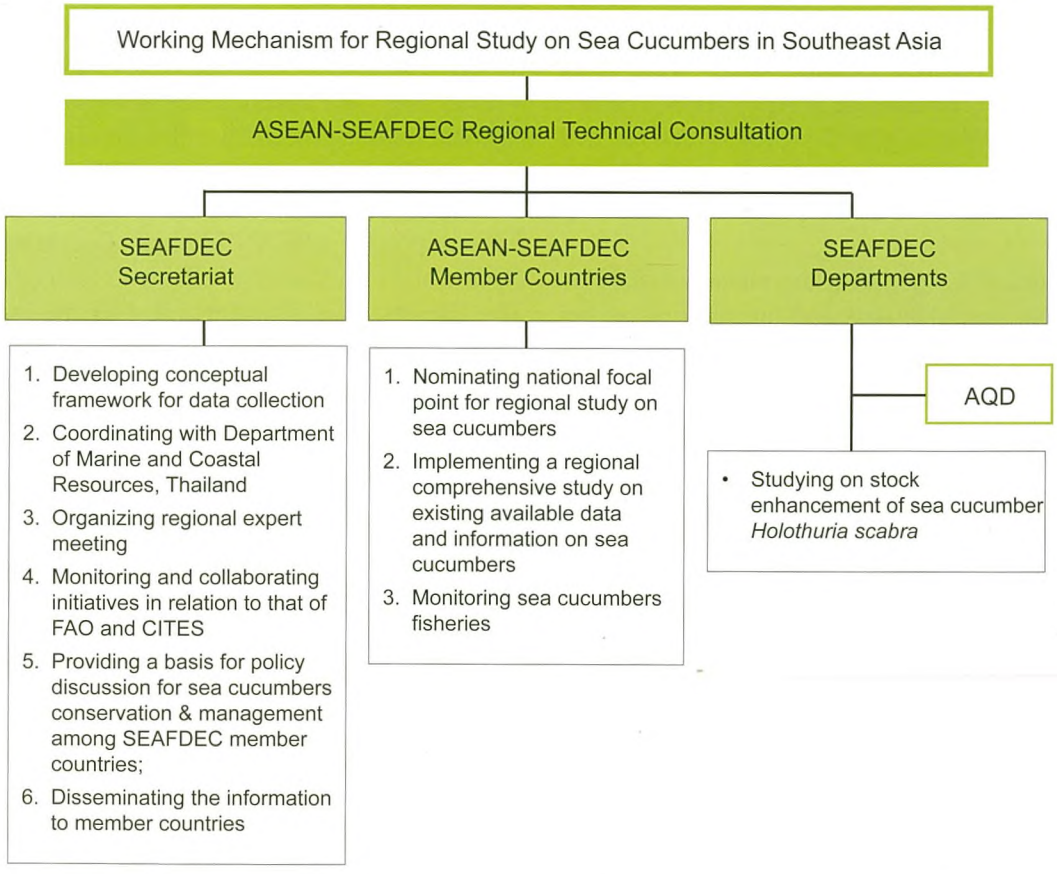


Figure 1. Working Mechanism for Regional Study on Sea Cucumbers in Southeast Asia

1.4 Scope of Study

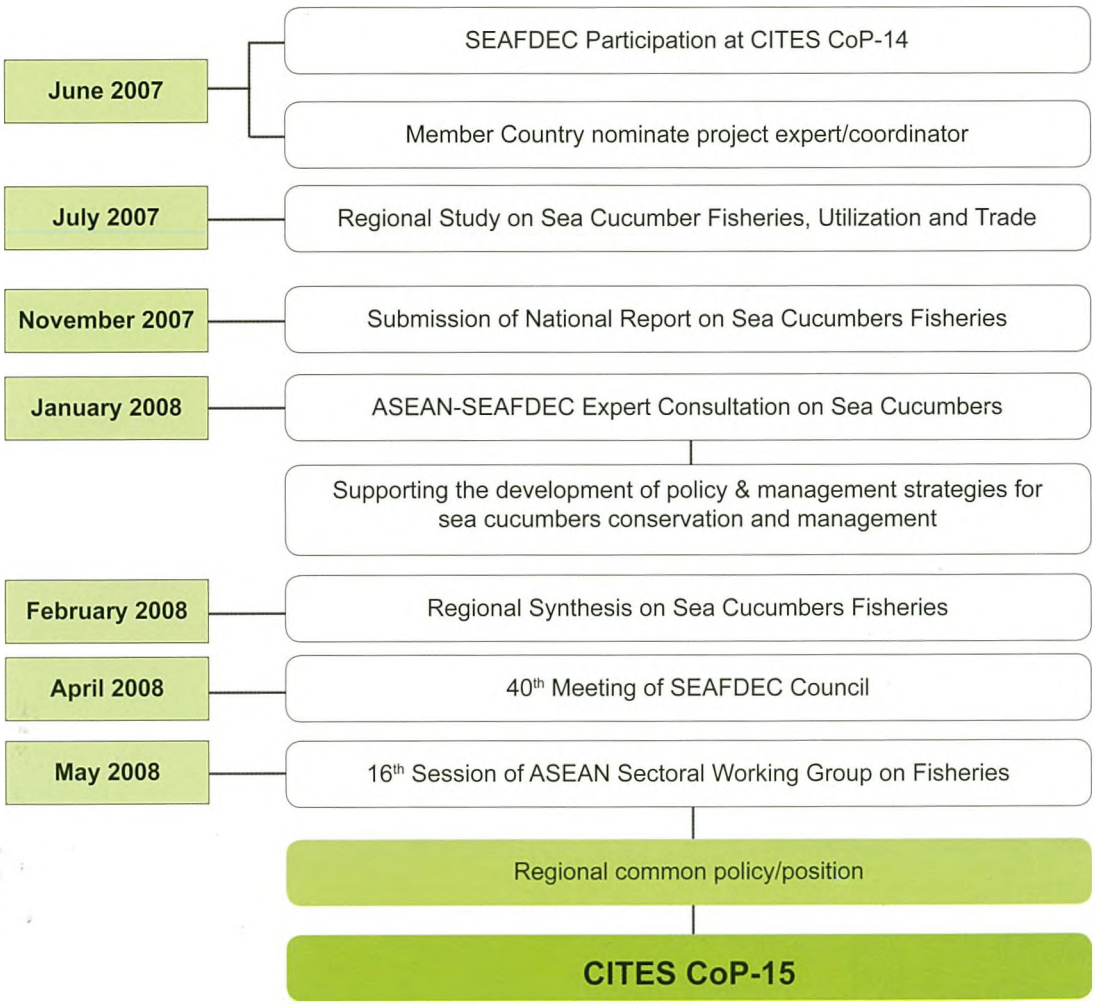
In principle, the study on sea cucumbers should be based on secondary data and information available through statistics and researches works and cover the following aspects:

- Taxonomic information – species available in the country
- Production and utilization – data from statistics or research on the production of sea cucumbers, harvesting or fisheries of sea cucumbers (gear and methods used), and their utilization/ disposition
- Trade – main usage of sea cucumber products, data from statistics or research on trade (import/ export) including main countries of destination (export) or origin (import)

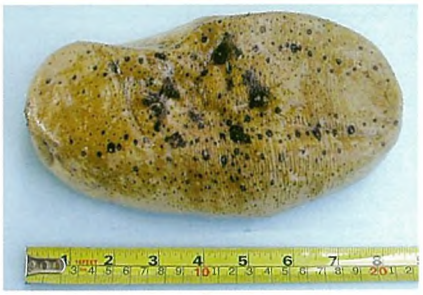
The national focal point and member of an Ad-hoc Regional Working Group on Sea Cucumber Fisheries is encouraged to collect existing secondary information on sea cucumbers in commercial species utilization and trade available in the government (e.g. Central Bureau of Statistics, Ministry of Trades, or others). Available data of at least the last 5-10 years should be collected.

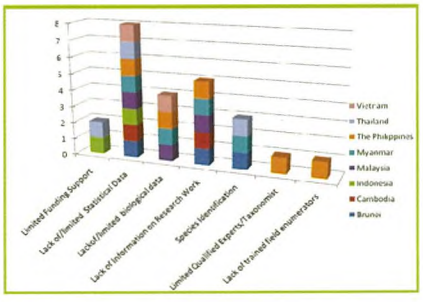
1.5 Time frame

The regional activities related to sea cucumbers issue have been pursued since June 2007. The specific work on regional study was started on 15th July 2007.



II. Summary of the Regional Study on Sea Cucumber Fisheries, Utilization and Trade in Southeast Asia





II. SUMMARY OF THE REGIONAL STUDY ON SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN SOUTHEAST ASIA

2.1 Dominant Species of Sea Cucumber in Southeast Asia

Sea cucumbers are benthic invertebrates generally found in coastal water with diverse species. They play the roles in ecosystem as decomposers and nutrient releasers in food chain. For human being, sea cucumbers have their long history as the traditional medical components and food. Thus, they are commercially important in many countries, especially in the Indian Ocean and South Pacific regions, for high-protein food, medical products, and supplementary food, resulted in a trend towards overfishing on the commercial species.

There are about 135 sea cucumbers species found in Southeast Asian region (**Table 1**).

Table 1. List of Sea Cucumber species found in the Southeast Asian region

Sea Cucumber	Found in	Sea Cucumber	Found in
Holothuria (Halodeima) atra	BRU, INA, MAS, MYR, PHP, THAI, VIET	*Thelenota ananas*	BRU, INA, MAS, MYR, PHP, THAI, VIET
Holothuria (Thymiosycia) impatiens	BRU, INA, MAS, PHP, THAI, VIET	*Holothuria (Microthele) nobilis*	INA, MAS, MYR, PHP, THAI, VIET
Actinopyga lecanora	INA, MAS, MYR, PHP, THAI	*Actinopyga miliaris*	BRU, INA, MAS, MYR, PHP, THAI
Bohadschia argus	INA, MAS, MYR, PHP, THAI	*Holothuria (Mertensiothuria) leucospilota*	INA, MAS, PHP, THAI, VIET
Stichopus variegates	INA, MAS, MYR, THAI	*Actinopyga mauritiana*	BRU, MAS, PHP, THAI, VIET
Holothuria (Metriatyla) scabra	INA, MAS, PHP, THAI, VIET	*Holothuria (Halodeima) edulis*	BRU, MAS, PHP, THAI
Bohadschia marmorata	INA, MAS, PHP, THAI	*Pearsonothuria graeffei*	MAS, PHP, THAI, VIET
Holothuria fuscogilva	INA, MAS, MYR, PHP	*Actinopyga echinites*	INA, PHP, THAI, VIET
Holothuria (Thymiosycia) hilla	INA, MAS, PHP, THAI	*Holothuria (Acanthotrapeza) coluber*	INA, MAS, PHP, THAI
Stichopus chloronotus	MAS, PHP, THAI, VIET	*Thelenota anax*	INA, MAS, MYR, PHP
Stichopus herrmanni	MAS, PHP, THAI	*Synapta maculata*	MAS, THAI, VIET
Synapta chloronothus.	INA, MYR, THAI	*Holothuria (Cystipus) rigida*	BRU, PHP, THAI
Holothuria (Metriatyla) martensi	BRU, MAS, THAI	*Holothuria (Microthele) fuscopunctata*	MAS, PHP, THAI
Actinopyga obesa	MAS, PHP, THAI	*Stichopus horrens*	MAS, PHP, THAI
Holothuria (Thymiosycia) arenicola	INA, PHP, THAI	*Holothuria (Selenkothuria) erinaceus*	INA, THAI
Holothuria (Semperothuria) flavomaculata	MAS, THAI	*Holothuria (Stauropora) fuscocinerea*	PHP, THAI
Holothuria (Metriatyla) ocellata	MAS, THAI	*Holothuria (Platyperona) difficilis*	INA, THAI
Bohadschia vitiensis	PHP, THAI	*Stichopus naso*	MAS, THAI
Synaptula sp.2	INA, THAI	*Synaptula* sp.1	INA, THAI
Holothuria (Lessonothuria) verrucosa	MAS, THAI	*Holothuria (Selenkothuria) moebii*	INA, THAI
Holothuria (Mertensiothuria) parvicax	MAS, PHP	*Holothuria (Theelothuria) notabilis*	INA, THAI
Stichopus pseudohorrens	MAS, PHP	*Bohadschia (Holothuria) bivittata*	PHP, THAI
Actinopyga caroliana	PHP, THAI	*Holothuria pardalis*	MAS, THAI

Sea Cucumber	Found in	Sea Cucumber	Found in
Holothuria scabra versicolor	MAS, PHP	*Labidodemas semperianum*	MAS, THAI
Bohadschia paradoxa	MAS, PHP	*Actinocucumis typicus*	MAS, THAI
Stichopus vastus	MAS, PHP	*Cladolebes schmeltzi*	MAS, THAI
Bohadschia similis	INA, MAS	*Stichopus nocvigatus*	MAS, PHP
Holothuria sucossa	INA	*Havelockia versicolor*	THAI
Holothuria (Theelothuria) spinifera	THAI	*Holothuria pervicax*	INA
Actinopyga caerulea	PHP	*Holothuria canaliculata*	PHP
S. badionotus	MAS	*Actinopyga palauensis*	PHP
Holothuria turricelsa	PHP	*Holothuria whitmae*	PHP
Holothuria pervicax	PHP	*Neocucumis proteus*	PHP
Holothuria coronopertusa	MAS	*Holothuria excellens*	PHP
Thelenota tubralineata	PHP	*Cucumaria mosaiica*	THAI
Holothuria kurti	INA	*Holothuria pulla*	PHP
Neothynidium magnum	MAS	*Holothuria inhabilis*	PHP
Opheodesoma glabra	MAS	*Euapta godeffroyi*	MAS
Synaptula lamperti	MAS	*Synaptula media*	MAS
Stolus buccalis	THAI	*Holothuria modesta*	INA
Phyllohorus (Urodemella) holothurioides	THAI	*Holothuria (Acanthotrapeza) pyxis*	THAI
Thyone cf. papuensis	THAI	*Colochirus quadrangularis*	THAI
Cercodemas anceps	THAI	*Bohadschia arta*	THAI
Bohadschia (Holothuria) koellikeri	PHP	*Holothuria (Metriatyla) albiventer*	THAI
Psedocnus (Cucumaria) echinata	THAI	*Holothuria (Microthele) axiologa*	THAI
Plesiocochirus australis	THAI	*Actinocucumis typicus*	THAI
Pseudocolochirus sp.	THAI	*Cucumaria frondosa*	THAI
Menamaria bilolumnata	THAI	*Pseudocolochirus violaceus*	THAI
Afrocucumis africana	THAI	*Leptopentacta javanicus*	THAI
Cladolebes schmeltzi	THAI	*Menamaria intercedens*	THAI
Holothuria (Stauropora) discrepans	THAI	*Holothuria (Semperothuria) cinerascens*	THAI
Thyone okeni	THAI	*Selenkiella malayense*	THAI
Stolus conjugens	THAI	*Selenkiella siamense*	THAI
Stichopus vatus	THAI	*Hemithyone semperi*	THAI
Phyllohorus sp.	THAI	*Globosita argus*	THAI
Phyllohorus (Phyllophorella) robusta	THAI	*Phyllohorus (Phyllophorella) kokkutiensis*	THAI
Phyllohorus (Phyllothuria) cebuensis	THAI	*Phyllohorus (Phyllophorella) parvipedes*	THAI
Molpadia(Ankyroderma) roretzi	THAI	*Pseudocolochirus axiologus*	THAI
Stichopus japonicus	THAI	*Acaudina molpadioides*	THAI
Paracaudina sp.	THAI	*Acaudina leucoprocta*	THAI
Synaptula recta	THAI	*Acaudina* sp.1	THAI
Synaptula aff. Virgata	THAI	*Acaudina* sp.2	THAI
Opheodesoma grisea	THAI	*Acaudina* sp.3	THAI
Opheodesoma lineate	THAI	*Paracaudina chilensis*	THAI
Opheodesoma australiensis	THAI	*Protankyra pseudodingitula*	THAI
Opheodesoma clarki	THAI	*Polyplectana kefersteini*	THAI
Pendekaplectana nigra	THAI		

2.2 Sea Cucumbers Utilization

Fishing Operation

Sea cucumbers in the nature have been harvested by the simple or traditional method by hand up to fishing gear operation. The methods are varying ranging from picking by hand during low tide from intertidal area and from shallow water, snorkelling at deeper water up to 5-10 m, and also punching by pointed metal spear mounted on a long pole.

Utilization and Marketing Product

Holothurian resources in Southeast Asian region are mostly utilised for both local consumption and export market. There are some different ways to sell the sea cucumbers to the market, whether to sell the sea cucumber as a fresh, dried or advanced processed products. The local consumption of these resources circles around the production of medicinal and nutritional products as well as culinary delicacies.

Fishermen often sell the product to the collector or buyer into two forms, fresh or dried of sea cucumber. After harvesting sea cucumbers, the fishers and his family processed or dried the catches in the sun or boiled with sea waters and smoke with charcoal. The marine products collector/buyer visit directly and collected from fishers, who based on the island.

The collector then sells the sea cucumbers to the manufacture or further processed them to become other advanced processed product form. The manufacture will then export the products to overseas or to the big cities within the country. The marketing scheme of sea cucumber in many ASEAN countries can be described in **Figure 1**.

The price of fresh and processed sea cucumbers varies by species and markets. Values of sea cucumbers are also 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. List of commercial value of dominant sea cucumbers species in ASEAN producer countries are shown in **Table 2**.

Table 2. List of commercial value of dominant sea cucumber species in each country

Sea Cucumber	Range Value (USD)
Actinophyga miliaris	8 - 44
Holothuria atra	1.75 – 22.5
Holothuria edulis	8 – 22.5
Holothuria impatiens	2.5
Holothuria martensii	NA
Holothuria rigida	3 - 59
Holothuria sp.	4.75 - 44
Thelenota ananas	12.5 – 67.5
Actinopyga echinites	4.5 – 57.5
Holothuria scraba	9 – 112.5
Holothuria fuscogilva	15.5 - 95
Bohadschia marmorata	1.40 – 23.75
Stichopus variegatus	6.75 – 62.5
Holothuria (Microthele) nobilis	20 – 78.95
Actinopyga lecanora	8 – 71.25
A. mauritiana c.f.	5-15
H. (M.) whitmaei	17.5- 112.5
H. (M.) leucospilota c.f.	4.75 - 5
Pearsonothuria graeffei	1.75 - 5
Stichopus chloronotus	21.25 - 65
Thelenota anax	3.68 - 60
Bohadschia argus	20 - 30
Stichopus hermanni	62.5

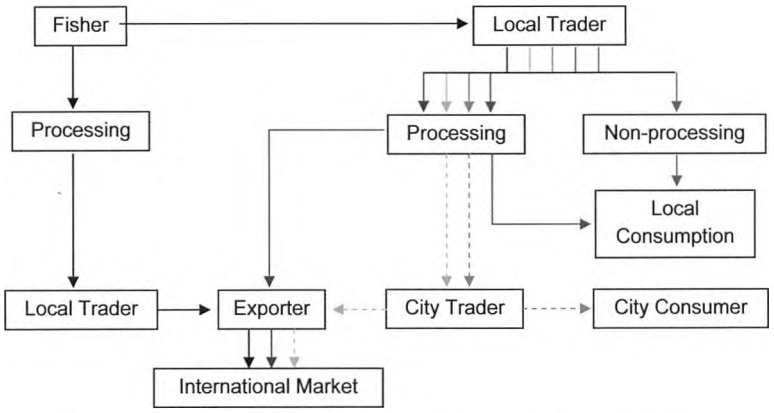


Figure 1. Sea cucumbers marketing scheme in ASEAN country

Sea Cucumber	Range Value (USD)
Neocucumis proteus	1.25 per piece
Stichopus horrens	62.5
Stichopus noctivagus	37.5
Thelenota rubralineata	13.75
Actinopyga mauritiana	50
Actinopyga obesa	NA
Bohadschia paradoxa	12.5
Bohadschia vitiensis	12.5
Holothuria arenicola	0.5
Holothuria coluber	22.5
Holothuria fuscocinerea	3
Holothuria fuscopunctata	6.58 - 9.25
Holothuria hilla	3
Holothuria scabra var. versicolor	23.75
Holothuria inhabilis	0.5
Holothuria pulla	13.75
(Tri kantos)	1.58
Holothuria pardalis (Bantunan)	1.32
Actinopyga miliaris	17.11
Stichopus sp.	17.89 - 23.68
(Broam beauty - white)	9.21
(Broam beauty - brown)	4.74
Bohadschia sp.	7.37- 9.21

2.3 Export Destination

Sea cucumber are a delicacy in the Far East; the Chinese consume them is processed formed while the Japanese and Koreans eat them fresh. They are also used in the production of oils, lotions, cosmetics and tablets. The major export destinations of ASEAN producer of sea cucumber are mainly China, Hong Kong, Korea and Japan. (**Table 3** and **4**)

2.4 Problems and Constraints

As aforementioned, there is very limit number of sea cucumber information, research, and study in the region, the problems and constraints during the conduct of regional study were identified by respective national focal points as shown in **Table 5**. The most common problems were facing during the conduct of regional study is lack of and/or limited statistical records, lack of information on research work, lack of and/or limited biological data, knowledge on species identification, and funding support respectively (**Figure 3**). The suggestions are also shown in **Box 1**.

Table 3. ASEAN Sea Cucumber's Product Export in International Market

ASEAN Countries	International Export Destination									
	HKK	JPN	CHN	USA	NIG	KOR	TWN	AUS	IND	CAN
Brunei Darussalam										
Indonesia	X		X	X		X	X			
Malaysia	X	X		X		X				
Myanmar	X	X	X			X				
Philippines	X		X	X		X				X
Thailand	X	X	X	X	X	X	X	X	X	
Vietnam	X	X	X	X		X		X		X

Table 4. ASEAN Sea Cucumber's Product Export in Intra-regional Market

ASEAN Countries	Intra-regional Export Destination (within Southeast Asia)							
	BRU	INA	MAS	MYR	PHP	SIN	THA	VIET
Brunei Darussalam			X		X			
Indonesia			X			X		X
Malaysia	X	X			X		X	
Myanmar								
Philippines			X			X	X	X
Thailand			X			X		X
Vietnam						X		

Table 5. Problems and constraints during the conduct of regional study

Country	Problems and Constraints
Brunei Darussalam	• The statistical records are not the actual quantity of sea cucumbers imported into Brunei because they categorized under 'other mollusks' which the amount of imported sea cucumber is generally small. • Lack of biological data because the sea cucumber is not a primary targeted species. • Lack of data on the temporal and spatial distribution. • Lack of assessment studies on the status of its habitat and the impact of various fishing activities. • Lack of proper species identification especially when reported only as sea cucumber in log books and data sheets. • Lack of information or records on the utilization, handling, post-harvest and marketing of sea cucumber particularly to the species level
Cambodia	• Lack of proper national data and information control system • No statistical data and record • No research program focusing on sea cucumbers
Indonesia	• There is a constraint with trade export values due to the number of sea cucumbers exported less than 1000 tons for one time of export activity. Therefore the Indonesian trade authority of fisheries product includes export value of sea cucumbers with other marine products, namely "exotic marine product" • Limited budget allocated in this study while sea cucumber are widely distributed, with relatively they could not visit the main locations of sea cucumbers producer to check and validate the data and information collected in the related office in Jakarta
Malaysia	• Knowledge gap exists with respect to biological and ecological information. • Lack of annual landing of sea cucumbers in the Malaysian Fisheries Statistics because its figures are insignificant compared to the landings of fish and prawns. • Limited statistic data on fisheries, market and trade.
Myanmar	• Lack of identification into species level • Lack of Biological data • Only few studies have been devoted. • Lack of or limited basic data and statistical data due to illegal fishing. • Lack of expertise to identify both live animals and the cured products at the point of export
Philippines	• Lack of trained field enumerators • Limited access to information. Production data in the succeeding years and socio-economic information such as the number of coastal families who depend on sea cucumber fisheries for livelihood are not available. • Lack of baseline data • Lack of taxonomic identification due to few taxonomists • No inventory of sea cucumber per regions, province and municipality • Limited knowledge on reproductive biology of commercially important species • Limited funding/financial assistance • Limited qualified experts to conduct basic research
Thailand	• Lack of identification into species level • Lack of the record on fisheries, marketing and trade in national fisheries statistics. • No study on stock assessment and recruitment. • Limited funding on desk study
Vietnam	• Lack of clear import-export statistical data due to unconnected and incomprehensive data through many years. • Lack of full studies and statistic in stock assessment. • Lack of biological data

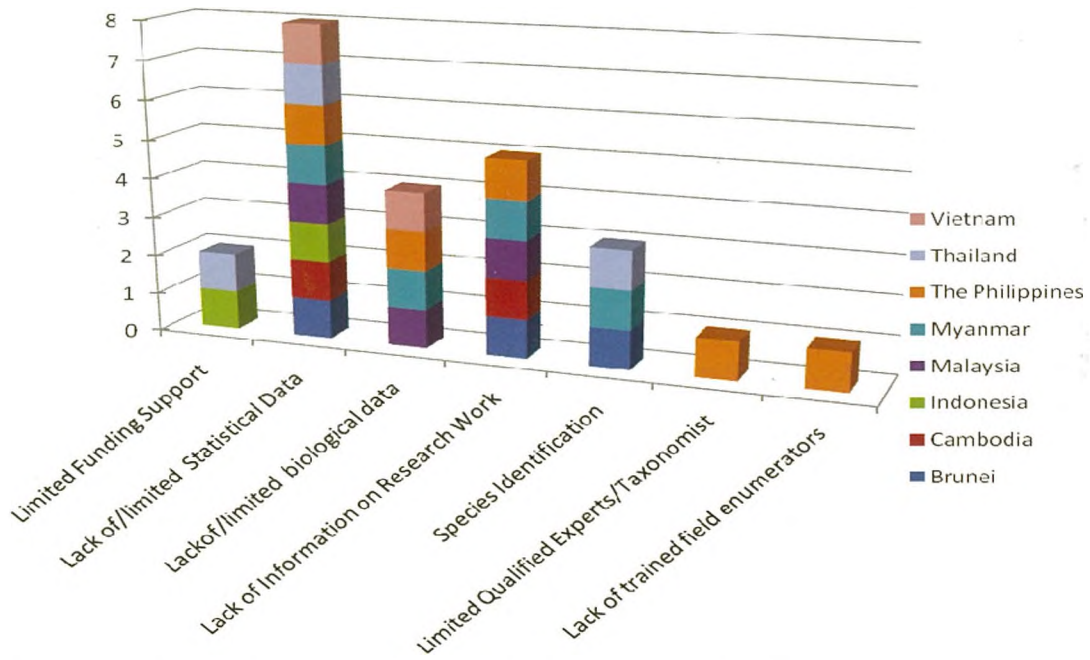


Figure 3. Common problems and constraints in conducting regional study on sea cucumbers

Box 1: The Ad-hoc Regional Working Group on Sea Cucumbers suggested that the following areas should be strengthened.

- Statistical records do not reflect the actual sea cucumber fisheries;
- Existing research capacity limit the appropriate data collection including biological data, resource status, its habitat, trade status and fisheries;
- Existing taxonomical knowledge limit the appropriate identification of sea cucumber species; and
- Lack of trained staff

III. Conclusion and Recommendations

Regional Expert Meeting on Sea Cucumber Fisheries,
18-20 March 2008 Bangkok, Thailand

III. CONCLUSION AND RECOMMENDATIONS

Based on the Summary Report on the Regional Study and the national reports on sea cucumbers presented during the ASEAN-SEAFDEC Regional Expert Meeting on Sea Cucumber Fisheries, held from 18 to 20 March 2008 in Bangkok, Thailand, the Meeting agreed as follow:

3.1 Status of Sea Cucumber Fisheries, Utilization and Trade in Southeast Asia

- More than 135 species of sea cucumber were found in Southeast Asia during the Study;
- Sea cucumbers are generally harvested by local fishermen using simple or traditional methods that vary and range from picking by hand during low tide, snorkeling at shallow waters and deeper waters up to 30 meters, punching by a metal spear as well as using trawl net;
- Sea cucumbers are mostly utilized for both local consumption and export market particularly the Chinese market. Sea cucumbers are sold in various forms, e.g. fresh, dried, and advanced processed products for consumption as culinary delicacies as well as medical and nutritional products; and
- Data and information related to trade in sea cucumbers may have been underestimated and/or overestimated at national levels due to various reasons, i.e. it is the target species, having high demand for export, could be traded at border-to-border, etc.
-

3.2 Sustainable Utilization of Sea Cucumbers in Southeast Asia including Conservation

Within the context of sustainable utilization of sea cucumbers in Southeast Asia, the ASEAN-SEAFDEC Member Countries agreed that:

Recommendations:

- Improvement of existing information gathering mechanism related to data collection, taxonomic identification and assessment of current status and trend of sea cucumbers at the regional level;
- A good landing data collection is imperative to be able to establish the trend and status of sea cucumbers. The involvement of traders, importers and exporters in the data collection should also be considered to ascertain the trend of the market and trade of sea cucumbers;
- To have management measures of sea cucumbers in place in an effective and efficient manner, it should be accommodated into a national fisheries management framework where exists. These include the use of appropriate fishing gears and best practices, effective law enforcement, and designation of fishing areas or zones. Development of appropriate management strategies at national and local level should also be taken into consideration; and
- Enhancement of commercial stock should be promoted through the development of aquaculture techniques and restocking program. Each Member Country should recognize and distinguish the economically important species and identify ways for the stock enhancement program of such species.

3.3 Future Follow-up Actions and a Joint Approach of ASEAN-SEAFDEC Member Countries at International Fora

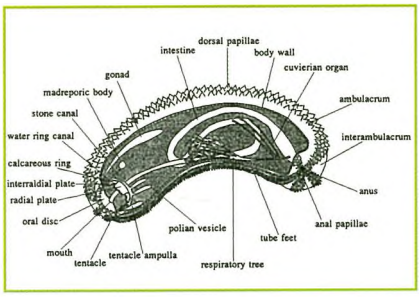
- In parallel with FAO initiatives, the outcome of this Meeting should be conveyed to FAO in order to reflect the ASEAN-SEAFDEC Member Countries' view on the sustainable utilization of sea cucumbers;
- SEAFDEC in close consultation with regional/ international organizations sharing similar characteristic of sea cucumber resources should collaborate for the promotion of the sustainable utilization of sea cucumbers;
- Appropriate technical information, e.g. identification guide to the highly diverse sea cucumber species in Southeast Asia with focus

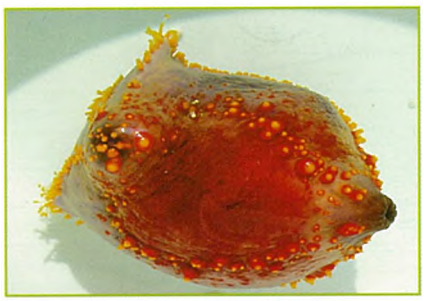
on the commercial species, their scientific names, local names, Chinese name, and photographs of species in different states or forms as well as proceedings from this Meeting should be published and disseminated in appropriate form and disseminated at appropriate regional and international fora particularly during the CITES CoP15; and

- Fisheries related agencies of the Member Countries should make an effort to closely collaborate with CITES authorized agencies within their respective countries in order to reflect the concerns and seriousness in managing sea cucumbers by the fisheries sector of the region.

To support the ASEAN-SEAFDEC Member Countries on the issues related to sea cucumbers conservation and management, the above recommendations will be digested and submitted to SEAFDEC Council and ASEAN Sectoral Working Group on Fisheries (ASWGFi) for their consideration and providing regional policy directive and guidance. The outcomes of the Regional Study on Sea Cucumbers Fisheries, Utilization, and Trade in the Southeast Asia would serve as a guide for SEAFDEC and the Member Countries in addressing possible issues that may be raised at national, regional, and international fora particularly sustainable utilization of sea cucumbers in the Southeast Asian Region.

IV. National Report on Sea Cucumbers Fisheries, Utilization, and Trade





Brunei Darussalam
Cambodia
Indonesia
Malaysia
Myanmar
Philippines
Thailand
Vietnam

SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN BRUNEI DARUSSALAM

By Ms. Ranimah Hj Abd Wahabs [1]

1. Introduction

Brunei Darussalam has a total marine territorial area of about 38,600 km3 covering within the 200 nautical miles of Brunei Fishery Limits. The bottom physical feature of the Brunei Darussalam's water includes a narrow continental shelf having the total area of about 8,600 km2 followed by sharp decline in the continental slope that extends to a deep trench with over 1000m in depth. It has estimated potential fishery resources at Maximum Sustainable Yild (MSY) of 21,300 mt with the value of about B$112 million.

In this study, the data and information of the sea cucumber are based on the landings by 2 (two) licensed boats using hooks, traps and long line that are operating within 3 to 20 nautical miles from the shore, also known as fishing zone 2, which mainly caught coral fish, lobsters as well as sea cucumbers. The trade statistics which revealed imports of sea cucumber, mainly processed products, are extracted from the Brunei Darussalam's External Trade Statistics and direct interviews with the fishermen, traders as well as the seafood consumers.

2. Taxonomic Information

There are eight types of sea cucumbers found in Brunei Darussalam waters based on the reported landings and assessment surveys conducted early on by the Department of Fisheries (**Table 1**).

Table 1: Species of Sea Cucumber in Brunei Darussalam

Species Name	Family Name	Local Name	Gate Price (Wet)	Seling Price (Dried)
Actinophyga miliaris	HOLOTHURIIDAE	TIMUN LAUT TIMPO	B$2.50/piece	B$60.00/kg
Holothuria atra	HOLOTHURIIDAE	TIMUN LAUT TIGER	B$1.00/piece	B$ 30.00/kg
Holothuria edulis	HOLOTHURIIDAE	TIMUN LAUT KASUT	B$0.50/pice	B$10.00/kg
Holothuria impatiens	HOLOTHURIIDAE	TIMUN LAUT	NA	NA
Holothuria martensii	HOLOTHURIIDAE	TIMUN LAUT	NA	NA
Holothuria rigida	HOLOTHURIIDAE	TIMUN LAUT SUSU	B$10.00/piece	B$80.00/kg
Holothuria sp.	HOLOTHURIIDAE	TIMUN LAUT BAKUNGAN	B$2.50/piece	B$60.00/kg
Thelenota ananas	HOLOTHURIIDAE	TIMUN LAUT TALIPAN	B$1.00/piece	B$35.00/kg

Table 2: Biology of Sea Cucumbers in Brunei Darussalam

FAMILY: HOLOTHURIIDAE

Scientific Name: *Actinopyga miliaris*
Common Name: Sea cucumber
Local Name: TIMUN LAUT TIMPO

Description:
Black, tegument smooth with small scattered soft papillae; spicules include only small rods. Reefs and coastal waters.

[1] Member of the Ad hoc Regional Working Group on Sea Cucumber Fisheries and National Focal Point for Brunei Darussalam, Department of Fisheries

FAMILY: HOLOTHURIIDAE

Scientific Name: *Holothuria (Holodeima) atra*
Common Name: Sea cucumber
Local Name: TIMUN LAUT TIGER

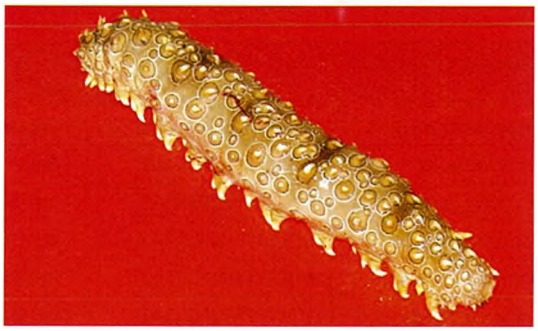
Description:
Black with black tentacles, but frequently covered with sand, small to very large, fissiparous, cylindrical with rounded ends, tegument smooth, body wall pliable, toxic red fluid released from skin on rubbing; spicules tables with reduced disc on moderate spire bearing a 'Maltese Cross' and rosettes but no buttons. Small specimens tend to have thin coating of sand with open patches of black skin showing through, large specimens are seen either with no sand covering or with a thick unbroken covering above. Animals are conspicuous and common lying exposed on sand flats of reef and coast.

Scientific Name: *Holothuria (Halodeima) edulis*
Common Name: Sea cucumber
Local Name: TIMUN LAUT KASUT

Description:
Dark red/black above pink below, small to large, cylindrical with rounded ends, tegument smooth, body wall pliable: spicules with tables and smaller disc than in atra. Reef exposed or concealed amongst rubble

Scientific Name: *Holothuria (Thymiosycia) impatiens*
Common Name: Sea cucumber
Local Name: TIMUN LAUT

Description:
Variegated pinks and browns with variable dark and light bands of transverse color are the most common patterns from reef animals, small to large cylindrical, tegument tough, papillae prominent, body firm but pliable, cuvierian tubules sometimes ejected: spicules well developed square tables and smooth buttons. Reefs, below rocks of reef flat.

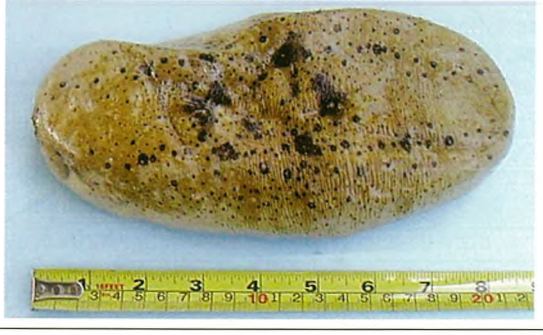


Scientific Name: *Holothuria (Metriatyla) martensii*
Common Name: Sea cucumber
Local Name: TIMUN LAUT

Description:
Grey/brown with double row of dark spots on upper surface, small, flattened, teguments rough, thin white cuvierian tubules: spicules tables extended to track-like bodies with 7 ridges. Coastal, trawled or from silty foreshores

Scientific Name: *Holothuria (Cystipus) rigida*
Common Name: Sea cucumber
Local Name: TIMUN LAUT SUSU

Description:
White to grey, often covered with sand, with double row of dark spots along upper surface and lateral row of blunt papillae on each side, stout flattened and rigid, 20 spicules; spicules low tables, fenestrated spheres and knobbed buttons. Reef flat, below rocks



Scientific Name: *Holothuria sp.*
Common Name: Sea cucumber
Local Name: TIMUN LAUT BAKUNGAN

Description: NA

No sample available.

FAMILY: STICHOPODIDAE

Scientific Name: *Thelenota ananas*
Common Name: Sea cucumber
Local Name: TIMUN LAUT TALIPAN

Description:
Grey, orange, red often with a purple cast, very large (to 600 mm), square in cross section with prominent 'cockscomb' papillae over upper surface of thick but pliable body, tegument smooth; spicules delicate dichotomously branched rods without lateral spines. Reefs, exposed on rubble

3. Production and Utilization

3.1 Production

Currently there are no fisheries specifically targeting sea cucumber in Brunei Darussalam. However, the Department of Fisheries has issued 2 licenses for catching sea cucumber and lobsters through diving since 1993 and to date they are still in operation. No specific gear is used to harvest the sea cucumber. They are collected manually and delivered to the land based mini factory. The sea cucumber are then boiled for many hours and the skin are peeled off to make the appearance more presentable in the market and soaked in the water, before being delivered to the local restaurants (mostly seafood restaurants) and some supermarkets. Some of the sea cucumbers are further processed into dried salted products for local and export markets. Table 3 indicates the landing of the sea cucumber from 1993 to 2006:-

Table 3: Annual Landings of sea cucumber from 1993 to 2006 in Brunei Darussalam

Year	Landing (Kg)
1993	64
1994	NA
1995	NA
1996	386
1997	NA
1998	25
1999	46
2000	36
2001	NA
2002	446
2003	212
2004	1,295
2005	1,463
2006	193

Source: Department of Fisheries, Ministry of Industry and Primary Resources
Note: NA – Data not available

The landings fluctuated greatly over the years and the highest catch was recorded in 2005 with the total weight of 1,463 kgs. The landing data are generally recorded under local and generic names of mixed sea cucumbers, hence it was difficult to identify and segregate the species by landings and value.

3.2 Marketing

The harvested sea cucumbers are sold in wet form in supermarkets as well as in the restaurants but not in the wet fish market due to the low demand for sea cucumbers. The price varies depending on the product form and type of the species sold. The price of sea cucumber in the wet form ranged from B$ 0.50 to B$ 2.50 per piece or B$ 2.50 to B$ 12.50/kg. The price in dried form offer better selling price in the range of B$ 10.00 to B$ 80.00 per kg depending on the species. There are about 3 to 5 pieces of sea cucumber per kg of some species. Hence, the producers prefer to process sea cucumbers into dried products as they fetch better price than in the wet or boiled product.

In Brunei Darussalam, the consumption of the sea cucumber is not that popular among local Malays unlike the Chinese who consider this as one of the rich delicacy in their food menu as well as for medicinal purposes. However the local Malays only utilize the extracts of sea cucumber oil for medicinal and cosmetic purposes. These sea cucumber oil extracts are imported and are available in local groceries, shops as well as in big stores. **Table 4** indicates the consumption and marketing of sea cucumbers in Brunei Darussalam.

4. Trade

4.1 Export

Due to the low demand of sea cucumbers, the excess quantities are exported to Malaysia (Sabah and Sarawak) and the Philippines as indicated in **Table 5**. Most export products are in wet and dried form.

4.2 Import

Early on, imported sea cucumber products are categorized under 'other mollusk' including aquatic invertebrates frozen, dried, salted or in brine. Hence, the statistics may not be the actual quantity of sea cucumber products imported into Brunei. The amount of imported sea cucumber is generally small and the import figures may be bloated with a combination of other mollusk products under this category. It was found that the data has been improved in 2005 when the actual imported sea cucumber was recorded in one category as (trepang) dried, salted or in brine. Most sea cucumber products were imported from Singapore. **Table 6** indicates the imports of aquatic invertebrates frozen, dried, salted or in brine including sea cucumber.

Table 4. Consumption and Marketing of Sea Cucumbers in Brunei Darussalam

Sea Cucumber Species	Family Name	Product Form	Locally consumed (C); Discarded (D); Traded (T)	Market Destination
Holothuria rigida	HOLOTHURIIDAE	Fresh	(C)	Supermarket, seafood restaurants
Holothuria atra	HOLOTHURIIDAE	Fresh	(C)	seafood restaurants
Thelenota ananas	HOLOTHURIIDAE	Fresh and wet	(T)	Export to Sabah, Malaysia
Actinophyga miliaris	HOLOTHURIIDAE	Fresh and wet	(T)	Export to Sabah, Malaysia

Table 5. Exports by Year and Country Destination

Year	Qty (Kg)	Price/Kg	Total Value B$	Country Destination
2003	120	$ 45.00	$ 5,400	Philippines
2004	64	$ 25.00	$ 1,600	Philippines
2005	1,088	$ 5.62	$ 6,121	Sabah and Sarawak(Miri)
2006	1,000	$ 4.20	$ 4,200	Sabah
2007 (Jan-Aug)	400	$ 4.50	$ 1,800	Sabah

Table 6. Imports from 2000-2005

Year	Quantity (metric tons)	Total Value (B$)
2000	16	$ 492,842
2001	NA	-
2002	21	$ 144,878
2003	21	$ 179,814
2004	NA	-
2005	5	$ 7,966

5. Conclusions and Recommendations

5.1 Conclusions

Sea cucumber is not a primary targeted species in Brunei Darussalam and the demand of this species is minimal. The biological information on sea cucumber and related habitats is still lacking which includes among others:

- Lack of biological data on sea cucumber such as length and weight, sex, maturity, behavior and life cycle
- Lack of data on the temporal and spatial distribution of sea cucumbers as well as lack of assessment studies on the status of its habitat and the impact of various fishing activities
- Lack of proper species identification especially when reported only as sea cumber in log books and data sheets;
- Lack of information or records on the utilization, handling, post harvest and marketing of sea cucumber particularly to the species level

5.2 Recommendations

The following are the recommendations in improving this study and to ultimately in supporting the conservation and management of sea cucumber and their long term sustainable use under the comprehensive national fisheries management policy, plan and program.

5.2.1 Improvement of fisheries statistics and monitoring system.

This includes improvement in the database system that will help improve in the storage, retrieval and analysis of the fisheries statistical in general;

5.2.2 Strengthen data collection and analysis.

5.2.2.1 Strengthening the technical survey to map out the spatial and seasonal distribution of the sea cucumber that will include the identification of habitats for breeding and nursery grounds;
5.2.2.2 Gather ecological information on sea cucumber to assess the general health of the environment and critical habitats where these species are found;
5.2.2.3 Conduct the comprehensive study on the utilization, processing, handling, marketing and trade of sea cucumber;

5.2.3 Research

5.2.3.1 Facilitate and encourage research on little known sea cucumber species that are of known commercial value. Some species are not reported properly and their identifications are not properly established, therefore a close attention must be given on other species that are not commonly caught by fishers;
5.2.3.2 Promote research activities to maximize the utilization of sea cucumber that also address the issues on how to improve the quality and value of the product to tap potential export market especially for the medicinal purposes;

5.2.4 Strengthening the capacity building especially in the area of taxonomy and biology of the sea cucumber. This also includes promoting the close coordination with other local and overseas institutions and agencies regarding the research and capacity building.

5.2.5 Promoting awareness on the sea cucumber resource management among the stakeholders and public. The Department of Fisheries is gearing to promote awareness on marine life especially among the youth and one way to do this is through the establishment of marine parks and marine aquaria. This set up will also serve as center for research in conservation and management of marine ecosystem and at the same time educating the general public through awareness programs. It is also emphasized to monitor and ensure that no destructive fishing gears is used in Brunei Darussalam Waters especially the use of cyanide and blast fishing methods which may result in the destruction of coral reefs, which are the main breeding and nursery grounds for most fishes including sea cucumbers.

SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN CAMBODIA [2]

By Pich Sereywath [3]

1. General Overview

Coastal and Marine fisheries serve a very good service to demand of sea product and human's favorability. In other words, these environmental goods are very important for supporting to the livelihoods of the coastal people and contributing to the national economy

Further, marine fisheries resources play a very important role to contribute to national food security after the production of inland fisheries. Even though, this richness was constantly declined from day to day due to lack of proper national data and information control system, past poor management and less research activities.

Along this line, many products of marine species, including sea cucumber are not included in the statistic figure of any marine catch report. And since now, there has no any research and conservation program have been directly focusing such invertebrate species like sea cucumber. Only few reports were slightly emerged information in regarding to sea cucumber in the Cambodia Sea. Through these reports elaborated that five species of sea cucumber found in Sihanoukville (Rath & Vana, 2008), three abundant species of sea cucumbers, Holothuria fuscopunctata, Holothuria edulis, and Holothuria leucospilota, found during the survey in the coastal areas of Cambodia (Tana, 1999) and other reported that some edible sea cucumber were also found in Koh Kong Water (Chou et. al., 2003).

Although, this species were target specie by fishermen-skin diving and were collecting by some middlemen, and till now sea cucumber is still target by fishermen even it become rare. Sea cucumber was also caught by accident by two kinds of fishing gear, crab gillnet and trawling net (shrimp trawling). However it is known that dried sea cucumber is able to find from some Cambodian local processors in some islands or fishmen themselves as well as can find either market in the Phnom Penh city or any market of the coastal areas.

Large amount of dried sea cucumber found in few markets in Phnom Penh are imported through middlemen imported from neighboring countries, typically Viet Nam and it also occasionally imported from others sources like Hong Kong.

Through this market flow, there is no one of Cambodia do not know about sea cucumber, they generally know sea cucumber in process form (dried form) and always taste through special china food items during attending the wedding, traditional ceremonies, and restaurant, notably any restaurant serve with China Food.

The current price of dried sea cucumber is higher and higher from day to day, this because of number of stock in the sea is extremely declined by over exploitation and is due to lack of clear conservation and management manner.

These are due to limitation of research activities and limited human and institutional capacity.

2. Status of Sea cucumber in Cambodia Marine Fisheries

2.1. Habitat

In Cambodian Water, Sea Cucumbers are encountered in white sandy seagrass bed, coral areas and islands with good health of coral reef and reef. Particularly, sea cucumber likes living in coral reef or rocky area with clear water condition if compared to area with low water visibility.

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[2] This report was prepared only for information supporting a regional study on sea cucumber fisheries, utilization and trade in Southeast Asia. Only few reports were found during the desk review, this is due to sea cucumber is a very new subject for Fisheries Administration of Cambodia.

[3] Member of the Ad hoc Regional Working Group on Sea Cucumber Fisheries and National Focal Point for Cambodia, Fisheries Administration, Cambodia

2.2. Catch

Sea cucumber is target species by fishmen by diving (skin diving) with air produced by compressor on boat, to specially find in the coral areas and reef areas. By using this method, in between year 2004 and 2005, per fishing trip (around 7 to 10 days) fishmen are able to collect sea cucumber in amount of 30 to 50 kg (the weight of individual piece was from 0.8-3 kg), and they can harvest Sea cucumber for round year.

Apart from targeted catch, sea cucumber was also caught by accident by some fishing gears, trawling net and floating crab net. During 2002 and 2004 only accidental catch by trawling net trawler can collect sea cucumber from 100 to 200 pieces per trip of seven-days fishing operation. Whilst, crab net can rarely accidentally caught sea cucumber in amount of only 2 to 3 pieces per trip of three-days fishing operation. Fishermen try to harvest sea cucumber either in day time or night, the fishing time is based on the species of sea cucumber.

Local fisher had informed that there are about 3 abundant species in the Cambodian sea territory. The most abundant are *Holothuria fuscopunctata*, then following by *Holothuria edulis*, and last following by *Holothuria leucospilota* so called locally as Chhloeung Kmao. These species is mainly caught by trawl as by-catches of shrimp fisheries, especially in the shallow water of the Kompong Som bay and Kompot bay (Tana, 1999).

Based on Rath and Vanna (2006) reported that two species of sea cucumber, so-called in Khmer Chhleung Maras and Chhleung Sor, were collected by fishermen during the night time, whereas another three species were harvested by fishermen during the day time. Although, the catch effort of fishermen were only two target species, Chhleung Maras and Chhleung Saor. This was a motive of imbalance among sea cucumber species in the Cambodia Water.

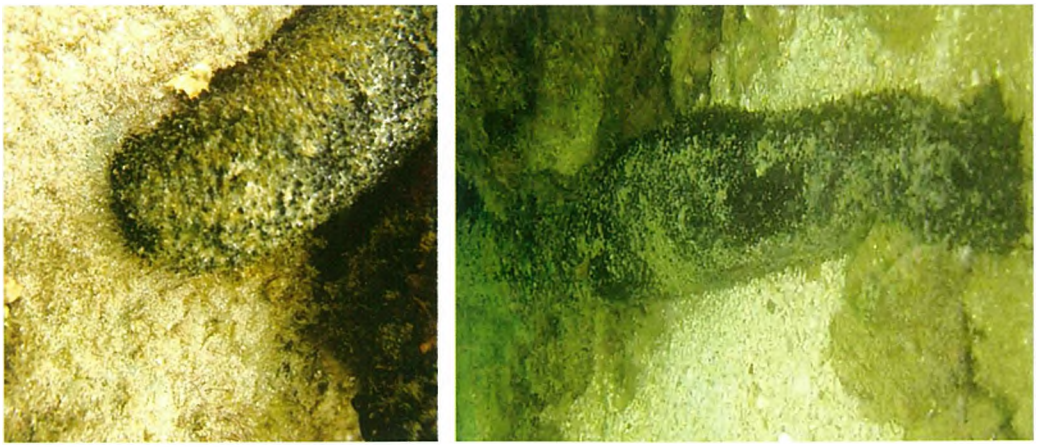
The report emphasized that the number of other three species are higher 60 % than these two targeted species. Other recent survey of Vibol and Bart (2007), reported that only few black sea cucumbers found during the survey if compared to other biodiversity. Figure below is sea cucumber found during the reef check survey.

Unfortunately, during the desk review there is a very few pictures of sea cucumber to prove existing species in Cambodia water.

2.3. Market

The market for sea cucumber had started since 1985 in small collection activity and then later during 2002 and 2004, there have been a big market of collection of sea cucumber in large amount by middleman in Sihanoukville. Meanwhile, the middlemen were able to buy dried sea cucumber in amount of 500 kg per month. These dried sea cucumbers distributed to market in Viet Nam, Thailand and Phnom Penh, and only 10 % was used by Sihanoukville people.

Apart from the process form, during year 2004, alive or fresh sea cucumber was also sold in the market of Sihanoukville. And also there were some collection in fresh form by middlemen from the fishermen. The price is following the market value of species demand. The report was only wrote those sea cucumber name in Khmer language.



Source: Vibol and Bart, 2007

No.	Local Name	English and Scientific	Price ($)
1	Chhleung Maras	There is a need to find out	2.5-3.00
2	Chhleung Sor		2.5-3.00
3	Chhleung Khmao		0.075-0.125
4	Chhleung Chor		0.075-0.125
5	Chhleung Dangkov Toek		

Source: Rath and Vanna, 2006, Sihanoukville Fisheries Office, in Khmer.

Although through this report many relevant data and information relating to sea cucumber provided. Clearly, the table below indicated the name of sea cucumber in local language with market price in 2004.

Through interview with few middlemen in Sihanoukville responded that total collection of number of dried sea cucumber current time is about 20 to30 kg per month. Through such huge drop in production, the collection of dried sea cucumber by middlemen was stop, but there is still a distribution activity of dried sea cucumber to the city by some local processor or fishmen themselves.

2.4. Information-based direct interpersonal interview to support the desk review

Current Source of dried sea cucumber: through some observation in few markets in Phnom Penh, found that most of dried sea cucumber number sell in a few shop were provided by middleman imported from Viet Nam, Hong Kong, and only small amount of dried sea cucumber from Kampot province. These three markets are selling dried sea cucumber with the price per kilogram of dried sea cucumber is in between 70 to 100 $USD, its price is based on the market classification. Three kinds of dried sea cucumber, in which type one is the processed product produced by Cambodian processor in some island and fishermen, type 2 is the dried sea cucumber imported from Viet Nam through Kampot province, and type 3 is the dried sea cucumber imported from Hong Kong. Figure below is pictures of dried sea cucumber in the Phnom Penh market

However, there is still no any official record to clearly prove about dried sea cucumber circulation in the country, especially in the city or other resident center.

2.5. Usage of dried sea cucumber

The dried sea cucumber is not commonly consume for the daily meal (the price is too expensive). Favorably, dried sea cucumber is for making China Food items in some ceremonies, especially during the wedding season, Chinese New Year and Khmer New Year (only household who are living in/around the resident center). Apart from special ceremonies, dried sea cucumber was also bought, for occasional daily meal, by especially China people who are employing in Cambodia.

3. Management and Conservation of Sea Cucumber

In terms of management and conservation of the fisheries resources, biodiversity and habitat, several legislations have been adopted in a general perspective on marine resources management. In relation to this some location are became a protected area and some areas are proposing for Marine Sanctuary for marine biodiversity.

It is due to the fact that, one national plan of action on coral reef and seagrass had adopted and distribute to the relevant stakeholder and along line with this

many management approach and mechanism, and conservation activities, have been implementing in collaboration with all relevant line agencies, as well as good collaboration with neighboring country like Viet Nam. In regards to this context, even there has no any specific plan and activities, research or sea ranching, in association with the direct management and conservation among the Fisheries Administration Plan, in terms of Sea cucumber, but this may indirectly help protecting the sea cucumber species in Cambodia water.

4. Future Consideration

Inside the Action Plan of Fisheries Administration, in terms of marine fisheries management and conservation, there are gaps that need to be eliminated from item to item from day to day by filling with a good collaboration and practical implementation with its partners either in broad manner or specific action.

Within such conceptual perspective, even specific action in connection to the management and conservation of sea cucumber will be initiated and started some actions even in the trial process or kick-started activity. In support to such consideration, SEAFDEC is an unavoidable partner to take into account in sea cucumber management and conservation for Fisheries Administration, to enable to overcome its constraints and approach its dream, respectively.

5. Suggestion and Recommendation

Even all above elaborated information is not enough yet, but it is a light lantern to enable to know the ways and approaches to address any difficulties encountered in the past and fill information lack for better future perspective.

By understanding this context, it would suggest to take more action on sea cucumber issue in Cambodia water to enable to make a proper plan and activities for management and conservation of all sea cucumber species and habitats. In doing so, there is a need of conducting a survey or research program on its status in Cambodia water as well as in the regional scale. Then following to the result of the research, a management and conservation plan will require making for sustainability of sea cucumber species. Consequently, an appropriate legislation and challenge policy are significantly needed to formulate and perceive, for the sack of good implementation of formulated plan and activities among the relevant institution.

Apart from such regards one unforgettable effective factor that really wanted is a very good collaboration of all research academic institution, NGOs and line agencies in both financial and technical support to Fisheries Administration to enable to improve its human and institutional capacity in addressing sea cucumber issues, as well as this will become a good background for other marine species resulting in fisheries resources harmonization in the future.

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SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN INDONESIA

By Dr. Ngurah N. Wiadnyana [4]

1. Introduction

Indonesian waters contain high marine biodiversity including sea cucumbers which are used intensively in whole regions. Sea cucumbers constitute a group of animal having relatively no movement, so that it is easy to harvest these echinoderms organisms in large quantity to be commercialized. As trade commodity and an important export product of Indonesia, sea cucumbers might be exploited continuously by fishermen in large quantity to provide the market demand. In fact, this phenomenon has influenced the existence of sea cucumbers themselves. The actual condition shows that it is more and more difficult to find sea cucumbers in enough quantity, because their populations in the nature tend to decrease. Certain species seem suffer the depletion of its population or be vulnerable, for example: prickly redfish (*Theleonata ananas*) and sandfish (*Holotoria scabra*). A similar condition has occurred in some countries, so that it stimulates many countries to propose sea cucumbers entered to CITES (The Convention on International Trade of Endangered Species of Fauna and Flora).

As a country having potential sea cucumbers resource, Indonesia would need to provide accurate information on the existence of sea cucumbers stock in nature in order to find out necessary management measure. For that, it is needed scientific data and information of sea cucumbers on several aspects such as: species composition, stock size, distribution, production, utilization, trade, the effort of marine culture of sea cucumbers. To fulfill necessary data and information some scientific and technical reports published from publication from ten to fifty years ago are traced as follow: Yusron (1987, 1989, 1990, 1991); Andamari et al., (1989); Yusron and Pramudji (1995); Pralampita et al. (1992); Suprapto et al. (1992); Darsono and Djamali (1998) for biological and fisheries aspects; General Directorate of Capture Fisheries (2006) for production and trade; and Darsono et al (2002) and Yusron (2004a, 2004b) for marine culture aspects.

Sea cucumbers resource is known for years ago as delicious food for certain people, especially for Chinese ethnic. Actually the consumers of sea cucumbers have increased widely. Beside of China, Japan and Korea, export of sea cucumber product is also to United State of America (Hartati et al., 2002). As export commodity, sea cucumbers has played important role for foreign exchange earning and increases yearly both in volume and trade value (General Directorate of Capture Fisheries, 2006). In accordance with highly demand and price of sea cucumbers which reach to about US $ 65 per kg it stimulates the fishermen to exploit intensively sea cucumbers in Indonesian waters.

In Indonesia, sea cucumbers fishery has done by the people since Dutch colonization (Nuraini, et al., 1990). The areas of its harvest spread from west to eastern part of Indonesia. These benthic organisms inhabit usually coral reefs that are found potentially in Indonesian waters and its species composition includes those with high economic value such as Holoturia scabra and many others with having no economic value (Aziz, 1997).

The continuous exploitation of sea cucumbers by fishermen has influenced the current population status of sea cucumbers which tend to decrease in the waters (Darsono, 2002, Hartati et al., 2002, Andamari et al., 1989). In fact, the density of sea cucumbers population is relatively low also the size becoming small and the fishermen must harvest sea cucumbers in deeply waters. However, the awareness on sea cucumbers by stakeholders is still low (Darsono & Djamali, 1998) in conserving its stock populations. Therefore, management measure of sea cucumbers should be done before these important resources become vulnerable or endangered. Scientific knowledge on the condition of sea cucumbers would be needed to good manage these important resources.

Hence, studies and understanding related to the resources and fishery status including species

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composition, distribution, biological aspects as well as market, trade of sea cucumbers are all necessary to be scientific witness for orientation and solution to manage and maintain its resource in sustainable uses in Indonesia and as necessary information for CITES authority.

2. Potency and Distribution of Sea Cucumbers

2.1 Species Composition

Inventory activities on sea cucumbers have conducted since in the end of 1970's in Indonesian waters. It was found about 53 species of sea cucumbers that are belonging from genera: *Holothuria, Actinopyga, Bohadschia, Labiodemas, Thelonota dan Stichopus* (Clark & Rowe, 1971). From all species identified, there are about 22 consumable species and only 8 species of these Echinoderms that constitute important fishery commodity with highly economic value (**Table 1**). The mostly species exploited is sandfish (*Holotoria scabra*), especially that collected in Bangka Belitung waters, Seribu Islands, Riau Islands, South Sulawesi, Buton, West Nusa Tenggara. The next species also strongly exploited is black fish (*A. miliaris*) that highly captured in Seribu Islands of Jakarta and West Nusa Tenggara. Other important species is prickly redfish (*T. ananas*), that especially collected in West Nusa Tenggara (Aziz, 1987).

The species presented in **Table 1** are systematically belonging to the family of Holothuridae and Stichopodidae. Furthermore, the systematic of sea cucumbers is done according to classification of University of Michigan Museum of Zoology (http://animaldiversity.ummz.umich.edu).

Phylum: Echinodermata
Class : Holothuroidea
SubClass : Aspidochirotacea
Ordo : Aspidochirotida
Family : Holothuriidae
Genus : Holothuria, Actinopyga, Bohadschia
Species : *Holothuria scraba, H. nobilis, H. fuscogiva Actinopyga miliaris, A. echinites, A.lecanora Bohadschia argus*
Family : Stichopodidae
Genus : Thelonota
Species : *Thelonota ananas*

Based on existing information, it was reported that the highest biodiversity of sea cucumbers is found in North Sulawesi (Kwandang Bay, Tiga Islands, and Sangir Islands) with number of 21 species. In Koloka District Sulawesi Tenggara Province it found about 20 species of sea cucumbers with dominant species of *Bohadschia marmorata* (87%), *Holothuria leucospilota* (6%) and *Synapta maculate* (7%) (Nuraini et al., 1990). The high biodiversity of sea cucumbers is found also in Alas waters of West Nusa Tenggara with number of 20 species and dominant species of *Synapta chloronothus*

The species inhabiting dominantly each location is different from one to other locations depending on water habitat condition. In North Sulawesi waters (Kwandang Bay, Tiga Islands and Sangir Island) the dominant species are *Holothuria pervicax, H. impatient, H. atra, H. coluber* and *Bohadshia marmorata* (Darsono, 2002). While in Seribu Islands of Jakarta Bay the dominant species are *H. impatiens, B. marmorata* and *Synapta maculate* (Hartati et al., 2002). In coastal waters of Waisisil, Saparua of Maluku Province the dominant species is sandfish (*Holotoria scabra*), reaching about 77 % of total number of the sea cucumbers production

Table 1. Sea cucumbers species with highly economic value

Scientific Name	Common Name	Local Name
Holothuria scraba	Sandfish	Teripang Pasir, Teripang putih
H. nobilis	Black teathfish	Teripang koro, teripang susuan
H. fuscogiva	White teatfish	Teripang susuan
Actinopyga echinites	Brown fish	Teripang batu
A. lecanora	Stone fish	Teripang bilabo, Teripang batu , Teripang tempulu
A. miliaris	Black fish	Teripang lotong
Bohadschia argus	Leopard (tiger) fish	Teripang mata kucing, Teripang kridou bintik
Theleonata ananas	Prickly redfish	Teripang pandan, Teripang nanas

Source: *Darsono (2005); (www.isoiblog.com), Hartati et al. (2002)*

(Andamari, 1989). At Batuampar of Lombok the species, *H. marmorata* is found in highest number, reaching about 68 % of total number of sea cucumbers collected (Prahoro & Suprapto, 1991).

The abundance of sea cucumbers in Indonesian waters is in general low, based on research results their abundance was less than 1 individual m^{-2}, excepted in Bunaken of North Sulawesi where the sea cucumbers abundance might reach to 3 individuals m^{-2} and in Southern Tanimbar (South-East Maluku) the abundance reached to 2.75 individuals m^{-2} (**Table 2**).

2.2 Spatial Distribution

2.2.1 Habitat and Food Composition

Spatial distribution of sea cucumbers in Indonesian waters is widely significant, these Echinoderms spreading from west to east Indonesian region. They occur from Bangka – Belitung, Mentawai Island, Seribu Island, Karimun Jawa waters, Kangean, Sulawesi (along of southern coast, south-east, middle, northern part including Sangir Talaud waters), Maluku (middle, northern, south-eastern parts), West Nusa Tenggara covering some waters of Sumbawa Island (Saleh Bay, Waworada, Sape and Alas Waters) and East Nusa Tenggara covering the waters of Flores, Sumba, and Timor waters (Djamali *et al.*, 1998).

Sea cucumbers habitat is found in coral reef and seagrass ecosystems, from intertidal zone to the deep sea water of about 20 m. However some of them inhabit offshore deeper waters. Under their good adaptation capability, sea cucumbers are capable to inhabit in various substrates (Aziz, 1995). In general, sea cucumbers occur in clear waters, fine sandy bottom or mud mixed with sand with water plants such as seagrasses ((*Enhalus*) and seaweeds (*Sargasum* and *Laminaria*) that may protect directly sea cucumbers from sun shine and strong sea currents (Aziz 1999; Hartati *et al.*, 2002). The investigation conducted in Kolaka District waters of South-East Sulawesi by Nuraini et al.

Table 2. Species abundance, density/potnecy of sea cucumbers in some locations of Indonesia

Area	Location	Species Number	Density/Potency	Source
Maluku	Kulur, Saparua	3	Nd	Andamari et al. (1988)
	Waisisil, Saparua	4	0.88 ind. m^{-2}	Andamari et al. (1988)
	Yamdena, Tanimbar Selatan	12	2.75 ind. m^{-2}	Rumahpurute (1990)
	Kep. Kai Kecil	15	1.08 - 2.03 ind. m^{-2}	Yusron & Pramudji (1995)
Sulawesi	Sopura Kolaka	6	0.003 - 0.4 ind. m^{-2}	Mangawe & Daud (1988)
	Bunaken	8	2.98 ind .m^{-2}	Tamanampo et al. (1989)
	Pulau-pulau Tiga	21	Nd	Darsono (2002)
	P. Sembilan, Sinjai	13	15 ton $year^{-1}$	Nuraini et al. (1992)
	Kolaka	20	36 ton $year^{-1}$	Nuraini et al. (1990)
	Sulawesi Selatan	3	0.003 - 0.03 ind .m^{-2}	Darsono, & Djamali (1998)
	Sulawesi Tengah	4	0.002 - 0.06 ind .m^{-2}	Darsono & Djamali (1998)
	Sulawesi Utara	6	0.002 - 0.03 ind .m^{-2}	Darsono, & Djamali (1998)
Nusa Tenggara	Batunampar Lombok, NTB	5	0.19 ind m^{-2}	Prahoro & Suprapto (1991)
	Lombok, NTB	4	0.003 - 1.03 ind .m^{-2}	Darsono & Djamali (1998)
	Dompu, Bima, NTB	16	350 ton $year^{-1}$	Wahyuni (1992)
	Perairan Alas NTB	20	Nd	Prahoro & Wahyuni (1992)
	Lembata, Flores Timur, NTT	7	0.61 ind m^{-2}	Prahoro et al. (1994)
Jawa	Kep. Seribu	17	0.028 - 0.189 m^{-2}	Hartati et al. (2002)
	P. Pari Kep. Seribu	6	0.24 ind m^{-2}	Pralampita et al (1992)
	Sapeken, Kangean, Madura	10	30 ind Ha^{-1}	Suprapto et al. (1992)
	Karimun Jawa, Laut Jawa	14	20 ton $year^{-1}$	Nuraini & Wahyuni (1989)
Sumatera	Kepulauan Mentawai	9	0.003 - 0.09 ind m^{-2}	Darsono & Djamali (1998)

Note: nd = no data available.

(1990) showed that in the high density of seagrasses sea cucumbers occurred in higher number than those found in the waters with low density of seagrasses. The species, *H. leucospilota, H. atra, B. marmorata, B. similis, H. hilla, H. sucossa* and *H. scraba*, inhabit shallow waters such as seagrass bed and coral reefs with water depth under 2 m. While *H. nobilis, T. anax, T. ananas, S. variegates, A. achinetes, A. miliaris* and *Holothuria sp* inhabit deeper waters. The other sea cucumbers found in deep waters are *Actinopyga miliaris, Holothuria arenicola, H. difficilis, H. erinaceus, H. modesta, H. notabilis, H. moebi* and *H. kurti* (Aziz, 1995).

According to Pawson (1970), sea cucumbers prefer inhabit waters with normal salinity of about 30 – 33 ppt, and inversely in the low salinity. Bakus (1973) stated that sea cucumbers may tolerate waters condition with temperature of 26 – 31 °C. The proper dissolved oxygen for sea cucumbers is between 4 - 8 ppm (Panggabean, 1987) in range with dissolved oxygen in nature (Alwi, 1995).

Sea cucumbers obtain their food by sucking and filtering particles in the waters such as plankton and detritus attached on the substrates (Hyman, 1955; Hartati *et al.*, 2002). Results of their investigations showed that phytoplankton contributed as main food for sea cucumbers with preponderating index more than 50 %. Phytoplankton composition of sea cucumbers diet consists of diatom group such as *Chaetoceros* sp, *Pelagothix* sp, *Amphora* sp, and *Thallasiotrix* sp.

2.2.2 Reproductive Season

The spawning season of sea cucumbers is usualy going on the rainy season, because in this season the salinity decreases to the low level stimulating for the maturity of gonad and the spawning (Alwi, 1995). Some sea cucumbers species spawn two times per year on April and November (Misnawati, 1998). In Seribu Island waters, the spawning season of sea cucumbers probably occurs on the west monsoon period during December to February.

3. Sea Cucumbers Fisheries

3.1 Sea Cucumbers Fishery Activity

In Indonesia sea cucumbers fishery constitutes a traditional activity, on going since long time ago and mostly artisanal fishery (Darsono, 2002) or small scale fishery. Fishermen exploit sea cucumbers continuously without consider its ecological values this causes the impact of decreasing of sea cucumbers population in Indonesian waters (Aziz, 1997).

There are not all sea cucumbers being economically important. It is only some sea cucumbers having high economic value such as *H. scraba* and *H. nobilis*, while *T. ananas* and *H. atra* costs moderate price and low price, respectively (Aziz, 1997).

The harvest activity of sea cucumbers is usually along of year when the water is clear and calm sea. During west monsoon period in November to February the harvest is almost absent because the water condition is not accessible. The harvest of sea cucumbers is done traditionally only by using a lamp on the night, and sea cucumbers are collected by hand. To harvest in high scale fishermen usually use boat and compressor. The harvest using compressor is conducted in deep sea waters but the depth less than 30 m in the night as well as in day time (Hartati *et al.*, 2002; Nuraini *et al.*, 1990, Prahoro & Suprapto, 1991; Prahoro & Wahyuni, 1991; Suprapto *et al.*, 1992). In Alas (West Nusa Tengggara the harvest of sea cucumbers has done by using "ladung" of sea cucumbers that operates as similar to harpoon, and "cengkeraman" of sea cucumbers that operates as pincers (Prahoro & Wahyuni, 1991).

3.2 Production

Production of sea cucumbers fishery in the region is in correlation to the fishing effort. By using a boat and a compressor, the production of dray sea cucumbers in Seribu Island of Jakarta is around 8 – 10 kg per day, or about 30 – 60 kg of dray sea cucumbers per week (Hartati *et al.*, 2002). While based on result of research conducted in Kolaka of South-East Sulawesi in 1990, the production of sea cucumbers in this area reached to amount of 3 tons per month (Nuraini *et al.*, 1990).

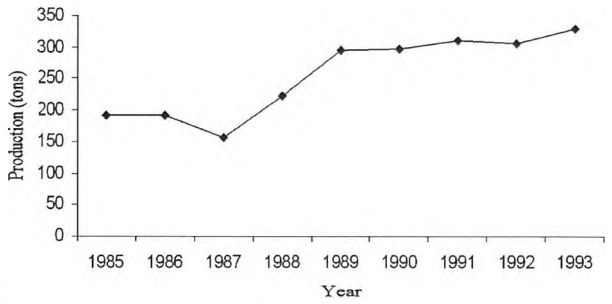
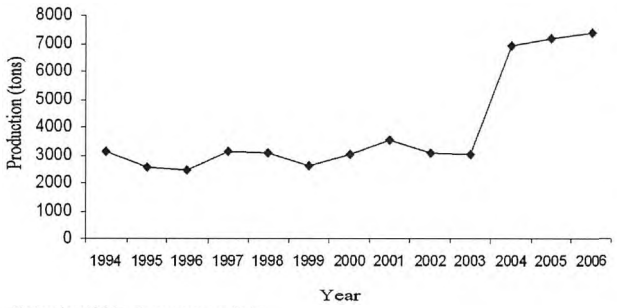


Figure 1. Fluctuation of sea cucumber production in South-East Maluccas District.



Note: In 2006 - temporary data

Figure 2. Trend of dray sea cucumbers production in Indonesia during 1994 to 2006.

In Maluccas, as the main production place of sea cucumbers in Indonesia, the production value increases from year to year (Yusron, 2001). According to export production data of South-East Maluccas District, the production value has always increased during 1985 to 1993 (**Figure 1**).

According to Indonesian capture fisheries statistic data, the harvest production of sea cucumbers from 1994 to 2003 was between 2,000 to 3,000 tons per year. The production increased significantly since 2004 when the production became twice than that in 2003 (**Figure 2**). The production during 2005 to 2006 has also increased significantly, reaching to about 7,000 tons per year. This increase of production might be related to the better data system application in whole regions of Indonesia. Beside of this condition, this high production was due to more intensively harvest of sea cucumbers. This situation is stimulated by high price and demand of sea cucumbers in the market.

As the impact of highly exploitation of sea cucumbers, it caused the depletion of sea cucumbers stock in the waters. Research result reported by Darsono (2002) who stated that in North Sulawesi the suplay of sea cucumbers decreased a half quantity in 2002 than the suply in 2001.

4. Trade

Almost there is no local utilization of sea cucumbers in Indonesia. Most part of catches is exported to foreign countries (Hartati *et al.*, 2002; Prahoro & Wahyuni, 1991, Darsono, 2002) through three steps trade mechanism. Firstly, the catch is bought by a collector as first buyer ("Penampung") who keeps sea cucumbers till a large quantity before selling them to second collector as second buyer ("Pengumpul"). The latter then sell sea cucumbers to exporter.

The price of sea cucumbers varies widely with sea cucumbers species. **Table 3** shows market price of certain species of dray sea cucumbers sold in Seribu Island of Jakarta in 2002.

The actual price of dray sea cucumbers more and more increases in the market, because the stock available in the nature tends to decrease, for example dray sea cucumbers black teathfish and white teatfish (*Holothuria fuscogiva* and *H. nobilis*) cost up to 70.00 US $ per kg.

Table 3. Composition and dray sea cucumber price in Seribu Island of Jakarta

Species	Price in fishermen per kg (US $)	Price in buyer 2 per kg (Rp)
Holothuria scraba	30.30	60.60
Stichopus variegatus		
Super (size 20 cm)	12.20	15.50
Moderate (size 15 cm)	10.00	11.75
Small (size 10 cm)	5.00	6.75
Theleonota ananas	12.20	15.75
Bohadschia marmorata	1.00	1.40
Achtinopyga echinites	12.00	15.75

Source: Hartati et al. (2002)

Those highly price and export demand of sea cucumbers might cause more intensively the exploitation of this commodity by fishermen in Indonesian waters. This high exploitation may directly cause the dramatically depletion of sea cucumbers stock in whole Indonesia waters (Aziz, 1997). Therefore, to maintain the market supply it needs to develop sea cucumbers culture. For the time being, there is just only one species i.e sandfish (*H. scabra*) which has taken place successfully in marine culture.

Some countries noted as main importers for Indonesian sea cucumbers are South Korea, Singapore, Taiwan, Hongkong, Malaysia, China, Vietnam, and USA. According to data available of sea cucumbers mixed with other marine product ("exotic marine product) from January to April 2007 (Central Statistic Board, 2007), the highest export value is Hongkong with trade value of about 497,682 $US and three other countries play an important importer of sea cucumbers from Indonesia are South Korea, Vietnam and Singapore (**Figure 3**).

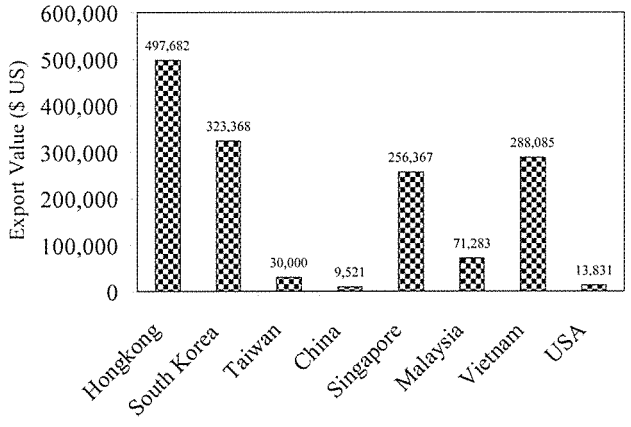


Figure 3. The variation of export trade value of sea cucumbers and the other marine products to eight principal countries.

5. Sea Cucumbers Resource Management

5.1 Management Policy

As mentioned previously that sea cucumbers catches increased significantly with increasing the price and demand of this marine commodity. The intensively harvest had resulted high production of sea cucumbers in some regions. This finally caused the depletion of sea cucumbers stock, for example two species of sea cucumbers: *H. scabra* and *T. ananas* are more and more difficult to collect them in the waters. Moreover, since the regulation is not yet available to manage the exploitation of sea cucumbers, this marine product would become vulnerable or endangered.

In their life, sea cucumbers are generally associated with coral reefs as their habitat. Therefore, the management of sea cucumbers would be a part of coral reefs management. The management policy of coral reefs is through the Ministry of Marine Affairs and Fisheries Decree No.KEP 38/ MEN/2004 on General Guideline for Coral Reefs Management. However, the specific regulation for sea cucumbers management that should include seasonal harvest, minimum size and fishing ground is actually not yet available. At the time being the sea cucumbers fishery is open for all people. Beside of that, applying the regulation would be difficult since the sea cucumbers fishery is traditional and not an industrial fisheries scale activity.

5.2 Research Status on Sea Cucumbers Resource

Research activity on sea cucumbers has been developed since 10 to 15 years ago with focus on biological aspect, ecology, marine culture, and processing. Many research activities were deal with Inventory Program on Sea Cucumbers Resource. Results of this program identified species composition, distribution, habitat condition, and standing stock of sea cucumbers. The methods used include direct observation in the field and census at the fishermen level and the collector 2 ("Pengumpul") to know the species composition. Some research activities on sea cucumbers condition have been conducted in several Indonesian waters as presented in **Table 4**.

Table 4. Some research activities on the sea cucumbers condition in Indonesia

Location	Research Aspect	Researcher
Maluccas	Utilization and Management of Sea Cucumbers	Yusron (1987)
Maluccas	Status of Sea Cucumbers Resource	Yusron (1990)
Maluccas	Habitat Condition	Yusron (1991)
Maluccas	Community Structure	Yusron & Pramudji (1995)
Maluccas	Food Analysis	Yusron & Sjafei (1997)
Maluccas	Status of Sea Cucumbers Resource	Yusron (2000)
Maluccas	Status of Sea Cucumbers Resource	Yusron (2001)
Maluccas	Community Structure	Yusron (2001)
Maluccas	Status of Sea Cucumbers Resource	Yusron (2003)
Maluccas	Community Structure	Yusron & Pita (2004)
Maluccas	Status of Sea Cucumbers Resource	Andamari et al. (1989)
West Nusa Tenggara	Status of Sea Cucumbers Resource	Yusron (2003)
West Nusa Tenggara	Status of Sea Cucumbers Resource	Yusron (2003)
West Nusa Tenggara	Status of Sea Cucumbers Resource	Yusron (2003)
West Nusa Tenggara	Sea Cucumbers Stock	Prahoro & Indar ()
Sulawesi	Status of Sea Cucumbers Resource	Prahoro & Suprapto (1991)
Sulawesi	Status of Sea Cucumbers Resource	Darsono (2002)
Seribu Islands	Biological Aspect	Hartati (2002)
Seribu Islands	Sea Cucumbers Stock	Hartati (2002)
Seribu Islands	Potency	Pralampita (1992)
Madura	Status of Sea Cucumbers Resource	Suprapto (1992)
Indonesia waters	Potency and Distribution	Subani et al. (1989)
Indonesia waters	Biological Aspect	Aziz (1995)
Indonesia waters	Status of Sea Cucumbers Resource	Darsono & Djamali (1998)
Indonesia waters	Status of Sea Cucumbers Resource	Djamali et al. (1998)

Research on marine culture of sea cucumbers has been developed since several times ago, especially for sandfish (*H. scabra*). The main aspects investigated in some occasion of studies includes: spawning, breeding, and experiments on the growth of sea cucumbers in the laboratory. **Table 5** presents some research activities on marine culture of sea cucumbers in Indonesia.

Table 5. Research on sea cucumbers culture in Indonesia.

Research Aspect	Reference
Growht aspect in laboratory	Yusron (1989)
Breeding	Darsono et al. (2002)
Larva rearing	Yusron (2001)
Spawning	Yusron (2004)

In developing marine culture of sea cucumbers, breeding aspect plays an important role in providing seeds stock. Therefore, in 2004 the Research Centre for Aquaculture, the Agency for Marine and Fisheries Research published a technical book as guideline of breeding technology of sandfish (*H. scabra*).

Research on processing aspect has been not developed with reason that in general Indonesia does export sea cucumbers with simple processing for which sea cucumbers are just sold in dry product, and there is not any local consumption of sea cucumbers.

5.3 Conservation Aspect

The depletion of sea cucumbers stock may be seen from the low density of these organisms found in most research locations. From 23 research activities conducted in some locations of Indonesian waters, most of results show that the density of sea cucumbers in the waters are less than 1 individual m^{-2}. This condition may not meet with the highly harvest activities of sea cucumbers. Therefore, it needs to develop the conservation effort or appropriate management to enhance the sea cucumbers stock in the waters, for instant the development of stock enhancement program of sea cucumbers. Hence, providing of sea cucumbers seeds seems to be crucial to implement this program.

For the conservation effort, there are some measures necessary which might be implemented such as:

a. Regulation on the size of sea cucumbers allowed to be harvested for trading purpose. Giving low price for small size of sea cucumbers does not decrease the harvest of sea cucumbers with small size.
b. Applying of marine protected area (MPA) where sea cucumbers do not be allowed to harvest by fishermen, except for research purpose.
c. Improving control and law enforcement.

In term of restocking program as part of sea cucumbers stock enhancement, stakeholders such as fishermen, collectors and exporters must be involved in the program. While in term of ecological aspect, restocking activity needs a water condition with good environment as well: clean, clear protected waters condition. Wahyuni et al. (2004) reported for their sea cucumbers stock enhancement activity in Seribu Island that sea cucumbers seeds with size of 67,0 g per individual and 78,0 g per individual might be life and grew well with growth rate of 0.95 to 6.37 % per day.

6. Conclusion and Recommendation

In Indonesian waters it is found about 53 species of sea cucumbers belonging to Genera *Holothuria, Actinopyga, Bohadschia, Labiodemas, Thelonota* and *Stichopus*. Among those species, there are about 22 species which are consumable and only 8 species of those sea cucumbers constituting marine product with highly commercial value. These eight species are belonging to family Holothuriidae such as: *Holothuria scraba, H. nobilis, H. fuscogiva, Actinopyga echinites, A. lecanora, A. miliaris, Bohadschia argus*, and family Stichopodidae with single species, *Theleonata ananas*.

Sea cucumbers fishery in Indonesia constitutes as traditional fishery activity done by small fishermen since several years ago. This marine product is processed with simple way by draying the animals before selling to market. The market mechanism includes three steps: from fishermen to collector 1 as first buyer, collector 1 to collector 2 as second buyer, and collector 2 to exporter. Almost there is no local utilization of sea cucumbers. Most part of this marine product is exported with mainly direction to: Hongkong, South Korea, Vietnam and Singapore Taiwan, Malaysia, China, and USA. Due to highly price and market demand, the exploitation of sea cucumbers increased significantly, this produced a large quantity of sea cucumbers. For last two years the production reached to about 7,000 tons per year.

The impact of highly exploitation of sea cucumbers has caused the depletion of sea cucumbers stock in the waters. In fact, in the most locations the density of sea cucumbers was fairly low with density of less than 1 individual m^{-2}. Some studies on sea cucumbers have been conducted since more than 10 years including marine culture. Research on marine culture might provide seeds of sea cucumber in order to support and develop its marine culture.

In respect to maintain the sustainability use of sea cucumbers in the nature, it is recommended to take measure in managing of sea cucumbers resource including size catch regulation, establishment of marine protected area, controlling of harvest by low enforcement, development of sea cucumbers stock enhancement program, and developing sea cucumbers culture. Establishing and developing of good data record and statistic on sea cucumbers production are also recommended in order to better manage sea cucumbers fishery as important resource for small fishermen in Indonesia.

Photography of eight most important sea cucumbers species of Indonesian waters

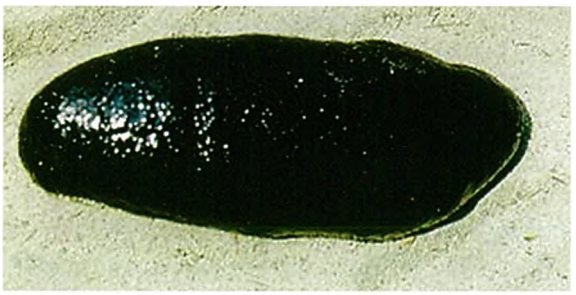
Holothuria scabra (sandfish)
TL: 400 mm; W: 1.5 kg
Local name: Teripang pasir

Holothuria nobilis (black teatfish)
TL: 400 mm; W: 1.5 kg
Local name: Teripang susuan

Holothuria fuscogilva (white teatfish)
TL : 300 mm ; W : 1 kg
Local name: Teripang susuan

Actinopyga echinites (Deep water redfish)
TL : 400 mm; W: 3 kg
Local name : Teripang bilalo

Actinopyga lecanora (stoneffish)
TL: 400 mm; W: 3 kg
Local name: Teripang batu



Actinopyga miliaris (blackfish)
TL: 300 mm; W: 2 kg
Local name: Teripang lotong

Bohadschia argus (leopard/tiger fish)
TL: 500 mm; W: 2 kg
Local name: Teripang kridou bintik

Thelenota ananas (prickly redfish)
TL: 700 mm; W: 6 kg
Local name: Teripang nanas, Teripang pandan

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SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN MALAYSIA

By Kamarruddin Ibrahim [5]

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
Stichopus chloronotus	Stichopodidae		Low
Stichopus horrens	Stichopodidae	Talifan varieti hitam	High, Used in the production of traditional medicines
Stichopus noctivagus	Stichopodidae	-	None
Stichopus variegatus	Stichopodidae	Gamat biasa, Gamat pasir, Kebasik laut	Medium to low
Stichopus hermanni	Stichopodidae	-	N/A
Stichopus vastus	Stichopodidae	-	N/A
Stichopus pseudohorrens	Stichopodidae	-	N/A
Thelenota ananas	Stichopodidae	-	High
Thelenota anax	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
Pearsonothuria graeffei	Holothuriidae	-	Low
Bohadschia marmorata	Holothuriidae	Bat yandung, Bat andung, Trepang benang.	Low
Bohadschia argus	Holothuriidae	-	Low
Bohadschia paradoxa	Holothuriidae	-	Low
Actinopyga obesa	Holothuriidae	-	Low to medium
Actinopyga lecanora	Holothuriidae	-	Low
Actinopyga mauratiana	Holothuriidae	-	Low to medium
Actinopyga miliaris	Holothuriidae	-	Low to medium
Holothuria (Acanthotrapeza) coluber	Holothuriidae	-	Low
Holothuria (Halodeima) atra	Holothuriidae	Hitam	Low
Holothuria (Halodeima) edulis	Holothuriidae	Durun	Low
Holothuria (Lessonothuria) pardalis	Holothuriidae	-	None
Holothuria (Lessonothuria) verrucosa	Holothuriidae	-	None
Holothuria (Stichothuria) coronopertusa	Holothuriidae	-	None
Holothuria (Mertensiothuria) leucospilota	Holothuriidae	-	Low
Holothuria (Mertensiothuria) parvicax	Holothuriidae	-	None
Holothuria (Metrartyla) martensi	Holothuriidae	-	None
Holothuria (Metrartyla) ocellata	Holothuriidae	-	None
Holothuria (Metriatyla) scabra var. versicolor	Holothuriidae	Putih	High
Holothuria (Microthele) nobilis	Holothuriidae	-	High
Holothuria (Microthele) fuscopunctata	Holothuriidae	-	Low
Holothuria (Microthele) fuscogilva	Holothuriidae	-	High
Holothuria (Thymiosycia) hilla	Holothuriidae	-	None
Holothuria (Thymiosycia) impatiens	Holothuriidae	-	None
Holothuria (Semperothuria) flavomaculata	Holothuriidae	-	None
Holothuria species 1	Holothuriidae	-	None
Labidodemas semperianum	Holothuriidae	-	None
Actinocucumis typicus	Phyllophoridae	-	None
Cladolabes schmeltzi	Phyllophoridae	-	None
Neothyonidium magnum	Cucumariidae	-	None
Euapta godeffroyi	Synaptidae	-	None
Opheodesoma glabra	Synaptidae	-	None
Synapta maculata	Synaptidae	-	None
Synaptula media	Synaptidae	-	None
Synaptula lamperti	Synaptidae	-	None

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

Table 2. Biology of sea cucumbers in Malaysia

FAMILY: STICHOPODIDAE

Scientific Name: *Stichopus chloronotus*
Common Name: Greenfish
Local Name: Talifan varieti hitam

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.

Distribution: Pulau Payar Group, Pulau Tioman, Pulau Redang groups, Pulau Perhentian, Pulau Tinggi groups and Pulau Mantanani

Scientific Name: *Stichopus horrens*
Common Name: None
Local Name: Gamat

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.

Distribution: Pulau Langkawi, Pulau Payar, Pulau Pangkor, Port Dickson, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups and Tunku Abdul Rahman Park

Scientific Name: *Stichopus noctivagus*
Common Name: None
Local Name: None

Description: Similar to *S. horrens* but has a more translucent, off-white body with brown striations and orange markings at the base of the tube feet.

Distribution: Pulau Mantanani

Scientific Name: *Stichopus variegatus*
Common Name: Curryfish
Local Name: Gamat biasa, Gamat pasir, Kebasik laut

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.

Distribution: Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Redang groups and Pulau Bohey Dulang

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

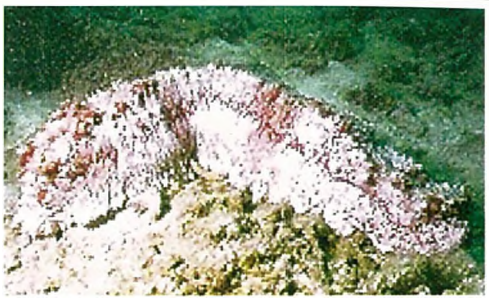
Description: Body is roughly square in cross section. Numerous large crowned papillae over entire upper body surface. Colouration is reddish-orange, papillae slightly darker than body surface. Flat underside is covered in numerous large tube feet. Maximum length: 70 cm.

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

Scientific Name: *Actinopyga mauratiana*
Common Name: Surf Redfish
Local Name: None

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.

Distribution: Pulau Mantanani

Scientific Name: *Actinopyga miliaris*
Common Name: Blackfish
Local Name: None

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.

Distribution: Pulau Perhentian and Pulau Redang groups

Scientific Name: *Holothuria (Acanthotrapeza) coluber*
Common Name: None
Local Name: None

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.

Distribution: Pulau Tioman, Pulau Tinggi, Pulau Perhentian groups, Sabah Turtle Islands, Pulau Bohey Dulang and Kudat area

Scientific Name: *Holothuria (Halodeima) atra*
Common Name: Lolly Fish
Local Name: Hitam

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.

Distribution: Pulau Payar, Pulau Pangkor, Pulau Tinggi, Pulau Tioman, Pulau Perhentian, Pulau Redang groups, Tunku Abdul Rahman Park, Pulau Mantanani, Kudat and Pulau Sipadan

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

Scientific Name: *Holothuria (Mertensiothuria) leucospilota*
Common Name: None
Local Name: None

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.

Distribution: Langkawi, Pulau Payar, Pulau Tinggi, Pulau Tioman, Pulau Besar, Kudat, Tunku Abdul Rahman Park and Turtle Islands

Scientific Name: *Holothuria (Mertensiothuria) parvicax*
Common Name: None
Local Name: None

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.

Distribution: Pulau Tinggi, Pulau Redang groups, Pulau Mantanani, Sabah Turtle Islands and Pulau Bohey Dulang

Scientific Name: *Holothuria (Metrartyla) martensi*
Common Name: None
Local Name: None

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.

Distribution: Pulau Payar

Scientific Name: *Holothuria (Metrartyla) ocellata*
Common Name: None
Local Name: None

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.

Distribution: Pulau Payar

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

Scientific Name: *Holothuria (Thymiosycia) impatiens*
Common Name: None
Local Name: None

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.

Distribution: Pulau Tinggi group

Scientific Name: *Holothuria (Semperothuria) flavomaculata*
Common Name: None
Local Name: None

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.

Distribution: Pulau Tinggi group

Scientific Name: *Holothuria* species 1
Common Name: None
Local Name: None

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.

Distribution: Semporna

Scientific Name: *Labidodemas semperianum*
Common Name: None
Local Name: None

Description: Cylindrical body, tapering more at posterior than at anterior. Colouration is uniform white with purple anterior end. Prominent white papillae arranged in rows.

Distribution: Kudat

FAMILY: PHYLLOPHORIDAE

Scientific Name: *Actinocucumis typicus*
Common Name: None
Local Name: None

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.

Distribution: Pulau Mantanani

Scientific Name: *Cladolabes schmeltzi*
Common Name: None
Local Name: None

Description: Body is cylindrical in cross section and tapers at both ends. Smooth tegument. Firm body. Tube feet cover entire body.

Distribution: Pulau Mantanani

FAMILY: CUCUMARIIDAE

Scientific Name: *Neothyonidium magnum*
Common Name: None
Local Name: None

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.

Distribution: Pulau Bohey Dulang

FAMILY: SYNAPTIDAE

Scientific Name: *Euapta godeffroyi*
Common Name: None
Local Name: None

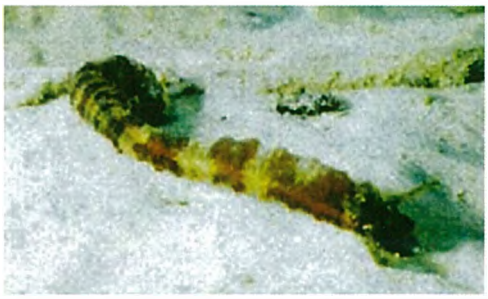
Description: Cylindrical and translucent body, with mottled cream white and grey, brown or green longitudinal stripes with darker bands in enlarged "beaded" areas of the skin. Fifteen cream colour tentacles. Maximum length: 1.5 m.

Distribution: Port Dickson and Tunku Abdul Rahman Park

Scientific Name: *Opheodesoma glabra*
Common Name: None
Local Name: None

Description: Relatively large. Colouration is deep brown to grey with some white flecking. 15 tentacles.

Distribution: Tunku Abdul Rahman Park



Scientific Name: *Synapta maculata*
Common Name: None
Local Name: None

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.

Distribution: Sabah Turtle Islands and Pulau Bohey Dulang

Scientific Name: *Synaptula media*
Common Name: None
Local Name: None

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.

Distribution: Pulau Payar and Pulau Redang groups

Scientific Name: *Synaptula lamperti*
Common Name: None
Local Name: None

Description: Body is cylindrical. Lacks tube feet. Colouration of body and tentacles are opaque white with dark longitudinal stripes. Maximum length: 5 cm.

Distribution: Pulau Payar, Pulau Sengilan, Pulau Tinggi, Pulau Tioman, Pulau Redang groups, Pulau Bohey Dulang and Pulau Sipadan

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.

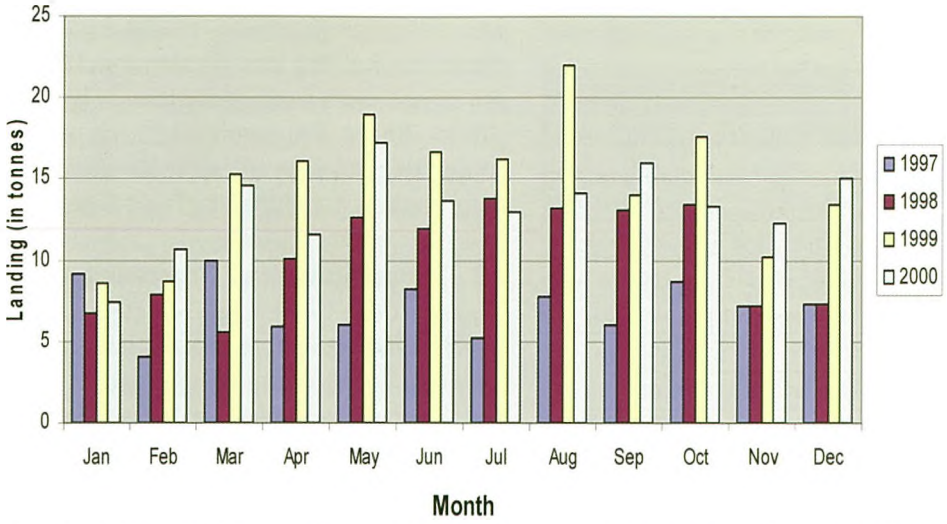


Figure 1. Seasonal landing of sea cucumbers in Sabah, Malaysia (based on landing data for 1997-2000)

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.

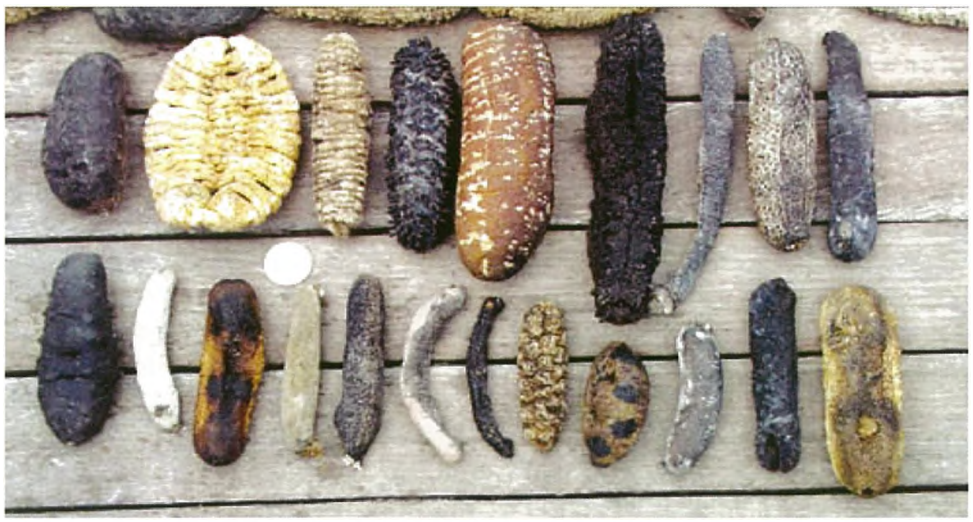


Figure 2. Local names of commercial species of sea cucumbers from Sabah. Top (left to right): boli-boli; kasut; gadol; talipan; bot-bot; legs; patola; leopard, black beauty. Bottom (left to right): susu; broam beauty (white); mother tadik; broam beauty (brown); powder; hotdog; patola; gadol; boli-boli; 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
H. nobilis, *H. fuscogilva*	Holothuriidae	Dried	C and T	42.10 or 78.95 (retail)	Domestic and International market
H. scabra	Holothuriidae	Dried	C and T	10.53 (small) or 18.42 (medium) or 36.84 (large)	Domestic and International market
H. fuscopunctata	Holothuriidae	Dried	C and T	6.58	Domestic and International market
H. leucospilota (Patola)	Holothuriidae	Dried	C and T	5	Domestic and International market
(Tri kantos)	Holothuriidae	Dried	C and T	1.58	Domestic and International market
Holothuria pardalis (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
Stichopus sp.	Stichopodidae	Dried	C and T	17.89 (small) or 21.05 (medium) or 23.68 (large)	Domestic and International market
Actinopyga miliaris	Holothuriidae	Dried	C and T	17.11	Domestic and International market
Thelenota ananas (Talipan or Timpul)	Stichopodidae	Dried	C and T	17.11	Domestic and International market
T. anax	Stichopodidae	Dried	C and T	3.68	Domestic and International market
Bohadschia 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	Philippinces	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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SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN MYANMAR

By Myint Pe [6]

1. Introduction

The Union of Myanmar with an area of 675,577 square kilometers is situated between 92 degree 10 minutes and 101 degree 10 minutes east longitudes and 9 degree 52 minutes and 28 degrees 25 minutes north latitudes. The country has a long coastline which extends from 9 degree 52 minutes to 21 degree north latitude with a distance of 1,800 kilometers. With its large number of estuaries and islands the length of the total coastline is about 3,000 kilometers and the continental shelf area within 200 meter depth is 225,000 square kilometers. The coastline contains highly productive ecosystem such as mangrove, coral reefs, sea grass beds and marshy lands. These coastal ecosystems are a valuable resource for the people of the country, particularly for coastal communities. Coastal ecosystems have been utilized as a food source and income generator for centuries and the rate of exploitation is increasing at an alarming rate. Collection and exporting coastal ecosystem- associated organisms have contributed substantially to the foreign exchange earning of the country. The collection of sea cucumber for export is one such industry. A sea cucumber fishery has existed in Tanintharyi coastal areas for many years, but along the coastal areas in the Ayeyarwady and Rakhine began only about last 10 years ago, after the country changed its economy system to Open Market Economy from Socialist Economy in 1989. Sea cucumber inhabit along the coast of Myanmar. Sea cucumbers are a fascinating group of marine animals. Invertebrates such as starfish and sea cucumbers ancient animals. Their habitat chiefly among corals but are also found among rocks and in muddy and sandy flats. They are distributed from the shore to the greatest depths. Their lengths range from a few millimeters to more than 2 m and they occur in all color combinations; white, black, red, blue, green, yellow, violet etc. Some of them are really very beautiful while alive and are in great demand for aquaria. The Chinese, Japanese and Koreans consider them as a delicacy. The Chinese consume them in process form while the Japanese and the Korean consume *Apostichopus japonicus*, fresh. The toxins of sea cucumber have antiviral, antitumoral, anticancerous and antifertility properties and find use in the pharmaceutical industry.

Numbering some 1,110 species worldwide, they are found in both tropical and temperate oceans, where they inhabit the intertidal zone as well as deeper waters. They appeared some 500 million years ago and are regarded as close to the line from which all vertebrates evolved. At present, nearly 1,400 species of sea cucumbers are known from all the seas in the world. Of these, only 15 species are used for processing at present. Inside the Mergui Archipelago mostly habitats include silt or sand bottoms, and sea grass meadows some in the reef and rocky bottom, and to 20-25 meter depths. Some small species also occur on the surface or barrel sponges or other sponge types.

2. History of Sea Cucumber Fisheries in Myanmar

Sea cucumber are locally known as " Pin-lai-myawt " but are not used locally as a food item or any other purposes. As with most sea cucumber producing countries, production is not meant for local consumption but rather for export to Asian countries (Conand, 1990). At present only 10 species of sea cucumber were identified in Myanmar coastal areas. Although sea cucumbers were abundant along the shallow coastal waters fishermen were not harvested until buyers from China created a demand. The buyers purchased two species: *Holothuria nobilis* and *Holothuria fuscogilva* for very low price. Although buyers paid only one thousand kyats per kilogram of wet weight, fishermen earned a considerable amount of money because of the organism's abundance in shallow coastal waters. The price increased up to five thousand per kilogram wet weight as suppliers

[6] Member of the Ad hoc Regional Working Group on Sea Cucumber Fisheries and National Focal Point for Myanmar, Department of Fisheries

dwindle. Harvesting at first was done by hand while wading or using snorkel gear in shallow waters. As the shallow areas were finished out scuba gear was used to exploit increasingly deep sea cucumber beds. Over the past three to four years, the sea cucumber fishery in the shallow areas off Myanmar declined rapidly . The fishermen and divers of these areas then turned to distant sea cucumber beds, such as Coco island, Preparis island and some parts of Andaman islands.

Sea cucumber is mainly harvest in November, December, January and February. Local divers harvest sea cucumber together with lobster, oyster and shell fishes. They are fairly interest in collecting only sea cucumber. This animal mostly found in Rakhing coastal area, Andaman Sea, Great coco, Little coco and inside the Mergui Archipalago. The group of fishermen based on the island and harvested sea cucumber together with lobster, oyster and shell fishes. The live animals are gathered from various reef and dried in the sun or smoke with charcoal.

3. Sea Cucumber Species Found in Myanmar

Current knowledge of sea cucumber biodiversity in Myanmar is poor, as few studies have been devoted. Even the Department of Fisheries has not yet undertaken research works in sea cucumber biology and fisheries some studies on these animals were done by universities for Master degree. According to these research papers it was learned that there are ten species of sea cucumber existing in Myanmar waters and utilizing for commercial purposes.

The sea cucumber species systematically identified from Myanmar waters are as follows:

Scientific Name	Common Name	Myanmar Name
Actinopyga miliaris	Black fish	Myawt mae
Actinopyga lecanora	Stone fish	Not myawt ni
Thelenota ananas	Prickly red fish	Na garr
Thelenota anax	Amber fish	Kha met
Stichopus variegates	Curry fish	Pein ne
Stichopus chloronotus	Green fish	Kyet hinn khar tee
Holothuria nobilis	Black Teat fish	Baung kyarr
Holothuria atra	Lolly fish	-
Holothuria fuscogilva	White Teat fish	Baung mae
Bohadschia argus	Leopard (tiger fish)	Kyar thit

1. *Actinopyga miliaris* (Blackfish) species habitat on reef flat of fringing and lagoon islet reefs and never found on barrier reefs. This species can found in the shallow waters depth range between 0 – 10 meters. The average total length of this species is 25 cm and common size is between 10 to 12 cm. This species is called " Myawt-Mae " which means black sea cucumber.

2. *Actinopyga lecanora* (Stonefish) species like to live on hard substrates. It is nocturnal species. In day time it can found under large stones, in gaps in reef slopes or in sheltered areas. This species can found water depth range of 0 to 20 meters. Its common size is between 10 to 12 cm in length. This species is locally known as " Not-Myawt-Ni" which means red sea cucumber.

3. *Thelenota ananas* (Prickly redfish) species can found reef slope and near passes, on hard bottom with large rubble and coral patches. This species can found in the waters depth between 0 to 25 meters. Its common size is between 20 to 25 cm in total length and average size is 45 cm. Local communities called " Nagarr " to this species according to dragon like appearance.

4. *Thelenota anax* (Amberfish) species habitat in reef slope, outer lagoon and near passes, on hard bottoms, large rubble and sand patches. This species prefer to live in water depth between 10 to 30 meters. Its common size is 15 to 20 cm in total length and the average size is 55 cm in length. Locally known this species as " Kha-Met ".

5. *Stichopus variegates* (Curryfish) species can found in sea grass beds, rubble and sandy-muddy bottoms. This species prefer to habit in the waters depth between 0 to 25 meters. The common size of this species is between 12 to 18 cm in total length and the average size is 35 cm. Local people called this species " Pain-Nair " according to " Jack fruit " like appearance.

6. *Stichopus chloronotus* (Greenfish) species can found on the reef flats and upper slop, mostly on hard substrate. This species can collect in the shallow waters depth between 0 to 15 meters. Its common size is 10 to 12 cm and average size is 18 cm in total length. Local name for this species is called " Kyet-Hinn-Khar-Thee "

7. *Holothuria nobilis* (Black Teatfish) species live in reef flats, slopes and shallow sea grass beds. It can collect in the water depth range between 0 to 20 meters. Its common size is 18 to 24 cm and average size is 37 cm in total length. Local people called " Baung-Kyar " to this species.

8. *Holothuria atra* (Lollyfish) species can found in inner and outer reef flats and back reefs or shallow coastal lagoons. Abundance on sandy-muddy grounds with rubble or coral patches and in sea grass beds. It can collect from shallow water, depth range between 0 to 20 meters. The common size of this species is between 15 to 20 cm and the average size is 20 cm in total length. Local name for this species is unknown.

9. *Holothuria fuscogilva* (White Teatfish) species can found in outer barrier reefs and passes, but also on sea grass beds. This species prefer to habit in the water depth between 10 to 40 meters. Its common size is 18 to 24 cm and average size is 42 cm in length. Local name for this species is called " Baung-Mae ".

10. *Bohadschia argus* (Leopard (Tiger) fish) species prefer to live in barrier reef flats and slopes or outer lagoons on white sand. This species can collect from the water depth 0 to 30 meters. The common size of this species is 12 to 18 cm and average size is 36 cm in length. Local people called this species " Kyar-Thit ", which means leopard, according to its appearance.

4. The Main Sea Cucumber Market

Sea cucumber are a delicacy in the Far East; the Chinese consume them is processed formed while the Japanese and Koreans eat them fresh (James, 2001). They are also used in the production of oils, lotions, cosmetics and tablets (Baine and Sze, 1999). Exports from Myanmar are usually in the processed form; the dried products are called beach-de-mer (Conand, 1998). The major export destinations for sea cucumber are China, Hong Kong, Korea and Japan. China has been the dominant buyers from Myanmar since 1999. Hong Kong, Korea and Japan are the second, third and fourth largest markets respectively. (**Table 2**). Since some fishermen are doing sea cucumber fishery illegally, information about sea cucumber are still lacking and statistical data are not sound enough to evaluate the situation of sea cucumber fishery in the country. For this reason, it was found that the yearly sea cucumber exported data are not stable. (**Table 3**)

Table 2. Sea cucumber exported from Myanmar (2004-2005)

Sr.No	Country	MT	US $
1.	China	46.383	304,000.00
2.	Hong Kong	0.224	896.00
3.	Korea	0.085	1,275.00
4.	Japan	0.002	11.00

Source: Statistics of exported fish and fishery products (2004-2005) Department of Fisheries

Table 1. Summary Table for Sea Cucumber Species Composition in Myanmar

Sea Cucumber Species	Family Name	Local Name	Commercial Value
1. *Actinopyga miliaris*	Holothuridae	Myaw-mae	Medium
2. *Actinopyga lecanora*	Holothuridae	Nut-myaw-ni	Medium
3. *Thelenota ananas*	Stichopodidae	Nagar	High
4. *Thelenota anax*	Stichopodidae	Kha-mae	Low
5. *Stichopus variegates*	Stichopodidae	Pain-naei	High
6. *Stichopus chloronotus*	Stichopodidae	Kyet-hin-khar-thee	High
7. *Holothuria nobilis*	Holothuridae	Baung-kyar	Medium
8. *Holothuria atra*	Holothuridae	Baung-kyar	Medium
9. *Holothuria fuscogilva*	Holothuridae	Baung-mae	Medium
10. *Bohadschia argus*	Holothuridae	Kyar-thit	Medium

Table 3. Sea cucumber exported from Myanmar (2002-2003 to 2007-2008)

Sr.No	Year	MT	US $
1.	2002 - 2003	23.66	236735.20
2.	2003 - 2004	0.88	4400.00
3.	2004 - 2005	97.094	826100.00
4.	2005 -2006	50.482	50100.0
5.	2006-2007	24.334	27400.0
6.	2007-2008	-	-

Source: Quality Control Unit,Department of Fisheries

Local Market

After harvested sea cucumber, the fishers and his family processed or dried in the sun or boiled with sea waters and smoke with charcoal. The marine products collector or buyer visited directly and collected from fishers, who based on the island. All products were collected from the fishers and carried to Yangon main market. The dried sea cucumber marker is always in China town. Chinese people preferred to eat very much and it costs about minimum 25,000 kyats / kg, to maximum 180,000 kyats / kg. according to species and sizes. (1000 kyats = 1 US $)

5. Present Status of the Fisheries

At present Myanmar fishermen are exploring sea cucumber beds in distant parts of the Indian Oceans. Although fishermen from Rakhine coastal areas and Tanintharyi coastal areas exploiting sea cucumber in their respective areas, fishermen from Ayeyarwady coastal areas are prefer to go to the sea cucumber beds close to Andaman Island which have very good resources of sea cucumber as well as other aquatic resources. Fishermen used multi-day operating boat and global position system (GPS) to navigate far from shore. Boats range from 10.7 to 15.2 meter (35 to 50 feet) with 25 to 45 HP engines. These boats are usually four to six years old and modified to accommodate 10 to 12 crew member. The crew consists of skipper, divers, a cook, a compressor operator and engine driver. At time these boats operate in group of two or three; by doing so they are able to maximize their profits by carrying fewer support personnel (such as cook and compressor operator) and a large number of divers.

The duration of fishing activity depends on the sea cucumber population and the number of boats and divers participating in the fishery. The harvesting method depends on the depth of the fishing ground. Snorkeling gear is used in shallow waters and the animals are collected by hand and place into the net bag. Sometimes, divers used small hand nets to collect sea cucumber from gullies and crevices on rocky bottoms. In deeper waters, scuba gear is used. The filled net bags are sent to the surface using lifting bags fill with air that is retrieved by the boat's crew. The catch is washed and store on ice in the hold.

The majority of the catch goes through collectors or middlemen for processing, which is mainly cottage industry involving family of collectors and middlemen. During processing sea cucumber are

Table 4. Summary for Consumption and Marketing of Sea Cucumber

Sea Cucumber Species	Family Name	Product Form	Locally consumed(C) Discarded(D) Traded(T)	Local Price (Kyats/Viss)	Main Destination
Actinopyga miliaris	Holothuridae	Dried	(T)	8,000	China
Actinopyga lecanora	Holothuridae	Dried	(T)	8,000	China
Thelenota ananas	Stichopodidae	Dried	(T)	60,000	China
Thelenota anax	Stichopodidae	Dried	(T)	60,000	China
Stichopus variegates	Stichopodidae	Dried	(T)	60,000	China
Stichopus chloronotus	Stichopodidae	Dried	(T)	60,000	China
Holothuria nobilis	Holothuridae	Dried	(T)	20,000	China
Holothuria atra	Holothuridae	Dried	(T)	20,000	China
Holothuria fuscogilva	Holothuridae	Dried	(T)	20,000	China
Bohadschia argus	Holothuridae			20,000	

gutted, cleaned, cooked in boiling water for half an hour and dried. Processed products are then stored in the plastic boxes and channeled to the export markets.

6. Future Development of the Fisheries

The Sea Cucumber fishery is not to expected to grow much beyond the current level; it is instead likely to decrease in the near future due to the scarcity of the resource. Demand will continue to rise, however. As a result, it is expected that the new species will be introduced to the market. The depletion of wild sea cucumber stocks may have the effect of increasing the value of those that remain, so that low value species become medium value, and medium value species become high value. Although the principal market for beach-de-mer are East Asian countries, there is a possibility that the market will expand towards Europe, America and Canada, where many East Asian live. Improve processing and cooking methods, and increase awareness of antiviral, antitumoral, anticancerous, and pro-fertility properties of these products could also increase demand. (James, 2001)

7. Management Measures

There are no effective management measures in place to ensure sustainability of the sea cucumber fishery in Myanmar. Although most sea cucumber fishermen are aware of the negative impacts of the fishery and the rate of resource depletion, the high revenue that this fishery brings, the low amount of fishing effort required, and the scarcity of alternate source of income of the same magnitude, drive them towards harvesting all available sea cucumbers in the shortest possible time.

There is a lack of coordination at different levels of government, particularly at the Township level where authorities do not have the required knowledge or understanding to management the environment. Monitoring stocks and trade in sea cucumber has been severely hampered in the past due to lack of expertise to identify both live animals and the cured products at the point of export. Sustainable use can be achieved through management of the resource. Replenishment of stocks by artificial culture and re introduction is an option to consider. Financial constraints are major obstacle to the implementation of an effective management system. Primary management costs are likely to be those associated with enforcement, provision of technical assistance, training, monitoring, and evaluation. These problems can be resolved with better understanding and dialogue between scientists and authorities.

8. Conclusion

The sea cucumber fishery in Myanmar has decreased due to overexploitation. As a result, Myanmar fishermen and divers exploit sea cucumber beds well away from Myanmar waters as an illegal fishery because of the high demand and the high income provided by the industry. Factors that limit the sustainability of the industry in Myanmar are inadequate information about current stocks, exploitation rates, fishing grounds, and absence of resource management regulations and awareness programmes. Research into improved processing techniques and possible culture techniques are advisable.

9. Recommendations

The following recommendation should be needed to take action in the future for sustainable fishery development.

- It is needed to collect sea cucumber catches data directly or indirectly from the fishers and stakeholders.
- The regional plan for data collection, study on biological and trade status of sea cucumber is urgently needed to implement.
- Identification of sea cucumber species and data collection of species composition from the catch along the coastal areas and landing sites are urgently needed to conduct.
- To identify and to provide information on current status and situation of sea cucumber based on series of meetings and documents are also required.
- Extension, education and public awareness program to local communities for conservation of sea cucumber is urgently need to implement.

SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN THE PHILIPPINES

By Ms. Ludivina L. Labe [7]

1. Introduction

Over-harvesting of shallow-water holothuroids, commonly known as sea cucumbers, throughout their geographical range has become an international concern. The alarming volume of extraction and trade in the high value processed meat, known by the trade names "trepang" and "beche-de-mer" came to the attention of international bodies such as the United Nations Food and Agriculture Organization (FAO) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora(CITES). The aforesaid entities initiated separate fora that provided the avenues to discuss the varied and country-specific issues on sea cucumber fisheries and trade. To wit: the FAO's Advances in Sea Cucumber Aquaculture and Management Workshop (ASCAM) in 2003 and the CITES International Workshop for the Conservation of Sea Cucumbers in the Families Holothuriidae and Stichopodidae in 2004. The CITES has been looking into listing the species in its Appendices according to the category of threat on the survival of wild populations. Recently, the International Union for the Conservation of Nature (IUCN) conducted the "Red List Categories" training for Filipino taxonomists and marine biologists. The clamor to have a National Red List for Marine Species was put forward identifying sea cucumbers as possible candidates for "red" listing.

Cognizant of the fact that the leading exports of sea cucumber products come from its geographical region, the Association of Southeast Asian Nations (ASEAN) and the Southeast Asian Fisheries Development Council (SEAFDEC) responded to the call for more initiatives to sustainable utilization of this economically and ecologically valuable resource. The ASEAN-SEAFDEC placed the outcome of the said international fora in the agenda of Council meetings. The Council came up with a resolution for the regional study on sea cucumber fisheries, utilization and trade. This initiative of the Council underscored its stand that fisheries management should be under the purview of the nations concerned. The results of the regional study would serve as bases of national and regional plans of action towards sustainable and responsible management of sea cucumber fisheries in the region. The ASEAN member nations, with funding from the program "Environmental Related Task in Southeast Asia", carried out secondary data collection from July to November 2007 through their respective designated National Focal Point, hence this report.

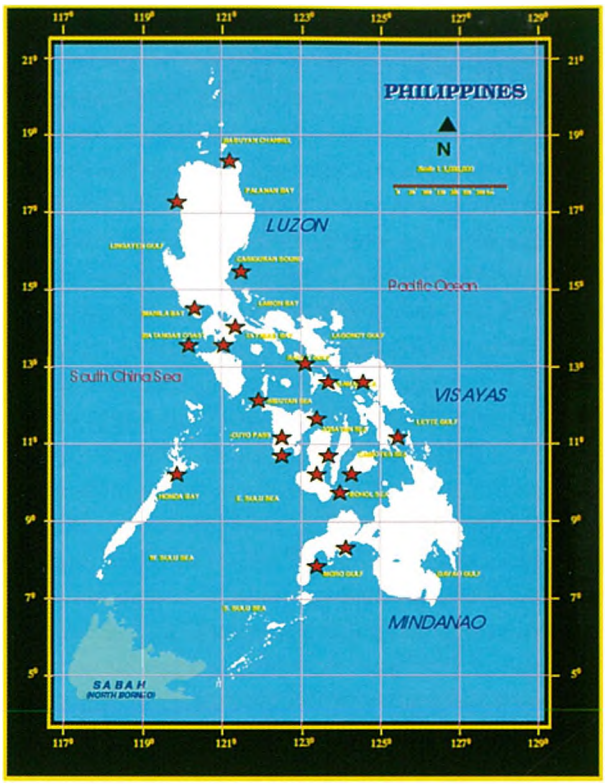


Figure 1. Traditional sea cucumber fishing grounds

The Philippines reportedly is the 2nd largest exporter of dried sea cucumber meat (Lovatelli, et. al, 2004). Since the advent of the fisheries in the 18th century, sea cucumber products have consistently been among the top export commodities of the country forming the basis of a multi-million dollar industry (BAS Fish. Stat. Philipp; Schoppe, 2000; Akamine,

[7] Member of the Ad hoc Regional Working Group on Sea Cucumber Fisheries and National Focal Point for the Philippines; National Fisheries Research and Development Institute (NFRDI)

2002; Ganchero, 2007). Artisanal fishers from about 60 municipalities in 14 regions of the country depend on sea cucumber collection as alternative to finfish fishing during off period (Labe *et. al, to be published*) (**Figure 1**).

The succeeding sections provide details on the current state of Philippine sea cucumber fisheries, utilization and trade and the major issues confronting the industry. Likewise presented are the multi sectoral initiatives to save the fisheries and effect sustainable and responsible utilization of this valuable fishery resource.

2. Taxonomic Information

One of the barriers to holothuroid stock monitoring for conservation and fisheries management purposes is the problem in species identification (Samyn, 2000). The animal loses the key morphological characteristics, e.g. color and body markings, once it is out of the natural habitat. It retracts its tentacles and podia, which are useful in identifying the species. Even more difficult is the identification of the processed products. The key to species identification remains the shape and structure of the tiny, calcareous skeletal pieces, technically termed "ossicles" that are embedded all over the skin of the animal. Using ossicles for taxonomic work also has problems as studies show ossicle shapes and structure change even within an individual depending on age, habitat and geographical location (Massin, 1994; Cutress, 1996; Kerr, 2000). Nowadays, molecular biology is being used in combination with classical taxonomy to confirm the identity of organisms.

Semper (1868), a French taxonomist did the earliest taxonomic investigation of Philippine shallow-water holothuroids using ossicles as key to species identification. The first Filipino to carry out similar work was Domantay (1933) in Port Galera Bay, Occidental Mindoro and adjacent waters. Other works include those of Tan Tiu (1981) in Mactan and neighboring islands, Central Philippines, Leonardo and Cowan (1984) in Calatagan, Batangas and Schoppe (2000) in the waters of Palawan and Leyte. Yllano and Lopez (1999) were the first to use ossicle as key character in identifying four species in Negros Occidental, Lingayen Gulf and Kalatagan, Batangas Islands. Published works on holothurians biodiversity by foreign scientists were those of Gosliner, Williams and Behrens (1996) in the waters of Central Philippines and Batangas Islands; Kerr, Netchy and Gawel (2006) in the waters of Negros Oriental, Cebu and Bohol and Groenewold and Wegmann (2007) along the coast of Negros Occidental.

The National Fisheries Research and Development Institute (NFRDI) through the National Sea Cucumber Research Program (NSCRP) of the Marine Invertebrate Research Section undertook a comprehensive taxonomic and fishery investigation of the commercial holothuroids from 15 sites in 14 regions of the country (Labe, *et. al, to be published*). Confusion regarding the identity and price of the traded holothuroids, particularly of the low value dried species, stems from the different local names given to each species depending on the dialect. Almost all local names are based on the striking characteristics of the animal. Although the NSCRP has the price data of fresh and dried holothuroids given by collectors and cooperative local traders, this has yet to be validated vis-à-vis the species identity. One of the assumptions was that species belonging to the same genus have more or less the same price except for the diverse genus Holothuria with several low value species. The NSCRP will soon come out with publications on the taxonomy and fisheries of commercial holothuroids.

Thus far, 47 commercially valuable species belonging to families Holothuriidae, Stichopodidae and Phyllophoridae have been accounted by the above-cited biodiversity undertakings in the Philippines (**Tables 1** and **2**). The price information is incomplete due to the confusion previously mentioned. One glaring result of recent surveys is the confirmation of the critical state of sea cucumber fisheries based on low densities and disappearance of a number of high value species in most of the historically rich fishing areas.

Table 1. Summary of Sea Cucumber Species Composition in the Philippines

Species	Family Name	Local Names	Commercial Value (Price Range: USD/Kg)[a]		
			2000[b]	2001[b]	2007[c]
Actinopyga mauritiana	Holothuriidae	bakungan	4.0-14.4	2.4-12.7	12.8-46.5
Actinopyga caerulea [d]	Holothuriidae	khaki			
Actinopyga caroliniana [d]	Holothuriidae	khaki			
Actinopyga echinites	Holothuriidae	brown beauty; khaki	15.6	12.7	27.9-53.5
Actinopyga lecanora	Holothuriidae	buli-buli; boli-boli; monang	10.4-24.4	7.8-21.6	19.8-66.3
Actinopyga miliaris	Holothuriidae	khaki			
Actinopyga obesa [d]	Holothuriidae	khaki			
Actinopyga palauensis [d]	Holothuriidae	khaki			
Bohadschia argus	Holothuriidae	leopard; matang-itik	8.4	8.2	15.1 – 26.7
Bohadschia bivittata d lawayan	Holothuriidae	lawa yan			
Bohadschia koellikeri [d]	Holothuriidae	lawa yan			
Bohadschia marmorata	Holothuriidae	lawa yan; pulutan	4.0-6.9	3.3 - 6.3	9.3 – 22.1
Bohadschia paradoxa [d]	Holothuriidae	lawa yan	5.3	4.3	10.9
Bohadschia sp. [d]	Holothuriidae	lawa yan			
Bohadschia vitiensis [d]	Holothuriidae	lawayan			
Holothuria arenicola [d]	Holothuriidae				
Holothuria atra	Holothuriidae	black beauty	2.2-5.3	1.6-3.9	20.9
Holothuria canaliculata	Holothuriidae				
Holothuria coluber	Holothuriidae	patola white; tambor	5.6	4.5	20.9
Holothuria edulis	Holothuriidae	red beauty	4.9 – 5.3	3.9 – 4.7	8.1 – 20.9
Holothuria excellens [d]	Holothuriidae				
Holothuria fuscocinerea [d]	Holothuriidae		0.4	0.4	2.9
Holothuria fuscogilva	Holothuriidae	susuan	12.1– 35.6	9.8 – 35.3	41.9 – 88.4
Holothuria fuscopunctata	Holothuriidae	sapatos	2.9	2.7	8.6
Holothuria hilla	Holothuriidae	bat-tuli	0.4	0.4	2.9
Holothuria impatiens	Holothuriidae	sunlot	0.4	0.4	2.3
Holothuria inhabilis	Holothuriidae	batunan	0.4	0.4	0.5
Holothuria leucospilota	Holothuriidae	patola	4.9	3.9	
Holothuria nobilis	Holothuriidae	susuan	11.1 – 26.7	9.8 – 19.6	34.9 – 69.8
Holothuria pervicax	Holothuriidae		0.4	0.4	2.9
Holothuria pulla	Holothuriidae	patola red, unotunot	5.6	4.5	12.8
Holothuria rigida [d]	Holothuriidae	batunan	0.4	0.4	2.9
Holothuria scabra	Holothuriidae	putian; kurtido	12.2 – 36.7	12.7–37.3	41.9 – 104.7
Holothuria scabra var. versicolor	Holothuriidae	kurtido bato			
Holothuria sp. [d]	Holothuriidae				
Holothuria turricelsa [d]	Holothuriidae				
Holothuria whitmae	Holothuriidae	susuan			23.3 – 104.7
Pearsonothuria graeffei	Holothuriidae	piña; lawayan; mani-mani	2.4	1.8	4.7
Thelenota ananas	Holothuriidae	talipan; taripan	10.0 – 14.4	13.7 (L)	34.9 – 62.8
Thelenota anax	Holothuriidae	legs	4.9	3.7	13.0
Thelenota rubralineata	Holothuriidae	talipan	4.9	3.7	13.0
Neocucumis proteus–	Phyllophoridae	bola-bola; balo-balo			0.5-1.2[e]

Species	Family Name	Local Names	Commercial Value (Price Range: USD/Kg)[a]		
			2000[b]	2001[b]	2007[c]
Stichopus chloronotus	Stichopodidae	kuatro kantos	23.3	19.6	60.5
Stichopus hermanni	Stichopodidae	hanginan	6.7 – 21.1	5.9 – 21.6	34.9 – 58.1
Stichopus horrens	Stichopodidae	hanginan	6.7 – 21.1	5.9 – 21.6	34.9 – 58.1
Stichopus noctivagus	Stichopodidae	hanginan			
Stichopus variegatus	Stichopodidae	hanginan; gadul			

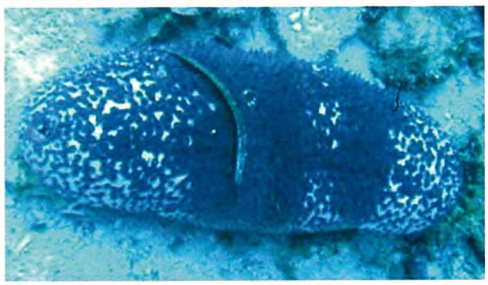
Legend:
a price range based on sorted size labels: extra small (XS), small (S), medium (M), large (L) and extra large (XL); unranged prices are unsorted.
b Akamine (2002); USD1 = Php 45.00 (2000); USD1 = Php 51.00 (2001)
c Labe, et. al (to be publ): USD1 = Php 43.00 (2007)
d photographs and species descriptions taken from Kerr, et. al (2006)
e price range per piece
***Note:** Prices not reflected for those species whose prices vis-à-vis species are being confirmed*

Table 2. Biology of Sea Cucumbers in the Philippines

FAMILY: Holothuriidae

Scientific Name: *Actinopyga caerulea*
Common Name: blue sea cucumber
Local Name: unknown

Description: Mottled variably in grayish blue on a white background; newly described species by Samyn, VandenSpiegel & Massin, 2006; length reaches to about 40 cm.



Taken from Kerr, et. al. (2006)

Scientific Name: *Actinopyga caroliniana*
Common Name: Caroline's sea cucumber
Local Name: unknown

Description: Light brown with teat-like protuberances bearing papillae along dorso-lateral side; grows to about 15 cm.

Taken from Kerr, et. al. (2006)

Scientific Name: *Actinopyga echinites*
Common Name: deep-water redfish
Local Name: brown beauty; khaki; hudhud

Description: Dark-brown; dorsally transverse black bands; smaller individuals have large conical papillae as shown by this specimen; grows to about 30 cm.

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Scientific Name: *Actinopyga lecanora*
Common Name: stonefish
Local Name: buli-buli; monang; manapaw

Description: Mottled chestnut brown and white blotches dorsally; characteristic white posterior; grows to about 25 cm.

Scientific Name: *Actinopyga mauritiana*
Common Name: surf redfish
Local Name: khaki

Description: Dark brown with more or less white spots; bivium sometimes wrinkled; densely covered with tube feet; grows to about 35 cm

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Scientific Name: *Actinopyga miliaris*
Common Name: hairy blackfish
Local Name: khaki

Description: Dark brown to almost black body color; body covered with papillae; grows to about 35 cm.

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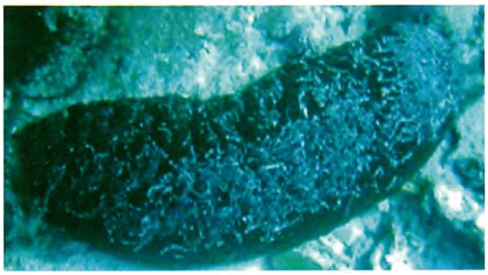
Scientific Name: *Actinopyga obesa*
Common Name: plump sea cucumber
Local Name: khaki

Description: Body robust; reddish brown or yellowish brown body color covered with spots of light brown; some individuals with large light brown spots ringed with yellow; partially covered by sediments.

Scientific Name: *Actinopyga palauensis*
Common Name: Palauan sea cucumber; Panning's blackfish
Local Name: unknown

Description: Bivium black generally covered by mucus and sediment dorsally; trivium lighter, dark brown; grows to about 40 cm.



Scientific Name: *Bohadschia argus*
Common Name: leopard fish
Local Name: leopard; matang-itik

Description: The species is easily identifiable with the numerous ocelli circled with white that are orange to yellow-brownish in color; the body markings are retained even in dried form; grows to about 60 cm in length; one of the most abundant species.

Scientific Name: *Bohadschia bivittata*
Common Name: two-ribboned sea cucumber
Local Name: putlan

Description: Distinguished by two transverse brown bands over the dorsum; bands visible in dried form; length reaches to 25 cm.

Scientific Name: *Bohadschia marmorata*
Common Name: chalky sea cucumber
Local Name: lawayan; pulutan

Description: Distinguished with large angular dark patches dorsally; patches become one wide vertical band on the biviumas shown in the photo; cuvierian tubules readily ejected; grows to about 20 cm.

Scientific Name: *Bohadschia paradoxa*
Common Name: paradoxical sea cucumber
Local Name: lawayan

Description: Yellowish in color with darker circles and somewhat short papillae; length reaches to 50 cm.

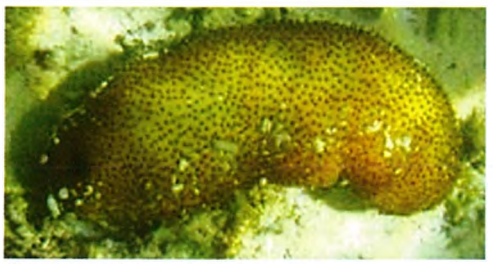
Taken from Poppe-Images, 2005
(www.poppe-images.com)

Scientific Name: *Bohadschia similis*
Common Name: brown-spotted sea cucumber
Local Name: lawayan; tagukan

Description: Bivium whitish to light yellow with small black spots and grayish patches; triviumwhite with black tiny spots; two rows of yellowish podia; grows to about 26 cm.

Scientific Name: *Bohadschia vitiensis*
Common Name: brown sandfish; speckled sea cucumber
Local Name: lawayan

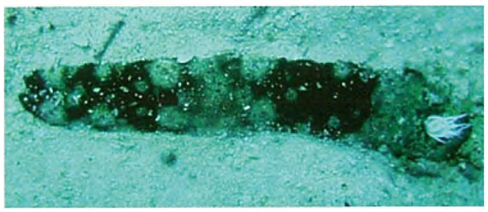
Description: Yellow in bivium with brown bands; trivium lighter; 20 small, short and yellowish tentacles; length reaches to 40 cm.



Taken from Kerr, et.al. (2006)

Scientific Name: *Bohadschia koellikeri*
Common Name: mottled sea cucumber
Local Name: unknown

Description: Bold camouflage pattern in deep brown and beige; tube feet spread over surface; grows to about 40 cm.



Taken from Kerr, et.al. (2006)

Scientific Name: *Holothuria arenicola*
Common Name: sand sea cucumber
Local Name: unknown

Description: Creamy white to grayish with two longitudinal rows of brown spots; trivium white; grows to about 30 cm.

Scientific Name: *Holothuria atra*
Common Name: lollyfish
Local Name: black beauty

Description: Entirely black and smooth body often covered by sand leaving two rows of round patches on the bivium; grows to about 45 cm.

Scientific Name: *Holothuria canaliculata*
Common Name: chanelled sea cucumber
Local Name: unknown

Description: Grayish cream splattered by numerous dark brown blotches dorsally; length reaches to 15 cm.

Scientific Name: *Holothuria coluber*
Common Name: snakefish
Local Name: patola white; tambor

Description: Black with white or yellow papillae all over the body; yellow tentacles; grows to about 60 cm.

Scientific Name: *Holothuria edulis*
Common Name: pinkfish
Local Name: red beauty; red powder; hotdog

Description: Sausage-shaped (Schoppe, 2000) with black dorsal surface and pink or reddish ventrally with small, dark dots; grows to about 35 cm.

Scientific Name: *Holothuria fuscocinerea*
Common Name: ashen sea cucumber
Local Name:bat-tuli, brown beauty

Description: Grey to brown mottled with dark white-ringed papillae dorsally; whitish ventrally; length reaches to 25 cm.

Scientific Name: *Holothuria fuscogilva*
Common Name: white teatfish
Local Name: susuan

Description: Yellowish white with dark brown markings; 6 to 8 teats on each side; grows to a maximum length of 57 cm.

Scientific Name: *Holothuria fuscopunctata*
Common Name: elephant trunkfish
Local Name: sapatos

Description: Distinguished with brown wrinkles over its stout,firm and rigid body; grows to about 70 cm.

Scientific Name: *Holothuria gracilis*
Common Name: yellow-bellied sea cucumber
Local Name: unknown

Description: Grayish dorsally with numerous papillae of equal size; trivium lighter, yellowish; length reaches to 25 cm. (Kerr, et al. 2006)

Scientific Name: *Holothuria hilla*
Common Name: Tigertail sea cucumber
Local Name: Bat-tuli

Description: Light brown with yellowish or whitish papillae; grows to about 25 cm.

Scientific Name: *Holothuria impatiens*
Common Name: bottle sea cucumber
Local Name: sunlot

Description: Brown or grayish body traversed with light and dark stripes; grows to about 30 cm.

Scientific Name: *Holothuria inhabilis*
Common Name: sandy sea cucumber
Local Name: batunan, nuog-nuog

Description: Long, slender, worm-like sea cucumber in different shades of brown; white colored mouth at posterior end; length reaches to about 50 cm.

Scientific Name: *Holothuria leucospilota*
Common Name: white threadfish
Local Name: patola

Description: Uniformly black, cylindrical, elongate body with soft papillae and black tentacles; grows to about 30 cm.

Scientific Name: *Holothuria nobilis*
Common Name: black teatfish
Local Name: susuan,; bakungan

Description: Generally black with 5 to 8 teats on each side; grows to about 55 cm.

Scientific Name: *Holothuria pervicax*
Common Name: stubborn sea cucumber
Local Name: Bat-tuli; sunlot

Description: Mottled with in grey and cream with variably sized papillae; length reaches to about 15 cm.

Scientific Name: *Holothuria pulla*
Common Name: brown sea cucumber
Local Name: unot-unot; patola red

Description: Deep reddish brown or black, thin and soft body; grows to about 40 cm. (Batoy, et al. 1998)

Scientific Name: *Holothuria rigida*
Common Name: rigid sea cucumber
Local Name: batunan

Description: Uniformly white to grayish white with small dark spots; worm-like species; grows to about 18 cm.

Taken from Kerr, et.al. (2006)

Scientific Name: *Holothuria scabra*
Common Name: sandfish
Local Name: putian; kurido; kiskisan

Description: Highly variable colors from whitish to dark brown bivium with dark transverse markings and strong folds; lighter trivium, generally whitish; length reaches to about 35 cm.

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Scientific Name: *Holothuria scabra versicolor*
Common Name: white sandfish
Local Name: kurtido bato

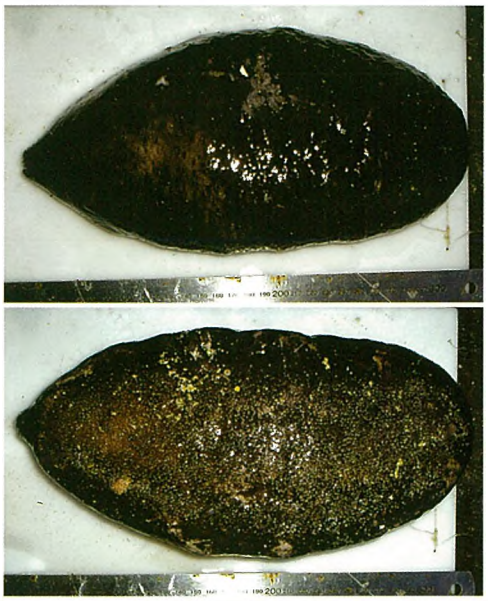
Description: Differ from *H. scabradue* to absence of strong folds on the dorsal body wall (bivium); colors in 3 main patterns (speckled, with moderate black areas, or black overall (as shown in the picture); grows to about 45 cm.

Scientific Name: *Holothuria turriscelsa*
Common Name: warty sea cucumber
Local Name: to be determined

Description: Uniformly grey, few individuals are lighter; cream colored ventrally; easily ejects cuveriantubules; recently described species (1980); grows to 30 cm in length.

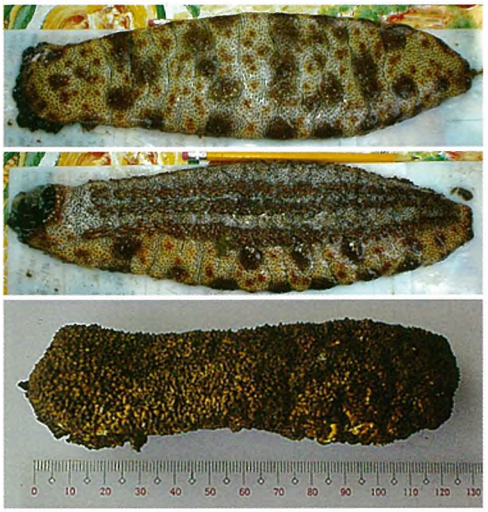
Scientific Name: *Holothuria whitmaei*
Common Name: teatfish; mammy blackfish
Local Name: susuan

Description: Bivium black and lighter trivium; no papillae dorsally; prominent teats but when disturbed it can no longer be seen; grows to about 35 cm.



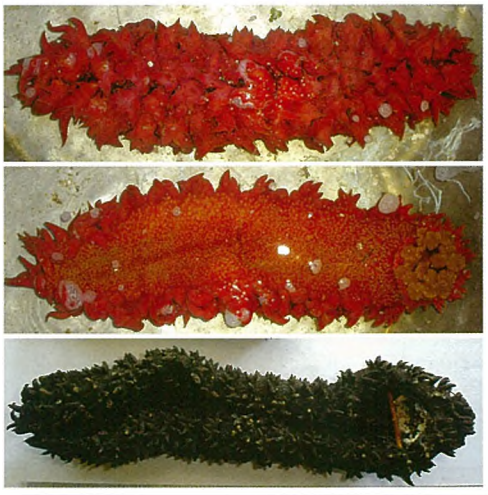
Scientific Name: *Pearsonothuria graeffei*
Common Name: black-spotted sea cucumber
Local Name: piña; mani-mani; hanginan; bulaklak; trompa

Description: Whitish with irregular big brown spots and small black spots; three longitudinal bands of tube feet; black tentacles with white crown; grows to about 45 cm.



Scientific Name: *Thelenota ananas*
Common Name: prickly redfish; pineapple sea cucumber
Local Name: talipan; taripan; tinikan; tres; kantos; pinyahan

Description: Distinguished by its reddish color and numerous large papillae; 20 large brown or yellowish tentacles; grows to about 80 cm.



Scientific Name: *Thelenota anax*
Common Name: amberfish; giant beche-de-mer
Local Name: legs

Description: Tan to whitish in color with brown or orange blotches; quadrangular in cross section; grows to about 80 cm.

Photo: N.C. Gatdula - Dapa, Surigao DN

Scientific Name: *Thelenota rubralineata*
Common Name: red-striped sea cucumber; candy cane sea cucumber
Local Name: legs

Description: Covered with red and white stripes; numerous, large papillae on dorsal side; trapezoidal in cross section; grows to about 50 cm.

FAMILY: Stichopodidae

Scientific Name: *Stichopus chloronotus*
Common Name: greenfish
Local Name: kuatro kantos; hanginan black

Description: Dark green to black in color characterized with double row of large papillae; quadrangular in cross section; grows to about 35 cm.

Photo: S. Tagaro - Pangiao Proj. 2004

Scientific Name: *Stichopus hermanni*
Common Name: curryfish
Local Name: hanginan

Description: Variable colors from olive green to orange with grayish spots; quadrangular in cross sections; grows to about 50 cm.

Scientific Name: *Stichopus horrens*
Common Name: Selenka's sea cucumber; horrendous sea cucumber
Local Name: hanginan

Description: Tan to grey in color with numerous brown or greenish irregular papillae; 4 rows of stout podia in the trivium; grows to about 50 cm.

Photo: S. Tagaro - Pangleo Proj. 2004

Scientific Name: *Stichopus noctivagus*
Common Name: curryfish
Local Name: hanginan

Description: Mottled orange-red and white with occasional dark blotches and white papillae; length reaches to about 20 cm. (Kerr, et al. 2006)

Scientific Name: *Stichopus variegatus*
Common Name: curryfish
Local Name: hanginan

Description: Greenish in color with black spots and covered with irregular warts dorsally; yellow podia arranged in rows; grows to about 50 cm

FAMILY: Phyllophoridae

Scientific Name: *Neocucumis proteus*
Common Name: ball-shaped sea cucumber
Local Name: bola-bola; balo-balo

Description: The species is ball-shaped when freshly caught; beige to light brown body covered with papillae that contract when disturbed; the animal takes a long time to assume the cucumber shape after collection; ball shape body is retained when processed.

3. Production and Utilization

3.1 Sea cucumber fisheries

The Philippine sea cucumber fishery depends solely on natural stocks. Commercial holothuroids are the target of artisanal fishery particularly during the lean months of finfishing. Around 100 target species once abound in nearly all shallow-water areas of the country. Only 47 species, each known by various local names, have been accounted by recent surveys. The methods and equipment used in sea cucumber collection remained the same since the advent of the Philippine sea cucumber fisheries in the 18th century, as reported by various authors (Domantay, 1933; Trinidad- Roa, 1987; Schoppe, *et. al*, 1998; Labe, 2005; Labe, *et. al*, *to be published*).

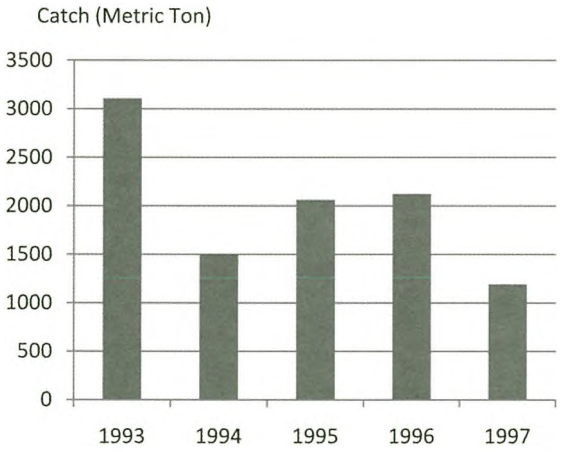


Figure 2. Sea cucumber production 1993-1997 (Labe, 2004)

Species in the families Holothuriidae and Stichopodidae are heavily collected by gleaning during low tide by members of fishing families in coastal villages all over the country. The local divers aided by the life-threatening improvised air compressor locally called "capandra" or "hookah" collect species inhabiting deeper areas such as those in the genera *Thelenota, Stichopus* and the newly discovered populations of *Neocucumis proteus* (family Phyllophoridae). Due to the "open access" fisheries in municipal waters, gatherers from neighboring towns and provinces could collect seacucumbers at any time putting additional pressure on the meager resource.

Sea cucumber production from artisanal fisheries showed fluctuating annual landed catches from the early 1970s to the present as reflected in the compilation of fisheries statistics by the Bureau of Agricultural Statistics (BAS). The highest production volume of 3109 MT was accounted in 1993 to a low 1191 MT in 1997 (**Figure 2**). Production data in the succeeding years and socio-economic information such as the number of coastal families who depend on sea cucumber fisheries for livelihood are unavailable. The scarcity of fisheries data and the inability of the BAS enumerators to breakdown production statistics into species have diminished the usefulness of these data in resource conservation and management.

The results of the NSCRP fishery investigations and recent biodiversity surveys validated the BAS accounts (Kerr, et. al, 2006; Groenewold and Wegmann, 2007; Labe, *et. al*, *to be published*). These further confirm the general perception and anecdotal reports of natural populations in traditional collection sites like the Jolo-Sulu-Tawi-Tawi strongholds are on the verge of collapse (**Figure 3** and **4**), collection sizes of commercial species are getting smaller (**Figure 5**) and the

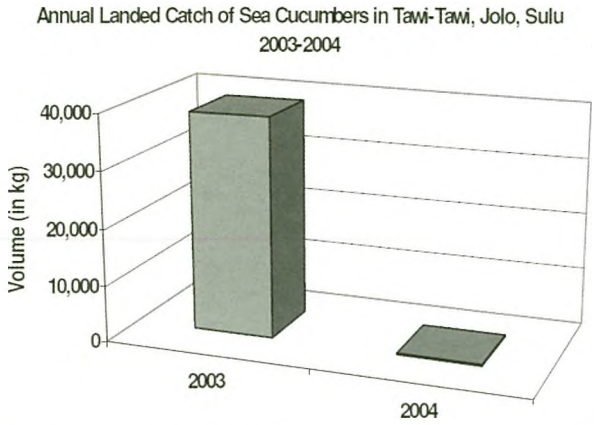


Figure 3. Sea cucumber production based on landed catch in Tawi-Tawi, 2003-2004.
The Sulu Archipelago was once a stronghold of sea cucumber (Source: BFAR ARMM, 2005),

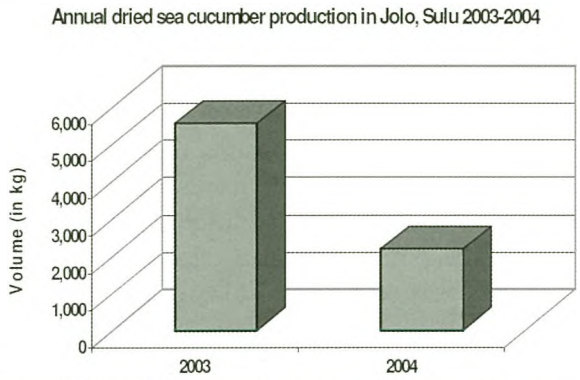


Figure 4. Abrupt decrease in annual dried sea cucumber production in Jolo, Sulu, 2003-2004 (Source: BFAR ARMM, 2005).

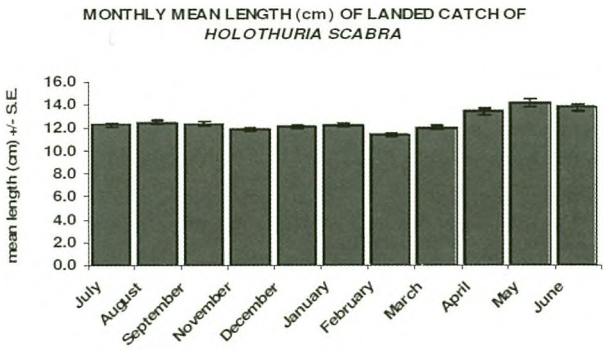


Figure 5. Undersized Holothuria scabra taken from the landed catches in Honda Bay, Puerto Princesa, Palawan based on the size limit (22 cm) set by Papua New Guinea for fresh/unprocessed meat of the species (Labe, et. al, to be published).

collection sites that were within the littoral zone, have now moved to deeper waters. Heavily fished areas have low densities or are now deplete of the high value species such as *Holothuria scabra, H. fuscogilva, H. nobilis, H. whitmae* and *Actinopyga* spp. The above-cited surveys carried out in different sites showed similar result as to the dominance of

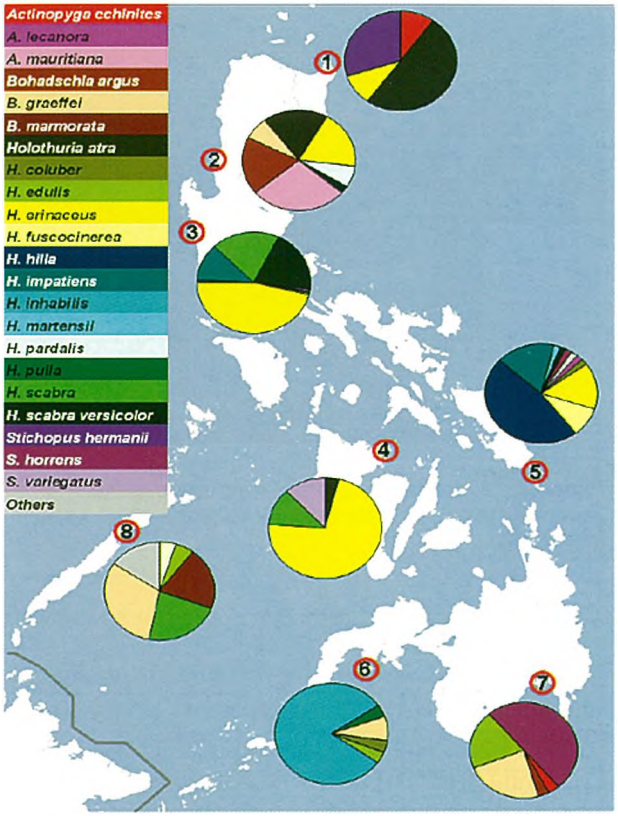


Figure 6. Relative abundance (number of individuals) of commercial holothuroids in survey sites of NSCRP showed dominance of low value species in all the sites and non-appearance of high value species in the landed catches in most sites (Labe, et. al, to be published).

low value species from the landed catches, such as *Bohadschia argus, B. marmorata, Pearsonothuria graeffei, Holothuria atra, H. fuscocinerea, H. leucospilota, H. hilla, H. impatiens, Stichopus spp.*, among others (**Figure 6**).

3.2 Local usage and processing

Sea cucumbers are not a basic food source of Filipinos, but fresh meat is a delicacy in some coastal villages. The fresh/frozen, salted/in brine, smoked and dried sea cucumber products are marketed locally in supermarkets and form part of cuisines in local hotels and restaurants. The bulk of processed products, particularly the dried and smoked forms are intended for the export markets where they remain in demand and high priced products. The crude method of processing sea cucumber meat: gutting, boiling, smoking, and sun drying is still the common practice in fishing communities nationwide (**Figure 7**). In some areas, major local buyers/middlemen invest on setting up their kiln for the final drying process before selling the product to middlemen in Manila or directly to exporters.

Figure 7. Crude method of processing sea cucumber commonly practiced in fishing villages (Labe, et. al, to be published)

Efforts to standardize sea cucumber processing method that is HACCP compliant has been initiated by the Post-Harvest Research and Development Division (PHRDD) of the NFRDI and some of the counterpart Division from the Regional Offices of the Bureau of Fisheries and Aquatic Resources (BFAR). Other initiatives to develop value-added products from sea cucumbers have been carried out by the above-mentioned entities. However, efforts to transfer such technology to stakeholders are still lacking.

Besides being high value commodity as food source, the pharmaceutical potential and other commercial uses of sea cucumbers have been discovered by scientists from the University of the Philippines in Los Banos, Laguna (UPLB). The chloroform extracts called lectins from *Holothuria nobilis, Bohadschia marmorata* and *Stichopus chloronotus* have been found to have anticancer and antibacterial activity (Mojica, et. al, 2003). More medical and pharmaceutical uses of sea cucumbers are being discovered by local and foreign research institutions.

3.3 Marketing

The existence of a market chain for sea cucumber products have been traced by the works of Schoppe (2000), Akamine (2002), Gamboa, *et. al* (2007), Labe, et. al (to be published). The chain includes the gatherers, local buyers, middlemen and exporters as key players (**Figure 8**). The gatherers themselves before selling the product to the major local buyers within their community do the gutting, boiling, smoking and sun drying. Some local buyers buy the fresh catch and do the processing themselves before the products change hands from the local buyers to middlemen from different parts of the country. These middlemen have the knowledge of the trading season in each locality.

The prices from the gatherers to local buyers depend on the species, size (extra small, small, medium, large, extra large), and are further graded into class A, B, C. The condition of the fresh and dried products and if the product requires final kiln or sun drying also determine the buying price from the gatherers to local buyers. The middlemen dictate and have control over the prices. Some of the high value species are *Holothuria fuscogilva, H. scabra, H. nobilis, Actinopyga lecanora, Stichopus hermanni* and the deep-water species *Neocucumis proteus*. The price of dried products ranged from Php 200.00-4,500.00 (USD 5.00-105.00), which even goes up to about Php 6,000.00 (USD 140.00) during the lean months for sea cucumber collection (**Table 3**).

Table 3. Summary for Consumption and Marketing of Sea Cucumber

Species	Family Name	Product Form	Locally Consumed (C), Discarded (D), Traded (T)	Local Price (P/Kg)
Actinopyga echinites	Holothuriidae	Dried	T	1,200 - 2,300
Actinopyga lecanora	Holothuriidae	Dried	T	850 – 2,850
Actinopyga mauritiana	Holothuriidae	Dried	T	550 – 2,000
Actinopyga miliaris	Holothuriidae	Dried	T	500 – 1,500
Actinopyga obesa	Holothuriidae	Dried	T	unknown

Species	Family Name	Product Form	Locally Consumed (C), Discarded (D), Traded (T)	Local Price (P/Kg)
Bohadschia argus	Holothuriidae	Dried; fresh	T	650 – 1,200
Bohadschia marmorata	Holothuriidae	Dried	T	400 - 950
Bohadschia paradoxa	Holothuriidae	Dried	T	500
Bohadschia vitiensis	Holothuriidae	Dried	T	500
Holothuria arenicola	Holothuriidae	Dried; fresh	C	20
Holothuria atra	Holothuriidae	Dried; fresh	T	900
Holothuria coluber	Holothuriidae	Dried; fresh	T	900
Holothuria edulis	Holothuriidae	Dried; fresh	T	350 – 900
Holothuria fuscocinerea	Holothuriidae	dried; fresh	C	120
Holothuria fuscogilva	Holothuriidae	Dried	T	1,800 – 3,800
Holothuria fuscopunctata	Holothuriidae	Dried	T	370
Holothuria hilla	Holothuriidae	Dried; fresh	T, C	120
Holothuria impatiens	Holothuriidae	Dried; fresh	C	100
Holothuria inhabilis	Holothuriidae	Dried; fresh	C	20
Holothuria leucospilota	Holothuriidae	Dried; fresh	C	150
Holothuria nobilis	Holothuriidae	Dried	T	1,500 – 3,000
Holothuria pulla	Holothuriidae	Dried; fresh	T,C	550
Holothuria rigida	Holothuriidae	Dried; fresh	C	120
Holothuria scabra	Holothuriidae	Dried	T	1,800 – 4,500
Holothuria scabra var. versicolor	Holothuriidae	Dried; fresh	T	400 - 950
Holothuria whitmae	Holothuriidae	Dried	T	1,000 – 4,500
Neocucumis proteus	Phyllophorida	Dried	T	20–50 per piece
Pearsonothuria graffei	Holothuriidae	Dried; fresh	T	200
Stichopus chloronotus	Stichopodidae	Dried	T	2,600
Stichopus hermanni	Stichopodidae	Dried	T	1,500 – 2,500
Stichopus horrens	Stichopodidae	Dried	T	1,500 – 2,500
Stichopus noctivagus	Stichopodidae	Dried	T	500 – 1, 500
Sticopus variegatus	Stichopodidae	Dried	T	1,500 – 2,500
Thelenota ananas	Holothuriidae	Dried	T	1,500 – 2,700
Thelenota anax	Holothuriidae	Dried	T	550
Thelenota rubralineata	Holothuriidae	Dried	T	550

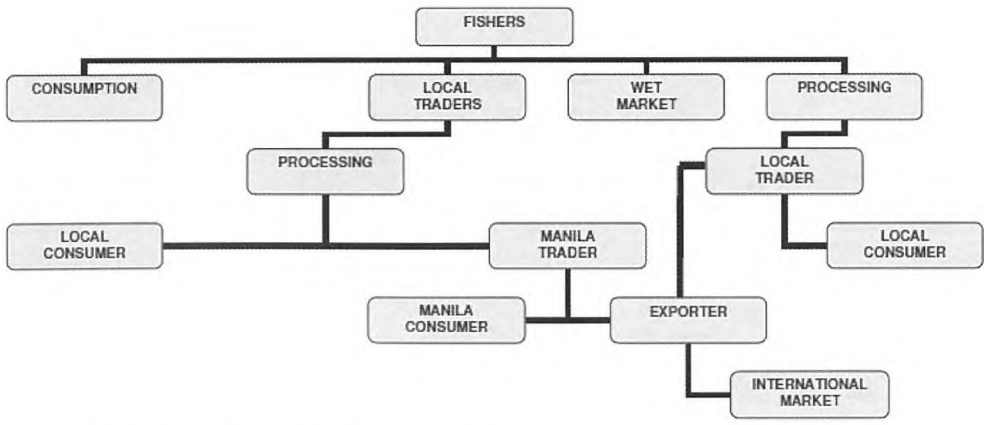


Figure 8. Market chain of sea cucumbers from fishers to consumers (Gamboa, 2007)

The international market is dominated by dried sea cucumber products with the Philippines as the 2nd major producer and supplier. Processed sea cucumber export was reported to rank 8th in the Philippines' top 10 major export commodities. Ganchero (2007), however, opined that the commodities might be on the 4th or 5th rank based on the increasing number of exporters and continuously increasing value of processed sea cucumber products despite the diminishing production volume. During the 1970s, Philippine export statistics showed increased export volume from 1970-2000 with 1984 having the highest at 3500 metric tons (MT) as shown in the works of Akamine (2002). However, in the 1990s, export volume started to fluctuate then showed decline up to the present time based on the compilation of export data from the Bureau of Export Trade Promotion (BETP) under the Department of Trade and Industry (DTI).(). Although the Philippines has maintained a 1000 MT export level (Akamine, 2002), it consists of few high priced species such as *Holothuria scabra, H. fuscogilva, H. nobilis, H. whitmae, Actinopyga lecanora and Stichopus* spp. and mostly undersized individuals (Labe, *et al, to be published*).

Asia is the biggest market for processed sea cucumber meat from the Philippines with an annual export value of USD 43.00 to USD 4.6 million from 1993 to 2006. To date, there are about 46 Filipino owned or partly owned companies engaged in processed sea cucumber export registered in the Bureau of Export and Trade Promotions (BETP) under the Department of Trade and Industry (DTI) supplying the markets of Hongkong, Korea, Singapore, Thailand, Malaysia, Canada, USA and Taiwan in the decreasing order of market dominance (Ganchero 2007). Export to China commenced in 2000 with the highest value of USD 231,000 decreasing annually. Vietnam started its trade with the Philippines in 1988 with a meager import until it reached a high USD 748,000 in 2006 ().

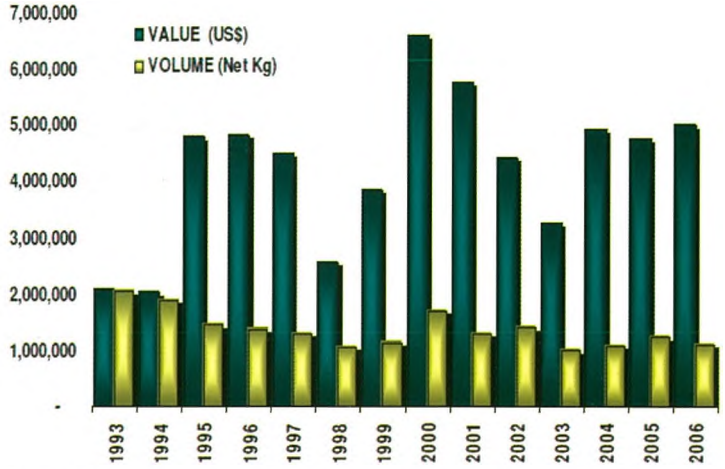


Figure 9. Fluctuating export volume and increasing export value sea cucumber exports from the Philippines, 1993-2006 (Sources: Labe, 2004; Ganchero, 2007).

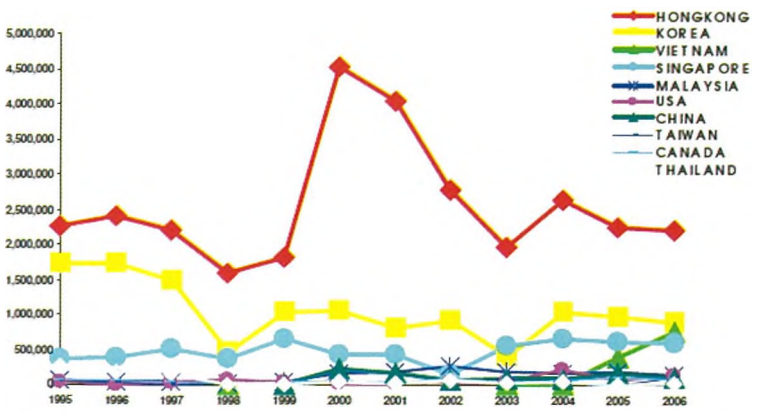


Figure 10. Major markets of Philippine sea cucumbers (USD) from 1993-2006 (Source: Ganchero, 2007)

Research initiatives by government, academic and non-governmental institutions have confirmed the critical state of the Philippine sea cucumber resources and fisheries. The most comprehensive investigation in terms of area and data coverage is the NFRDI Marine Invertebrate Research Section's National Sea Cucumber Research Project (NSCRP). The current socio-economic and governance condition, inability of government to provide management intervention, lack of baseline data, e.g. species, ecological, biological, production and trade; lack of efforts to develop aquaculture and postharvest techniques are only some of the major issues confronting sea cucumber fisheries, utilization and trade in the Philippines.

To date, the first and most significant government initiative to save the country's sea cucumber resources and heed the call of regional and international bodies was a national forum spearheaded by the NFRDI and BFAR, in collaboration with Philippine Council for Aquatic and Marine Research and Development (PCAMRD) and the University of the Philippines Marine Science Institute (UPMSI). The First National Forum on Sea Cucumber Fisheries Management was held on June 6-9, 2007 at the BFAR National Integrated Fisheries Technology Development Center (NIFTDC) in Dagupan City, Pangasinan in Northern Luzon. The forum gathered together participants from relevant government agencies, strategically located academic research institutions, BFAR Regional Field Offices, Local Government Units (LGUs); and stakeholders (sea cucumber collectors; growers and traders). The forum served as venue for all sectors concerned to share information and exchange views regarding the complex management and development issues on Philippine sea cucumber fisheries.

The general objectives of the forum were: 1) to assess the status of sea cucumber fishery and industry and develop management recommendations/input to national policy to ensure sustainability of the resource and equitable benefits to stakeholders; and 2) to formulate a multi-sectoral action plan towards a comprehensive management strategy for Philippine sea cucumber resources. Specifically, the forum intended to provide an overview of current state of knowledge and practices related to Philippine sea cucumber fisheries and culture, to facilitate information sharing and leveling of understanding among various stakeholders, and to identify key issues and strategic actions to improve the management of fishery and emerging culture practices.

During the forum workshops, two major sectors of sea cucumber fisheries were identified: production and post-harvest. The major sectors were further divided into subsectors, i. e., capture fisheries (production), grow-out culture (production), processing and value adding (post-harvest), and marketing and trade (post-harvest). The workshop groups identified the key environmental, socio-cultural and economic issues confronting each of the subsectors, their causes and recommended possible actions to address these issues through institutional policy, technical/management intervention, capacity building, and research and development initiatives. The following are the workshop outputs by subsector and the pre- and post-forum accomplishments by the entities concerned.

This scarcity of basic information on sea cucumbers i.e. identity of species in trade (holothuroid

ISSUES	CAUSES
A. Environmental	
Lack of taxonomic identification (Scientific names, common name, local names{cebuano, tagalog, ilocano})	Few taxonomists; limited access to field guides; no molecular studies
Lack of data on population status, impact of overexploitation in traditional & nontraditional fishing grounds	No standardized assessment methods; No inventory of sea cucumber per regions, province & municipality
Limited knowledge on reproductive biology of commercially important species	Limited funding & qualified expert to conduct basic research
Depletion of sea cucumber	Destructive fishing method, land based pollution; Deterioration of habitat; Unregulated harvest methods
Pollutants of sea cucumber	Destructive fishing method, land based pollution
No Philippine atlas of sea cucumber	Lack of information/ proposals/ financial assistance
No national catch data per species	Lack of trained field enumerators and insufficient funds

B. Socio-cultural and Economic	
Lack of understanding by stakeholders on sea cucumber	No IEC for sea cucumber; lack of information in popular form; no collated information; no socio-economics studies of sea cucumber fishery

RECOMMENDATIONS

A. Institutional Policy (National/Local)

1. To develop a comprehensive national management plan for sea cucumber.
2. To strengthen inter-institutional information networking.
3. In policy formulation, integrate holothurian conservation with MPA.
4. NFRDI to complete information gathering for sea cucumber atlas; coordinate with possible funding partners
5. DEPED, CHED to mainstream IEC materials

B. Technological/ Management Intervention

1. Collect production data
2. Develop MIS
3. Establish MPA and stock enhancement program

C. Capability Building

1. Conduct trainings on grow-out culture and proper postharvest (e.g. handling, sorting, processing).
2. Conduct trainings on taxonomic ID at various level (fisherfolk, managers, LGU, traders, NGA)
3. Conduct training on stock enhancement.
4. Conduct training for BAS enumerators

D. R&D

1. Develop bio-economic model on sea cucumber fishery.
2. Support scholarships for graduate studies related to taxonomy.
3. NFRDI spearheads inter-agency national R&D program for sea cucumbers.
4. Conduct studies on reproductive biology of other commercially important species.
5. Research on ecotoxicology.

E. Others

1. Production of taxonomic guides by DOST-PCAMRD or NFRDI.
2. NFRDI to collate information for the Phil. Atlas of sea cucumber.

taxonomy is complicated especially the processed forms), status of wildstocks and fisheries, their ecology and biology, ecological impacts of over-harvesting has been addressed by the NFRDI, which is the research arm of BFAR. The Marine Invertebrates Section of NFRDI carried out the National Sea Cucumber Research Project, the results of which would be the bases for BFAR to formulate and enact management policies for the threatened sea cucumber populations.

The significant accomplishments of NSCRP to date include identification of sea cucumber species in trade both fresh and processed forms; standardization of methods for the fishery independent and dependent surveys for sea cucumbers; development of database for sea cucumbers that could be expanded to cover other invertebrates; conduct of the national training/workshop on sea cucumber taxonomy and stock assessment with the technical personnel of BFAR Regional Field Offices as participants; production of poster of commercial sea cucumbers of the Philippines; preparation of materials for sea cucumber atlas, taxonomic guides, handbooks, field guides and other IEC materials; organization of the 1st National Forum on Sea Cucumber Fisheries Management; and submission of the proposed Fisheries Administrative Order (FAO) on sea cucumber size regulation.

Other academic institutions and the Fisheries Division of the LGUs have started stock assessment works following or modifying the NFRDI methodologies depending on the research objectives. Some BFAR Regional Offices have integrated sea cucumber stock monitoring into their regular activities depending on the availability of funds and work force.

Management strategies to curtail over-harvesting of natural stocks are now in place in some marine areas of the country. Worth mentioning are the Marine Protected Areas (MPAs) in Sagay City, Negros Occidental through the efforts of the Northern Negros Aquatic Resources Advisory Council (NNARMAC) and the Baliangao Marine Reserve that was established by Danao Bay Resource Management Office, both under the respective Local Governments. The Sagay City government also imposes rotational collection of sea cucumber by dividing their marine areas into collection zones. The DA-BFAR and NFRDI as the national government authorities assist their local counterparts through collaborative site selection works for the establishment of MPAs, resource assessment and monitoring.

The University of the Philippines Marine Science Institute (UPMSI) leads the grow-out, hatchery

and stock enhancement initiatives for the country in collaboration with other academic research institutions within and outside the UP System and the BFAR-NFRDI-NIFTDC in Dagupan City. UPMSI together with UP in the Visayas (UPV) and UP in Mindanao (UPMin) has initiated the hatchery breeding of sandfish (Holothuria scabra) funded by Philippine Council for Aquatic together and Marine Research and Development (PCAMRD) and Australian Cooperation in Agricultural Research (ACIAR) through World Fish (formerly International Center for Living Aquatic Resource Management or ICLARM). The BFAR-NFRDI-NIFTDC in Dagupan City was recently involved in the project with the on-going construction of sandfish hatchery farm at NIFTDC and consequently be the training center.

ISSUES	CAUSES
A. Environmental	
Degradation of habitat	Illegal fishing (e.g. cyanide, dynamite); coastal development (i.e. siltation)
Resource depletion or declining catch	Increased fishing pressure; weak law enforcement; lack of political will; no resource map to determine juvenile collection sites
Lack of technical knowhow (about species	Limited access to information; no baseline data; no production data available; secondary priority commodity of the gov't.; limited R&D support program
ID, production, and grow-out culture technology)	No commercial hatcheries; no reserved area for wild source; no regulation on harvest size
B. Inadequate supply of juveniles for grow-out	
Disparity in buying prices	Lack of information
Capitalization need	Limited credit window or access to credit
Uncertain feasibility of sea cucumber farming	Limited experience or expertise
C. Socio-cultural	
Possible conflict in resource allocation (usezonation-tenure)	Lack of zonation; LGUs not able to come up with zonation plan or water use plan; lack of regulations or policies
RECOMMENDATIONS	
A. Institutional Policy (National/Local) 1. Strict enforcement of fishery laws. 2. Develop a clear management guidelines & policies. 3. Develop guidelines on permit and licensing of grow-out area. 4. Zonation or identification of potential sites for culture 5. Formulate management plan (National & local)	
B. Technological/ Management Intervention 1. Formulation of management plan (FAO) 2. Ordinances on conservation management (c/o LGU) 3. Establish marine reserve or sanctuary	
C. Capability Building 1. Conduct training on entrepreneurial skills for the growers. 2. Conduct forum on investment. 3. Conduct training on responsible aquaculture. 4. Conduct training on proper utilization, conservation, and management of the resources 5. Conduct trainer's training on hatchery and grow-out culture. 6. Training on values formation (i.e. responsible parenthood)	
D. R&D 1. Piloting of grow-out of high value species in selected areas. 2. Broodstock sourcing and management 3. Refinement of hatchery protocols for culturable species. 4. Conduct studies on reproductive biology and ecology of other commercially important species.	

In some areas of the country, fishermen are already practicing the wild sea cucumber grow-out culture in pens or cages. Grow-out endeavors could be seen in Puerto Princesa City, Palawan; Bolinao, Pangasinan; Sta. Cruz, Davao del Sur; and Mauban, Quezon. Growers received technical advice on grow-out techniques during the national forum.

To conclude, the Philippine initiatives paved the way for a close linkage and strong information networking between and among Philippine

government institutions involved in sea cucumber conservation and management and the stakeholders. What remains the major constraint for the Philippine initiatives is funding and logistics support to implement various projects that have been identified in the action plan for each sector.

ISSUES	CAUSES
A. Quality and Safety	
High Moisture content	Lack of knowledge on proper handling and processing; trainings on processing is not provided
Poor packaging	
Poor hygiene and sanitation practices ID, production, and grow-out culture technology)	
Lack of knowledge on GMP/SSOP by the fisherfolk and processors	
Inconsistent quality of the final products	
Presence of toxic substances	
Product contamination with Pathogenic bacteria	
RECOMMENDATIONS	
A. Technological/ Management Intervention 1. Characterize the set quality standards. 2. The product must meet consumer expectations and quality standards. 3. Product must comply international standards. 4. The product must be competitively priced.	
B. Capability Building 1. Conduct training on effective application of GMP/ SSOP in the whole stages of processing. 2. Conduct training to improve collecting, handling, processing, and packaging technologies.	
C. R&D 1. Continuous R&D for processing and value-added product formulations. 2. Conduct more research to improve collecting, handling, processing, and packaging technologies.	

ISSUES	CAUSES
A. Economic	
Absence of formal marketing system in the local trade of sea cucumber products	Based on trust and loyalty; lack of formal negotiable instrument or contract; lack of information
Traders have no absolute idea on the export market system level	
No pricing standards or different price range	
Huge amount of transportation cost	Also based on trust
Credit assistance	
Poor standards, lack of quality control and not proper handling	Lack of information
Product contamination with Pathogenic bacteria	
RECOMMENDATIONS	
A. Institutional Policy (National/Local) 1. Implementation of LGU Coastal regulations (e.g. issuance of auxiliary invoice; fishery code regulations)	
B. Technological/ Management Intervention 1. Linkage of traders with the grow-out sector or to engage in sea cucumber	
C. Capability Building 1. Engage in direct exporting.	
D. R&D 1. To conduct a rapid market system study and value chain analysis. 2. Gather market information, and document market/ trade practices.	

On the regional level, the Philippines, through this Report hopes to have been able to lay the groundwork for other ASEAN members in developing national and regional management plans for sea cucumbers, for which, this ASEAN-SEAFDEC Regional study on sea cucumber fisheries, utilization and trade in Southeast Asia was carried out.

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SEA CUCUMBERS FISHERIES, UTILIZATION, AND TRADE IN THAILAND

by Ms. Ratana Munprasit [8]

1. Introduction

Sea cucumbers are benthic invertebrates generally found in coastal water with diverse species. They play the roles in ecosystem as decomposers and nutrient releasers in food chain. For human being, sea cucumbers have their long history as the traditional medical components and food. Thus, they are commercially important in many countries, especially in the Indian Ocean and South Pacific regions, for high-protein food, medical products, and supplementary food, resulted in a trend towards overfishing on the commercial species.

In Thailand, a number of sea cucumber species have long been harvested both from the Gulf of Thailand and the Andaman Sea for local consumption, restaurant, and international trade. To serve the sufficient fact and scientific information for internationally ecological concern, the taxonomic classification, biology, production, utilization, and trade of sea cucumbers in Thailand were gathered in this report. This information collection would be useful for the management of sea cucumbers in this area.

2. Taxonomic Information

Table 1 Summary for Sea Cucumber Species Composition in Thailand

Sea cucumber species	Family name	Local name	Commercial value
1. *Actinopyga echinites* (Jaeger, 1833)	Holothuriidae		
2. *Actinopyga lecanora* (Jaeger, 1833)	Holothuriidae		
3. *Actinopyga mauritiana* (Quoy & Gaimard, 1833)	Holothuriidae		
4. *Actinopyga miliaris* (Quoy & Gaimard, 1833)	Holothuriidae		
5. *Actinopyga obesa* (Selenka, 1867)	Holothuriidae		
6. *Actinopyga* sp.1	Holothuriidae		
7. *Actinopyga* sp.2	Holothuriidae		
8. *Bohadschia argus* (Jaeger, 1833)	Holothuriidae		(1)
9. *Bohadschia marmorata* (Jaeger, 1833)	Holothuriidae	pling sri namtarn	(1)
10. *Bohadschia arta* (Massin et al., 1999)	Holothuriidae		
11. *Bohadschia (Holothuria) bivittata* (Mitzukuri, 1912)	Holothuriidae		
12. *Bohadschia vitiensis* (Semper, 1868)	Holothuriidae	pling fak thong	
13. *Holothuria (Acanthotrapeza) pyxis* (Selenka, 1867)	Holothuriidae		
14. *Holothuria (Acanthotrapeza) coluber* (Semper, 1868)	Holothuriidae		
15. *Holothuria (Cystipus) rigida* (Selenka, 1867)	Holothuriidae		
16. *Holothuria (Metriatyla) albiventer* (Semper, 1868)	Holothuriidae		
17. *Holothuria (Microthele) axiologa* (H.L. Clark, 1921)	Holothuriidae		
18. *Holothuria (Microthele) nobilis* (Selenka, 1867)	Holothuriidae		(1)
19. *Holothuria (Microthele) fuscopunctata* (Jaeger, 1833)	Holothuriidae		
20. *Holothuria (Selenkothuria) erinaceus* (Semper, 1868)	Holothuriidae		
21. *Holothuria (Selenkothuria) moebii* (Ludwig, 1883)	Holothuriidae		
22. *Holothuria (Semperothuria) cinerascens* (Brandt, 1835)	Holothuriidae		
23. *Holothuria (Theelothuria) notabilis* (Ludwig, 1875)	Holothuriidae		
24. *Holothuria (Theelothuria) squamifera* (Semer, 1868)	Holothuriidae		
25. *Holothuria (Theelothuria) spinifera* (Theel, 1886)	Holothuriidae		(1)
26. *Holothuria (Thymiosycia) arenicola* (Semper, 1868)	Holothuriidae		

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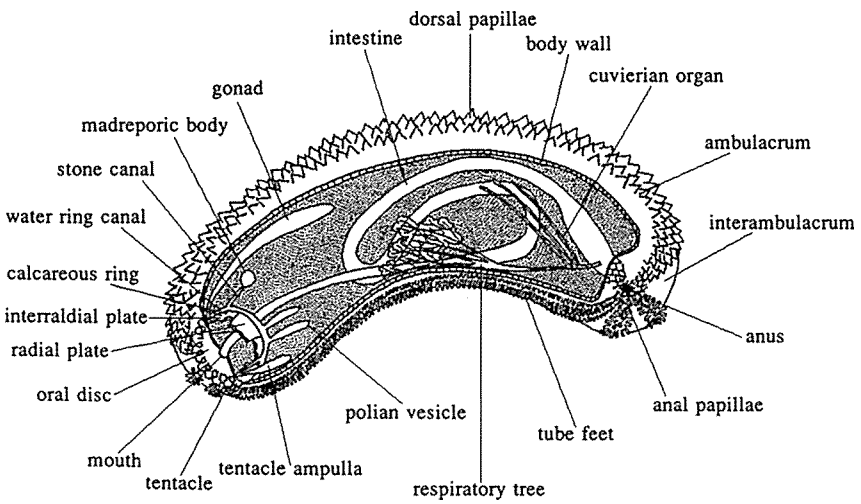
27. *Holothuria (Thymiosycia) conussalba* (Cherbonnier & Feral, 1984)	Holothuriidae		
28. *Holothuria (Thymiosycia) hilla* (Lesson, 1830)	Holothuriidae		
29. *Holothuria monocaria* (Lesson, 1830)	Holothuriidae		
30. *Holothuria (Halodeima) atra* (Jaeger, 1833)	Holothuriidae	pling dam	(2)
31. *Holothuria (Halodeima) edulis* (Lesson, 1830)	Holothuriidae		(1)
32. *Holothuria (Semperothuria) flavomaculata* (Semper, 1868)	Holothuriidae	pling sri muang	
33. *Holothuria (Stauropora) discrepans* (Semper, 1868)	Holothuriidae		
34. *Holothuria (Stauropora) fuscocinerea* (Jaeger, 1833)	Holothuriidae	pling sri namtarn	
35. *Holothuria (Metriatyla) martensi* (Semper, 1868)	Holothuriidae		
36. *Holothuria (Metriatyla) scabra* (Jaeger, 1833)	Holothuriidae	pling khao	(3)
37. *Holothuria (Metriatyla) ocellata* (Jaeger, 1833)	Holothuriidae	pling tha lay	
38. *Holothuria (Platyperona) difficilis* (Semper, 1868)	Holothuriidae	pling tha lay lek	
39. *Holothuria (Thymiosycia) impatiens* (Forskål, 1775)	Holothuriidae	pling tha lay kheo	
40. *Holothuria (Lessonothuria) verrucosa* (Selenka, 1867)	Holothuriidae	pling namtarn chude far	
41. *Holothuria (Lessonothuria) pardalis* (Selenka, 1867)	Holothuriidae		
42. *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835)	Holothuriidae	pling dam	(2)
43. *Pearsonothuria graeffei* (Semper, 1868)	Holothuriidae	pling dam	
44. *Labidodemas semperianum* (Selenka, 1867)	Holothuriidae		
45. *Stichopus naso* (Semper, 1868)	Stichopodidae	pling hin	
46. *Stichopus chloronotus* (Brandt, 1835)	Stichopodidae		(1)
47. *Stichopus horrens* (Selenka, 1867)	Stichopodidae	pling hin	
48. *Stichopus japonicus* (Semper, 1868)	Stichopodidae		
49. *Stichopus ariegates* (Semper, 1868)	Stichopodidae		(2)
50. *Stichopus vatus* (Semper, 1888)	Stichopodidae		
51. *Stichopus herrmanni* (Semper, 1868)	Stichopodidae		
52. *Thelenota ananas* (Jaeger)	Stichopodidae		(1)
53. *Actinocucumis typicus* (Ludwig, 1875)	Cucumariidae		
54. *Cercodemas anceps* (Selenka, 1867)	Cucumariidae	pling sri shom phoo luang	
55. *Colochirus quadrangularis* (Troschel, 1843)	Cucumariidae	pling sri kheo	
56. *Psedocnus (Cucumaria) echinata* (Von Marenzeller, 1881)	Cucumariidae		
57. *Cucumaria mosaiica* (Kochler)	Cucumariidae		
58. *Cucumaria frondosa* (Gunner, 1767)	Cucumariidae		
59. *Pseudocolochirus violaceus* (Theel, 1886)	Cucumariidae		
60. *Pseudocolochirus* sp.	Cucumariidae		
61. *Pseudocolochirus axiologus* (Clark, 1914)	Cucumariidae	pling apple	
62. *Leptopentacta javanicus* (Sluiter, 1881)	Cucumariidae		
63. *Menamaria bilolumnata* (Dendy& Hindle, 1907)	Cucumariidae		
64. *Menamaria intercedens* (Lampert, 1885)	Cucumariidae		
65. *Plesiocochirus australis* (Ludwig, 1875)	Cucumariidae		
66. *Afrocucumis africana* (Semper, 1868)	Scleodactylidae		
67. *Cladolebes schmeltzi* (Ludwing, 1875)	Scleodactylidae		
68. *Stolus conjugens* (Semper, 1868)	Phyllophoridae		
69. *Stolus buccalis* (Stimpson, 1855)	Phyllophoridae	pling sri dam	
70. *Selenkiella malayense* (Heding & Panning, 1954)	Phyllophoridae		
71. *Selenkiella siamense* (Heding & Panning, 1954)	Phyllophoridae		
72. *Thyone okeni* (Bell, 1884)	Phyllophoridae		
73. *Thyone cf. papuensis* (Théel, 1886)	Phyllophoridae	pling sri luang	

74. *Havelockia versicolor* (Semper, 1868)	Phyllophoridae	pling sri kheo	
75. *Hemithyone semperi* (Bell, 1884)	Phyllophoridae		
76. *Globosita argus* (Heding & Panning, 1954)	Phyllophoridae		
77. *Phyllohorus (Phyllophorella) kokkutiensis* (Heding & Panning, 1954)	Phyllophoridae		
78. *Phyllohorus (Phyllophorella) robusta* (Heding & Panning, 1954)	Phyllophoridae		
79. *Phyllohorus (Phyllophorella) parvipedes* (H.L. Clark)	Phyllophoridae		
80. *Phyllohorus (Phyllothuria) cebuensis* (Heding & Panning, 1954)	Phyllophoridae		
81. *Phyllohorus (Urodemella) holothurioides* (Ludwig, 1875)	Phyllophoridae		
82. *Phyllohorus* sp.	Phyllophoridae		
83. *Molpadia(Ankyroderma) roretzi* (Von Marenzeller, 1877)	Molpadiidae		
84. *Acaudina molpadioides* (Semper, 1868)	Caudinidae		
85. *Acaudina leucoprocta* (H.L. Clark, 1938)	Caudinidae		
86. *Acaudina* sp.1	Caudinidae		
87. *Acaudina* sp.2	Caudinidae		
88. *Acaudina* sp.3	Caudinidae		
89. *Paracaudina chilensis* (Müller, 1850)	Caudinidae		
90. *Paracaudina* sp.	Caudinidae		
91. *Synaptula recta* (Semper, 1868)	Synaptidae		
92. *Synaptula aff.* Virgata (Sluiter, 1901)	Synaptidae		
93. *Synaptula maculate* (Chamisso & Eysenhardt, 1821)	Synaptidae		
94. *Synaptula* sp.1	Synaptidae	pling soy khai muke	
95. *Synaptula* sp.2	Synaptidae	pling soy khai muke khao	
96. *Protankyra pseudodingitula* (Semper, 1868)	Synaptidae		
97. *Polyplectana kefersteini* (Selenka, 1867)	Synaptidae		
98. *Pendekaplectana nigra* (Semper, 1868)	Synaptidae		
99. *Opheodesoma grisea* (Semper, 1868)	Synaptidae		
100. *Opheodesoma lineate* (Heding, 1928)	Synaptidae		
101. *Opheodesoma australiensis* (Heding, 1931)	Synaptidae		
102. *Opheodesoma clarki* (Heding, 1928)	Synaptidae		

Note: (1), (2), (3) mean commercial value (price/kg) gradually increase, most of which the price is double 1 to 2 times approximately for each level



Body structure of sea cucumber (Clark & Rowe, 1971)

Table 2. Biology of sea cucumbers in Thailand

FAMILY: Holothuriidae	
Scientific Name: *Actinopyga echinites* (Jaeger, 1833) **Common Name:** deep-water red fish **Local Name:** - **Description:** Body dark brown/chocolate with hard body wall. Mouth with 20 dark brown peltate tentacles locate nearly ventral. Around anus were 5 calcareous teeth. A number of ciliated papillae scatter at dorsal part. Dark brown tube feet locate along the 3 bands of ambulacrum. **Habitat:** attaching on substrates such as rocks around coral reef at the depth of about 6 m **Distribution:** Indo-West Pacific: Indian Ocean, east Africa, Madagascar, Arabian Sea, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, and South Pacific islands	 **Size:** 200x65 mm, 5.0 mm-thick body wall **Figure:** Sumaitt Putchakarn **Site:** Samaesarn, Chonburi Province
Scientific Name: *Bohadschia marmorata* (Jaeger, 1833) **Common Name:** chalky fish **Local Name:**pling sri namtarn **Description:** Body long cylindrical with dorsal dark gray and ventral yellowish white. Mouth with 20 whitish yellow peltate tentacles locate at ventral side. No teeth at anus but 5 anal papillae. A number of black spot-like papillae scatter at dorsal part. Dark brown spot-like tube feet scatter around ventral part with high density at ambulacrum. **Habitat:** lying on or burying in sandy bottom around the outer part of coral reef at 5-10 m depth **Distribution:** Indo-West Pacific: east Africa, Madagascar, Red Sea, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, and South Pacific islands	 **Size:** 220x60 mm, 1.0 mm-thick body wall **Figure:** Sumaitt Putchakarn **Site: Laem Thong Lang, Koh Lan, Chonburi Province**
Scientific Name: *Bohadschia vitiensis* (Semper, 1868) **Common Name:** sea cucumber **Local Name:** pling fak thong **Description:** Body golden yellow, long cylindrical. Mouth with 20 whitish yellow peltate tentacles locate nearly ventral. No teeth at anus but 5 anal papillae. A number of dark brown spot-like papillae scatter at dorsal part. Dark brown spot-like tube feet scatter around ventral part with high density at ambulacrum. **Habitat:** lying on or burying in sandy bottom around the outer part of coral reef at 5-8 m depth **Distribution:** Indo-West Pacific: Bengal Bay, East Indies, Indonesia, north Australia, the Philippines, China, Japan, and South Pacific islands	 **Size:** 200x80 mm, 4.0 mm-thick body wall **Figure:** Arom Mucharin **Site:** Ao Tang Khen, Phuket Province

Scientific Name: *Holothuria (Halodeima) atra* (Jaeger, 1833)
Common name: lolly fish
Local name: pling dam

Description: Body black, long cylindrical, with rather hard and slippy skin. Mouth with 20 black peltate tentacles locate ventrally. A number of black spot-like papillae scatter at dorsal part. Short tube feet locate densely along the 3 bands of ambulacrum.
Habitat: lying on sand along sandy beach or coral reef at 3-6 m depth
Distribution: wide distribution at Indo-West Pacific: west Indian Ocean, east Africa, Red Sea, Arabian Sea, Persian Gulf, Maldives, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, South Pacific islands, Hawaii, and Tahiti

Size: 230x35 mm, 4.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Samaesarn, Chonburi Province

Scientific Name: *Holothuria (Halodeima) edulis* (Lesson, 1830)
Common Name: pink fish
Local Name: -

Description: Body long cylindrical with dorsal black and ventral dark pink, rather hard and slippy. Mouth with 20 pink peltate tentacles locate ventrally. A number of very small black spot-like papillae scatter at dorsal part. Short tube feet locate along the 3 bands of ambulacrum.
Habitat: lying in large group on the sand around the outer part of coral reef at 3-5 m depth
Distribution: Indo-West Pacific: east Africa, Red Sea, Madagascar, Red Sea, Arabian Sea, Bengal Bay, east India, north Australia, the Philippines, China, Japan, South Pacific islands, Hawaii, and Tahiti

Size: 180x35 mm, 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Tao, Surat Thani Province

Scientific Name: *Holothuria (Semperothuria) flavomaculata* (Semper, 1868)
Common Name: -
Local Name: pling sri muang

Description: Body reddish brown, long cylindrical. Mouth with 20 dark-yellow-tip peltate tentacles locate front most. Some yellow knob-like dorsal papillae scatter along the 2 bands of ambulacrum. Long dark-yellow tube feet locate along the 3 bands of ambulacrum, densely at body front.
Habitat: hiding among corals at the depth of 3-4 m
Distribution: Indo-West Pacific: Red Sea, East Indies, and South Pacific islands

Size: 190x40 mm, 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Leam Thong Lang, Koh Lan, Chonburi Province

Scientific name: *Holothuria (Stauropora) discrepans* (Semper, 1868)
Common name: -
Local name: -

Description: Body dark green, cylindrical, soft and mucous. Mouth with 20 peltate tentacles locate nearly ventral. Some dorsal papillae scatter along the 2 bands of ambulacrum. Tube feet scatter around ventral part.
Habitat: found under dead corals at 2-3 m depth
Distribution: reported in Thailand and South Pacific islands

Size: 70x25 mm, 3.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

Scientific Name: *Holothuria (Stauropora) fuscocinerea* (Jaeger, 1833)
Common name: -
Local name: pling sri namtarn

Description: Body brownish orange, long cylindrical, soft, with rough skin. Mouth with 20 light brown peltate tentacles locate nearly ventral. Big knob-like papillae with base-capsules for papillae protecting scatter at dorsal part. Short tube feet scatter densely along ambulacrum but sparsely along interambulacrum.
Habitat: hiding among corals in the rich coral reef at 2-6 m depth
Distribution: Indo-West Pacific: east Africa, Madagascar, Red Sea, West Indies, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, and South Pacific islands

Size: 140x30 mm, 3.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Phai, Chonburi Province

Scientific Name: *Holothuria (Metriatyla) martensi* (Semper, 1868)
Common Name: -
Local name:

Description: Body cylindrical. Dorsal dark gray with some black vertical bands. Mouth with 20 white peltate tentacles locates front most. Big and long cone-like dorsal papillae locate densely along ambulacrum. Ventral light gray with short tube feet along the 2 bands of ambulacrum.
Habitat: lying on sand around the outer part of coral reef
Distribution: Indo-West Pacific: east Africa, Madagascar, Arabian Sea, Maldives, East Indies, north Australia, the Philippines, China, and Japan

Size: 110x25 mm, 1.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

Scientific Name: *Holothuria (Metriatyla) scabra* (Jaeger, 1833)
Common Name: sand fish
Local name: pling khao

Description: Body cylindrical with dorsal blackish gray and ventral white. Body bent ventrally. Mouth with 20 white peltate tentacles locate nearly ventral. A number of papillae scatter around dorsal part. Black spot-like tube feet scatter ventrally.
Habitat: lying on sand around the outer part of coral reef at about 6 m depth
Distribution: Indo-West Pacific: east Africa, Madagascar, Red Sea, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, and South Pacific islands

Size: 250x70 mm, 4.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Had Sai Khao, Koh Lan, Chonburi Province

Scientific Name: *Holothuria (Metriatyla) ocellata* (Jaeger, 1833)
Common Name: -
Local name: pling tha lay

Description: Body haft cylindrical and soft. Mouth with 20 gray peltate tentacles locate nearly ventral. Dorsal blackish gray with roughly knob-like skin and unnoticed dorsal papillae. Ventral light gray with spot-like tube feet locating along the 3 bands of ambulacrum.
Habitat: lying on sand around the outer part of coral reef at the depth of about 12 m
Distribution: Indo-West Pacific: Red Sea, Bengal Bay, East Indies, north Australia, China, and south Japan

Size: 70x25 mm, 2.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

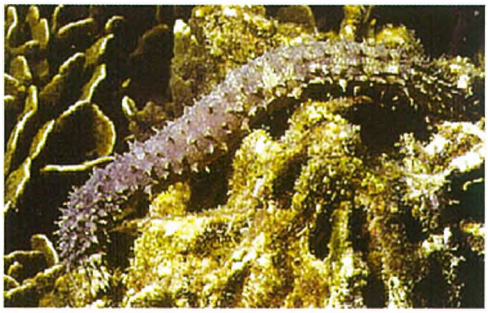
Scientific Name: *Holothuria (Platyperona) difficilis* (Semper, 1868)
Common Name: -
Local name: pling tha lay lek

Description: Body haft cylindrical and soft. Mouth with 20 gray peltate tentacles locate nearly ventral. Dorsal blackish green with some hard and small knob-like papillae. Ventral blackish green with rather long tube feet locating along the 3 bands of ambulacrum.
Habitat: attaching on big substrates in coral reef at the depth of about 5 m
Distribution: Indo-West Pacific: Indian Ocean, Red Sea, Bengal Bay, East Indies, north Australia, the Philippines, China, south Japan, and South Pacific islands

Size: 50x10 mm, 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Rin, Chonburi Province

Scientific Name: *Holothuria (Thymiosycia) impatiens* (Forskål, 1775)
Common Name: -
Local name: pling tha lay kheo

Description: Body long cylindrical, rough, with anterior part smaller than the posterior one. Mouth with 20 greenish gray peltate tentacles locate nearly ventral. Dorsal blackish green with black vertical bands and hard papillae densely scattering on the head. Ventral blackish green with short tube feet locating along the 3 bands of ambulacrum.
Habitat: hiding among corals in coral reef at 3-6 m depth
Distribution: widest distribution in Indo-West Pacific: Indian Ocean islands, east Africa, Madagascar, Red Sea, Persian Gulf, West Indies, Pakistan, Maldives, Bengal Bay, East Indies, north Australia, the Philippines, China, south Japan, and South Pacific islands



Size: 90x35 mm, 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Rin, Chonburi Province

Scientific Name: *Holothuria (Lessonothuria) verrucosa* (Selenka, 1867)
Common Name: -
Local name: pling namtarn chude far

Description: Body long cylindrical, soft, with anterior part smaller than the posterior one. Mouth with 20 brown peltate tentacles locate nearly ventral. Around anus are 5 papillae. Dorsal brown with a number of large blue-tip papillae. Ventral light brown with a number of long tube feet.
Habitat: hiding among corals in coral reef at 3-5 m depth
Distribution: Indo-West Pacific: east Africa, Madagascar, East Indies, north Australia, the Philippines, South Pacific islands, and Hawaii

Size: 270x50 mm, 3.0 mm-thick body wall
Figure: Arom Mucharin
Site: Koh Mak, Trat Province

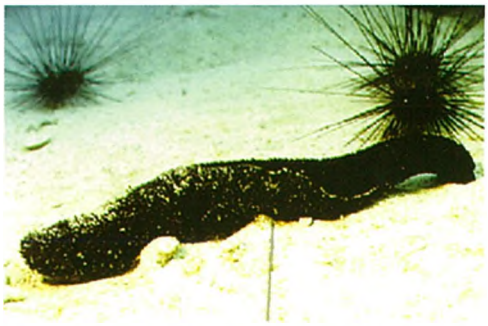
Scientific Name: *Holothuria (Lessonothuria) pardalis* (Selenka, 1867)
Common Name: -
Local name: -

Description: Body long cylindrical, soft, with thin body wall. Anterior part smaller than the posterior one. Mouth with 20 warm-yellow peltate tentacles locate nearly ventral. Around anus are 5 papillae. Doral orangey brown around which are numbers of white spots and some papillae. Ventral orangey brown with a number of ciliated tube feet.
Habitat: burying in sand or hiding beneath the rocks in coral reef at 3-4 m depth
Distribution: Indo-West Pacific: Indian Ocean islands, Madagascar, Red Sea, West Indies, Pakistan, Maldives, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, South Pacific islands, and Hawaii

Size: 130x45 mm, less than 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Mae Ram Pueng Beach, Rayong Province

Scientific Name: *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835)
Common Name: -
Local Name: pling dam

Description: Body black, long cylindrical, and soft. Mouth with 20 black peltate tentacles locate nearly ventral. A number of papillae scatter at dorsal part. Long tube feet are dense along ambulacrum bands but sparse along interambulacrum.
Habitat: sandy beach and sand bottom of coral reef at 3-6 m depth
Distribution: Indo-West Pacific: Indian Ocean islands, east Africa, Madagascar, Red Sea, Persian Gulf, West Indies, Pakistan, Maldives, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, South Pacific islands, and Hawaii



Size: 230x40 mm, 1.0-2.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Sak, Chonburi Province

Scientific Name: *Pearsonothuria graeffei* (Semper, 1868)
Common Name: -
Local Name: pling dam

Description: Body long cylindrical and rough. Mouth with 20 black and white-tip peltate tentacles locate nearly ventral. Anus locate nearly dorsal. Dorsal dark-brown and white longitudinally. A number of big blackish-brown and knob-like papillae closely scatter around dorsal part. Long and big dark-brown tube feet scatter densely along ventral ambulacrum bands.
Habitat: attaching on big rocks or corals in coral reef at 3-8 m depth
Distribution: Indo-West Pacific: Red Sea, Maldives, Bengal Bay, East Indies, the Philippines, and South Pacific islands

Size: 300x50 mm, 5.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Mak, Trat Province

FAMILY: Stichopoidae

Scientific Name: *Stichopus naso* (Semper, 1868)
Common Name: -
Local Name: pling hin

Description: Body long tetragonal, light brown with some black vertical bands. Two bands of big cone-like papillae locate longitudinally at dorsal edges. Mouth with 20 light brown peltate tentacles locate nearly ventral. Anus locate nearly dorsal. Long tube feet scatter along the 3 bands of ambulacrum
Habitat: sandy bottom around the outer part of coral reef at 6-15 m depth
Distribution: reported in Thailand and the Philippines

Size: 120x45 mm, 10.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Phai, Chonburi Province

Scientific Name: *Stichopus chloronotus* (Brandt, 1835)
Common Name: teat fish
Local Name: -

Description: Body totally black, long tetragonal, with smooth and slippy skin. Big cone-shaped papillae black with yellow tip, scattering in 2 bands along dorsal edges. Mouth with 20 black peltate tentacles locate nearly ventral. Anus locate nearly dorsal. Long tube feet scatter along the 3 bands of ambulacrum
Habitat: sandy bottom or dead corals around the coral reef at 1-2 m depth
Distribution: Indo-West Pacific: west Indian Ocean islands, east Africa, Madagascar, Maldives, Bengal Bay, East Indies, north Australia, the Philippines, China, Japan, South Pacific islands, and Hawaii

Size: 220x60 mm, 2.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Rawaii Beach, Phuket Province

Scientific Name: *Stichopus horrens* (Selenka, 1867)
Common Name: -
Local Name: pling hin

Description: Body long tetragonal. Two patterns of body color were found: yellowish brown and blueish yellow. The yellowish-brown one has short, big-base, and black-tip dorsal papillae. It has ventral light brown with long tube feet scattering along the 3 bands of ambulacrum. The blueish yellow one has short, knob-like, big white-base, and blue-tip dorsal papillae, scattering along dorsal edges. It has ventral light yellow with tube feet scattering along the 3 bands of ambulacrum. Both have their mouths, with 20 light brown peltate tentacles each, locating ventral. Anus locate nearly ventral.
Habitat: sandy bottom around the outer part of coral reef at the depth of about 6 m
Distribution: Indo-West Pacific: East Indies, north Australia, the Philippines, China, Japan, South Pacific islands, and Hawaii

Size: 180x50 mm, 10.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Leum Noi, Chonburi Province

Scientific Name: *Stichopus herrmanni* (Semper, 1868)
Common Name: curry fish
Local Name: -

Description: Body blackish brown/chocolate, long tetragonal. Short dorsal papillae with reddish-brown-tip and big brown-base scattering in 2 bands along dorsal edges together with the smaller ones scattering around. Mouth with 20 brown peltate tentacles locate nearly ventral. Anus locate nearly dorsal. Ventral brown with tube feet scattering along the 3 bands of ambulacrum
Habitat: sandy bottom around the outer part of coral reef at the depth of about 6 m
Distribution: Indo-West Pacific: East Indies, north Australia, the Philippines, China, Japan, South Pacific, and Hawaii

Size: 280x60 mm, 10.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Leum Noi, Chonburi Province

FAMILY: Cucumaridae

Scientific Name: *Actinocucumis typicus* (Ludwig, 1875)
Common Name: -
Local name: -

Description: Body dark gray, long pentagonal-spindle. Dark gray ciliated papillae scatter in 2 bands at dorsal part. Around the mouth are 20 dark gray dendritic tentacles. Tube feet scatter along the 3 bands of ventral ambulacrum. Interambulacrum black.
Habitat: found beneath the sponges in dead corals around coral reef at the depth of about 3 m.
Distribution: Indo-West Pacific: West Indies, Pakistan, Bengal Bay, East Indies, north Australia, China, and Japan

Size: 70x20 mm, 1.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

Scientific Name: *Cercodemas anceps* (Selenka, 1867)
Common Name: -
Local Name: pling sri shom phoo luang

Description: Body pink, cylindrical-spindle, with dark pink dorsal papillae. Around the mouth are 10 light pink dendritic tentacles. Tube feet scatter along the 3 bands of ventral ambulacrum.
Habitat: lying on sand or attaching on substrates in and out of coral reef at 3-15 m depth
Distribution: Indo-West Pacific: East Indies, the Philippines, China, Japan, and South Pacific islands

Size: 85x30 mm, 1.0-2.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Ta Waen Beach, Koh Lan, Chonburi Province

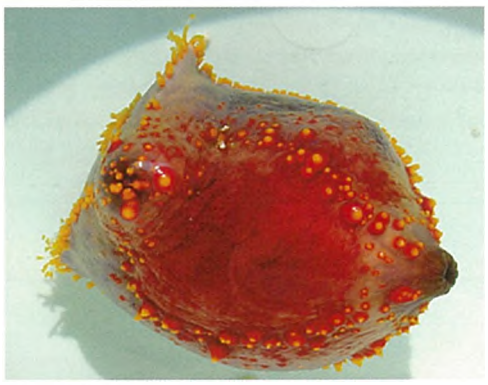
Scientific Name: *Colochirus quadrangularis* (Troschel,1846)
Common Name: -
Local Name: pling sri kheo

Description: Body greenish gray, long tetragonal-spindle, with cone-shaped dorsal papillae. Around the mouth are 10 light yellow dendritic tentacles. Tube feet scatter along the 3 bands of ventral ambulacrum.
Habitat: lying on sand or attaching on substrates around the outer part of coral reef at 10-15 m depth
Distribution: Indo-West Pacific: Bengal Bay, East Indies, north Autralia, the Philippines, China, and Japan

Size: 125x30 mm, 1.0-2.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Ta Waen Beach, Koh Lan, Chonburi Province

Scientific Name: *Pseudocolochirus axiologus* (Clark, 1914)
Common Name: red sea cucumber
Local name: pling apple

Description: Body round. Big cone-shaped dorsal papillae with yellow tip and red base scatter in 2 bands along the bright red dorsal part. Around the mouth are 10 yellowish red dendritic tentacles. Long yellow tube feet scatter along the 3 bands of ventral ambulacrum.
Habitat: lying on sand or attaching on substrates around coastal zone or coral reef at more than 10 m depth
Distribution: reported in Thailand and north Australia



Size: 80x50 mm
Figure: Arom Mucharin
Site: Bang Saen, Chonburi Province

FAMILY: Phyllophoridae

Scientific Name: *Stolus conjugens* (Semper, 1868)
Common Name: -
Local Name: -

Description: Body blackish brown, cylindrical-spindle, with short dorsal papillae scattering around. Around the mouth are 10 dark brown dendritic tentacles. Indistinct tube feet scatter along the ventral ambulacrum.
Habitat: burying in sand along sandy beach at the depth of about 3 m
Distribution: Indo-West Pacific: West Indies, Pakistan, the Philippines

Size: 32x15 mm, 1.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

Scientific Name: *Stolus buccalis* (Stimpson, 1855)
Common Name: -
Local Name: pling sri dam

Description: Body blueish purple, long cylindrical-spindle, with indistinct dorsal papillae. Around the mouth are 10 dark gray with black-tip dendritic tentacles. Tube feet scatter along the 3 bands of ventral ambulacrum.
Habitat: burying in sand along sandy beach at the depth of about 3 m
Distribution: Indo-West Pacific: east Africa, Madagascar, Arabian Sea, Persian Gulf, West Indies, Pakistan, Bengal Bay, East Indies, north Australia, the Philippines, China, and Japan

Size: 80x15 mm, 1.0-2.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Lan, Chonburi Province

Scientific Name: *Thyone cf. papuensis* (Théel, 1886)
Common Name: -
Local Name: pling sri luang

Description: Body deep yellow, small, cylindrical-spindle, with small dorsal papillae. Around the mouth are 10 yellow with black-tip dendritic tentacles. Tube feet scatter along the 3 bands of ventral ambulacrum.
Habitat: burying in sand around the outer part of coral reef at 6-8 m depth
Distribution: Indo-West Pacific: Bengal Bay, East Indies, and north Australia

Size: 25x10 mm, 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Leum Noi, Chonburi Province

Scientific Name: *Havelockia versicolor* (Semper, 1868)
Common Name: -
Local Name: pling sri kheo

Description: Body cylindrical-spindle, light brown with a dark brown longitudinal band and 2 bands of short ciliated dorsal papillae. Around the mouth are 10 blackish purple with black-tip dendritic tentacles. Tube feet scatter along the 3 bands of ventral ambulacrum.
Habitat: lying on sand or attaching on substrates around the outer part of coral reef at 4-6 m depth
Distribution: Indo-West Pacific: East Indies, north Australia, and the Philippines

Size: 60x15 mm, 1.0-1.5 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Leum Noi, Chonburi Province

FAMILY: Caudinidae

Scientific Name: *Acaudina leucoprocta* (H.L. Clark, 1938)
Common Name: -
Local Name: -

Description: Body dark gray, plump, without papillae and tube feet causing indistinguishable dorsal and ventral parts. Around the mouth are 15 digitate tentacles.
Habitat: burying in muddy sand at about 8 m depth
Distribution: reported in Thailand and north Australia

Size: 70x20 mm, 2.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

Scientific Name: *Acaudina* sp. 3
Common Name: -
Local Name: -

Description: Body light pink, plump, with blackish gray pigment densely scattering around the very thin body wall. No papillae and tube feet causing indistinguishable dorsal and ventral parts. Around the mouth are 15 digitate tentacles.
Habitat: lying on or burying in muddy sand around sea grass bed with Holodule pinifolia dominated
Distribution: reported in Thailand

Size: 95x35 mm, less than 1.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

Scientific Name: *Paracaudina sp.*
Common Name: -
Local Name: -

Description: Body transparently white, plump, with orange pigment scattering around. No papillae and tube feet causing indistinguishable dorsal and ventral parts. Around the mouth are digitate tentacles.
Habitat: lying on or burying in muddy sand around river mouth or sea grass bed including the outer part of coral reef
Distribution: reported in Thailand

Size: 40x15 mm, 1.0 mm-thick body wall
Figure: Arom Mucharin
Site: a specimen collected in Marine Science Institute, Bang Saen, Chonburi Province

FAMILY: Synaptidae

Scientific Name: *Synaptula* sp.1
Common Name: -
Local Name: pling soy khai muke

Description: Body snake-like, blackish gray with a pale white longitudinal band on the very thin body wall. No papillae and tube feet causing indistinguishable dorsal and ventral parts. Around the mouth are 13 dark gray pinnate tentacles.
Habitat: lying on sponges or corals in the coral reef at 2-3 m depth
Distribution: reported in Thailand

Size: 450x15 mm, less than 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Khrok, Chonburi Province

Scientific Name: *Synaptula* sp.2
Common Name: -
Local Name: pling soy khai muke khao
Synaptula sp.2

Description: Body white, snake-like, with very thin and transparent body wall. No papillae and tube feet causing indistinguishable dorsal and ventral parts. Around the mouth are 10 white pinnate tentacles.
Habitat: lying on sponges or corals in the coral reef at 2-3 m depth
Distribution: reported in Thailand

Size: 7x65 mm, less than 1.0 mm-thick body wall
Figure: Sumaitt Putchakarn
Site: Koh Man Wichai, Chonburi Province

3. Production and Utilization

3.1 Sea Cucumber Fisheries

Sea cucumbers have been harvested in Thailand by the simple method by hand up to fishing gear operation as followed:

- Picking by hand during low tide from intertidal area and from shallow water.
- Snorkeling at deeper water up to 5-10 m.
- Punching by pointed metal spear mounted on a long pole. This has been popular amongst sea gypsy fishermen targeting high value species such as *Thelenota ananus, Actinopyga echinites*, and *Holothuria nobilis*, in deeper water.
- Two sea cucumber trawlers in Trang Province of southern Thailand were recorded. They were 8-10 m long with 5-10 hp engines. The trawl was 2.5 inch mesh-size polyethylene of 5-6 m length and 3 cm codend mesh-size. Day-time operation was done at the coastal area near sea grass bed.

Local fishermen prefer to collect sea cucumbers within nearby coastal zones during low tide; others e.g., the sea gypsy in the Andaman Sea, indulge in extensive migrations to offshore islands for 1-7 days trip fisheries. During these trips, sea cucumbers are gutted and brought back to land for further processing. Income from sea cucumber fisheries varies from trip to trip depending on the fishing effort, availability of resources and species collected. Some species are collected during daytime e.g., *Holothuria leucospilota*, while others e.g., *Stichopus variegates*, are available at night.

Sea cucumbers from the by-catch of commercial trawlers are separated and sold at fishing port for further processing.

3.2 Local usage and processing

Normally sea cucumbers are gutted by cutting the head and bottom, cleaned with water and dried. However, there are differences in technique from place to place.

In southern Thailand, processing of *Holothuria scabra* involved gutting and boiling the animals in sea water for 1 hour. The fisherman then buries them in the sand overnight, then taking out and stepping on them for 10 to 20 minutes to squeeze out their color. The sea cucumbers are boiled in water again for 1 hour, then brushed to remove the spicules, before they are ready for consumption, or dried for storage.

In Phangnga Province, southern Thailand, the sea cucumbers are gutted and cleaned then boiled in seawater with alum (aluminium potassium sulphate) for 2 hours, before they are smoked for 1 day.

In Chonburi Province, eastern Thailand, the sea cucumbers are gutted and cleaned, boiled in their own coelomic fluid for at least 2 hours, then smoked for 10 hours and sun-dried for 2 more days. The water left in this process is put in 20-litre containers and sold as the component of traditional medicine.

Weight ratio of dry sea cucumber to the fresh ones is varied by species e.g., one hundred kilograms of fresh *Holothuria leucospilota* can be 10 kilograms of the smoked one.

The quality of dried sea cucumbers produced in some places appears to be poor. Processing requires basic equipments and the methods are straightforward, but it needs to be carefully undertaken if good quality product is desired.

Processed sea cucumbers are used for soup and traditional salad.

3.3 Marketing

Cooked, boiled, or dried sea cucumbers are sold at local fish markets in the big cities, where restaurants serve them in Chinese soup or salad. The price of processed sea cucumbers varies by species and markets. There are 12 species of sea cucumbers consumed in Thailand, some of them are exported:

Species	Family
1. *Holothuria scabra*	Holothuriidae
2. *Holothuria atra*	Holothuriidae
3. *Holothuria (Holothuria) argus*	Holothuriidae
4. *Bohadschia (Holothuria) marmorata*	Holothuriidae
5. *Holothuria spinifera*	Holothuriidae
6. *Holothuria leucospilota*	Holothuriidae
7. *Holothuria nobilis*	Holothuriidae
8. *Holothuria edulis*	Holothuriidae
9. *Actinopyga echinites*	Holothuriidae
10. *Stichopus chloronotus*	Stichopodidae
11. *Stichopus variegates*	*Stichopodidae*
12. *Thelenota ananas*	*Stichopodidae*

The most popular one among Thai is *Holothuria scabra* (white sea cucumber or pling khao), followed by *H. atra* (black sea cucumber or pling dam).

4. Trade

From the latest data reported in 2003, Thailand imported sea cucumbers from 22 countries listed in **table 3**. The major one was Madagascar, followed by Tanzania, China, Hong Kong, and others.

Thailand also exported sea cucumbers to 12 countries mostly to Hong Kong as shown in **table 4**. Apart from the majority in Asian countries, U.S.A., Niger, and Australia were included in the exported countries of Thailand.

From overall data in **table 5**, the amounts and values of imported and exported sea cucumbers in Thailand are nearly the same. They were traded mostly in processed form. Quantity and value of traded sea cucumbers increased remarkably since 1999.

In addition, there has been some volume of trade at borders of the country not existing in data base of the concerned organization.

Table 3 Thailand's Sea Cucumber Imported Countries

Rank	Country	Quantity (kg)	Value (baht)	Latest Year Recorded	Product Form
1	Madagascar	46,999	4,370,660	2003	processed
2	Tanzania	18,932	1,728,066	2003	processed
3	China	12,438	1,320,590	2003	processed
4	Hong Kong	10,103	1,620,621	2003	processed
5	Papua New Guinea	5,226	4,795,917	2003	processed
6	The Philippines	5,160	504,885	2003	processed
7	U.S.A.	4,499	4,708,233	2000	processed
8	Monaco	4,411	404,601	2003	processed
9	Korea	3,160	922,386	2001	processed
10	Maldova	3,000	210,142	2000	processed
11	Malaysia	2,298	852,506	2003	processed
12	Switzerland	1,500	90,258	1999	processed
13	India	1,160	38,280	1996	processed
14	Indonesia	1,019	122,905	2003	processed
15	Singapore	726	61,431	2003	processed
16	Myanmar	700	28,000	2003	processed
17	Vietnam	288	28,800	1995	processed
18	New Zealand	250	223,381	2003	processed
19	Japan	200	54,472	2002	processed
20	Australia	150	18,851	2003	processed
21	Norway	129	66,890	2000	processed
22	Fiji	5	1,628	2003	processed

Table 4 Thailand's Sea Cucumber Exported Countries

Rank	Country	Quantity (kg)	Value (baht)	Latest Year Recorded	Product Form
1	Hong Kong	120,045	11,350,128	2003	processed
2	Japan	30,000	1,095,000	1997	alive/fresh/ frozen
3	China	18,900	245,303	1999	processed
4	U.S.A.	5,880	849,744	1997	processed
5	Vietnam	3,810	511,145	2001	processed
6	Singapore	1,423	472,650	2003	alive/fresh/ frozen/ processed
7	Niger	1,235	344,902	1996	processed
8	Korea	790	189,172	2001	processed
9	Taiwan	762	121,043	2002	alive/fresh/ frozen/ processed
10	Australia	200	84,779	1996	processed
11	Malaysia	120	47,170	2000	alive/fresh/ frozen
12	India	31	45,992	1997	alive/fresh/ frozen

Table 5 Import-Export of Sea Cucumbers in Thailand

Year	Alive/Fresh/Frozen		Processed		Total	
	Quantiy (kg)	Value (baht)	Quantiy (kg)	Value (baht)	Quantiy (kg)	Value (baht)
IMPORT						
1993	69	14,659	10,705	919,011	10,774	933,670
1994	52	10,604	14,837	1,380,636	14,889	1,391,240
1995	2	2,405	31,839	2,552,356	31,841	2,554,761
1996	1,380	100,530	23,402	2,187,422	24,782	2,287,952
1997			71,391	13,470,810	71,391	13,470,810
1998	96	43,370	78,422	11,618,021	78,518	11,661,391
1999	660	381,048	150,362	31,168,130	151,022	31,549,178
2000	3,817	1,291,742	129,002	19,833,265	132,819	21,125,007
2001			115,416	22,374,305	115,416	22,374,305
2002			116,444	20,264,425	116,444	20,264,425
2003			108,417	16,054,042	108,417	16,054,042
EXPORT						
1993			60	12,931	60	12,931
1994	105	13,119	50	4,000	155	17,119
1995	204	20,016	4,000	489,582	4,204	509,598
1996			8,155	1,429,689	8,155	1,429,689
1997	30,031	1,140,992	10,413	2,732,935	40,444	3,873,927
1998	16	4,696	86,858	6,628,994	86,874	6,633,690
1999	19,765	244,606	205,151	11,872,920	224,916	12,117,526
2000	282	68,758	242,256	34,196,797	242,538	34,265,555
2001	58	11,640	120,982	19,022,848	121,040	19,034,488
2002	360	72,000	101,291	11,795,642	101,651	11,867,642
2003	20	7,172	121,448	11,815,606	121,468	11,822,778

5. Conclusion

Thailand has a high diversity of sea cucumbers recorded at 102 species in 8 families mainly Holothuriidae, lots of which are under genus-systematization. From those in Thai waters, 9 species of Holothuriidae and 3 species of Stichopodidae are reported as food. The most commercially important species is *Holothuria scabra* or sand fish, followed by *H. atra* or lolly fish. Most of sea cucumbers are coastal fauna, many of which prefer hiding around coral reef or sea grass bed. Sea cucumbers are exploited for long times in Thailand along the coastal area and islands. The common fishing methods are hand picking during low tide or snorkeling at deeper water. Processing is confined in local places with traditional techniques usually gutted, cleaned, boiled, and dried or smoked. For restaurant demand, Thailand imports processed sea cucumbers from many parts of the world, totally 22 countries of which Madagascar was the majority. At the same time the sea cucumbers are also exported from the country mainly to Hong Kong followed by the 8 countries in Asia and 3 other countries. Recently, the quantities and values of their import and export were not markedly different. The actual species traded are not recorded.

Although there have been exploitation and trade of sea cucumbers in the country for long times, the fisheries is not significantly commercial. Their fisheries, marketing and trade are not recorded in national fisheries statistics; their stock assessment and recruitment are not yet studied as well. Nevertheless, due to their common habitats locating in and around coral reefs, reef flats and sea grass bed, strong harvesting of the animals would certainly disturb or resulted in destruction of these significantly-important coastal-ecosystems. Thus, intensive monitoring on sea cucumber exploitation and trade should be carried out for conservation and long term sustainable exploitation purposes.

SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN VIETNAM

By Mr. Nguyen Quang Hung [9]

1. Introduction

Sea cucumber is a valuable and nutritious food. Sea cucumber meat contains many nutrients in a high percentage such as protein (76%), amino acids (lysine, proline ...) and many trace substances such as P, Cu, Fe..., many vitamins, hormones and active biological subtances such as Saponin Rg, Rh. It also contains few lipids and almost no cholesterol so that it is a kind of ideal food that can be used by obese people and people with blood-lipid disorders. Furthermore, it is also a kind of good medical material especially in traditional care and cure methods. It can be used in treatment of gastritis and stomach ulcers, anemia, nervous breakdown, lack of libido in men, and backache, amongst other things.

It has varying commercial values depending on species and product. Price of *Holothuria atra* is about $10 USD per fresh kg, *H. scabra* is about $20 USD per fresh kg, *H. echinites* is about $5 USD per fresh kg, *H. nobilis* is about $14 USD per fresh kg, and *H. ananas* is about $10 USD per fresh kg.

In Vietnam, sea cucumbers are plentiful and have high biodiversity, with about 90 known species. The *Holothuria*, *Sticopus*, and *Colochirus* families are the most abundant (Thai Tran Bai, 2004). They are found in a variety of geographical areas, from the littoral zone to deep sea, and coral reefs around islands. However, as they are of high economic as well as medicinal value, many species are being overfished. This situation is aggravated due to the irresponsible management and lack of closed control in coastal local authorities, causing the sea cucumber resources to rapidly decline. Many species now are listed as overfished in the Red Book of Vietnam in various distincts. Sea cucumbers live abundantly on bottom substrates or in burrows in sand or mud, making them especially vulnerable to fishing in high volume..Data from the Fisheries Department of Kien Giang showed that after 10 years (from 1993 to 2003), total catch around Phu Quoc Islands had reduced by about 10 times (in 1993 total catch was approximately 3 tons per day, but in 2003 total catch had dropped to nearly 0.3 tons per day). Meanwhile, fishing activities that use destructive techniques such as explosives,, bottom trawl, electrical push, and electrical trawl net all pose great threats for sea cucumbers and their ecosystems.

Hence, an understanding of species composition, distribution, biology, fishing status, commercial culture, processed products and extracts from sea cucumbers, as well as marketing and trade of sea cucumbers are all necessary to find suitable solutions to manage and maintain this resource sustainably in Vietnam.

2. Taxonomic information

2.1. Species composition

Statistics obtained from continuing studies indicate that there are about 90 species of sea cucumber in Vietnamese seawaters (Thai Tran Bai, 2004). Sea cucumbers are especially abundant around Cat Ba Island, Co To Island, Bach Long Vi Island, The Gulf of Tonkin, Ly Son Island, Khanh Hoa, Truong Sa Archipelago, Phu Quoc Island, and Tho Chu Island (Dao Tan Ho, 1996). Of the 90 species identified, 19 species belonging to five families Cucumariidae (3 species), Holothuriidae (10 species), Stichopolidae (1 species), Molpadiidae (1 species), Synaptidae (4 species) have been found in The Tonkin Gulf (annex 1).

Khanh Hoa is another area that has an abundant stock of sea cucumbers, of which many species are of economical value i.e. *Holothuria martensii, H. atra, H. Scabra, H. echinites, H. mauritiana, H. nobilis, H. Ananas*.

Con Dao also has high diversity of species with 16 species belonging to five families Holothuriidae (9 species), Stichopodidae (2 species), Cucumariidae (1 species), Caudinidae (1species), Synaptidae (3 species) (annex 2).

[9] Member of the Ad hoc Regional Working Group on Sea Cucumber Fisheries and National Focal Point for Vietnam, Research Institute for Marine Fisheries (RIMF)

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

Sea cucumber Species	Family name	Local name	Commercial value (Price/kg) – USD (1), (2), (3)
1. *Actinopyga echinites*	Holothuriidae	□□n □□t mít, H□i sâm mít	4,5; 10; 21
2. *Actinopyga mauritiana*	Holothuriidae	□□n □□t d□a, H□i sâm mít hoa	5; 8; 15
3. *Holothuria nobilis*	Holothuriidae	□□n □□t vú, □□n □□t d□a, H□i sâm vú.	1,7; 3; 5
4. *Holothuria atra*	Holothuriidae	H□i sâm □en	17,5; 20; 25
5. *Holothuria (Mertensiothuria) leucospilota*	Holothuriidae	-	9; 15; 25
6. *Holothuria impatiens*	Holothuriidae	-	2,0; 4,7; 8
7. *Holothuria Scabra*	Holothuriidae	H□i sâm cát, H□i sâm tr□ng	1; 1,7; 5
8. *Bohadschia graeffei*	Holothuriidae	-	10; 15; 21,3
9. *Thelenota ananas*	Stichopolidae	□□n □□t l□u, H□i sâm l□u	5; 8; 12,5
10. *Stichopus chloronotus*	Stichopolidae	D□a chu□t bi□n	-
11. *Synapta maculata*	Synaptidae	-	-

Note: (1), (2), (3) mean commercial value (price/kg) gradually increase, most of which the price is double 1 to 2 times approximately for each level.

Results obtained from previous studies have shown that genus *Holothuria* can adapt widely to various ecosystems. For example, it can live from high littoral zones to deep reefs around islands.

The genera and families in Vietnamese seawater with the greatest number of species, are Holothuriidae (*Holothuria, Sticopus*), Cucumaridae (*Colochirus, Cucumaria*), and Sinaptidae (*Protankyra*).

2.2. Biology characters of some common and commercial sea cucumbers in Vietnam

FAMILY: Holothuriidae

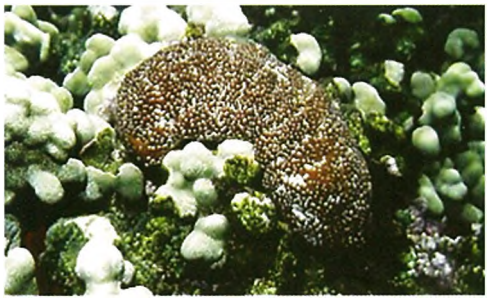
Scientific name: *Actinopyga echinites* (Jaeger, 1883)
Vietnamese name (local name): □□n □□t mít, H□i sâm mít
English name (common name): Deep – water redfish

Description:

- Size: Length: 20 - 30 cm; Width: 2 - 4 cm; Body wall thickness: 7 mm; Live weight: 0.5 - 1 kg
- Shape: Body shape is cylindrical, it is wider in the middle and tapers toward the two ends. It lies on dorsal side. There are many papillae and many podia arranged in line along the mouth on the ventral side and 20 tentacles in a circle. Anus is turned dorsally at the ends of the long axis of the body. anus has five tooths around them . (following the specimens)
- Color: Brownish. The ventral color is lighter than dorsal color.

Habitat: This species is abundant on reef flats and the upper part of coastal reef slopes, on sandy bottoms, turtle-grass beds and among living corals, under littoral, on dead coral, found in high density in 2-5m of water. Average density is a few hundred animals per hectare.
Distribution: Vietnam: Khanh Hoa (Hon Khoi, Hon Doi, Hon Tai, Hon Rua, Hon Tre, Hon Mieu), Truong Sa Archipelago, Con Dao Island, Phu Quoc, Tho Chu); World: East Africa, East India, West and South Pacific Ocean

Scientific name: *Actinopyga mauritiana* (Quoy & Gaimard, 1883)
Vietnamese name (local name): □□n □□t d□a, H□i sâm mít hoa
English name (common name): Surf redfish (White spotted sea cucumber)



Description:

- Size: Length: 25 - 30 cm; Width: 3 - 4 cm; Weight: up to 1 kg.
- Shape: The body of this species of sea cucumber is arched on the upper side and flat on the lower side. Large brown and white speckled cucumber, body lined with tube feet. There are many podia on the ventral side but not arranged into a line. Anus is turned dorsally at the ends of the long axis of the body; ring of five small teeth and a white ring around anus. Mouth with 25 tentacles (following the specimens)

Habitat: It is usually found where the surf breaks on the reefs, firmly attached to coral stones, often at a depth of 4 -7 m water.
Distribution: Vietnam: Khanh Hoa (Hon Khoi, Hon Tre, Hon Mieu), Truong Sa Archipelago, Con Dao Island, Phu Quoc, Tho Chu; World:, East India, North Sea of Australia, West and South Pacific Ocean and Hawaii.

Scientific name: *Holothuria nobilis* (Selenka, 1867)
Vietnamese name (local name): □□n □□t vú, □□n □□t d□a, H□i sâm vú.
English name (common name): Black teatfish

Description:

- Size: Length: 30- 40 cm; Width: 4- 6cm; Weight: 2- 3 kg
- Shape: Body is loaf-shaped. Six to eight teats like projections can be seen on each side of the body in live specimens. There are many podia on the ventral side but not arranged into a line. Mouth is directed toward the ventral side. Five small teeth and a bunch of teats around anus. The body is covered with a fine coat of coral sand, and is cream colored with black blotches (following the specimens)

Habitat: This species is found in shallow waters in lagoons. It is more commonly found on shallow reef bottoms that are not subject to terrigenous influence, or sandy bottoms at 4 – 7m of water. Juveniles may be found on turtle-grass beds.
Distribution: Vietnam: Khanh Hoa (Hon Doi, Hon Tre), Truong Sa Archipelago, Con Dao Island; World: East Africa, East India, West and South Pacific Ocean.

Scientific name: *Holothuria atra* (Jaeger, 1833)
Vietnamese name (local name): H□i sâm □en
English name (common name): Lolly fish

Description:

- Size: Length: 10- 50 cm; Width: 3- 8cm; Weight: 0,2- 1,5kg.
- Shape: Body is uniformly black with fine coating of sand and looks like a sausage.

Habitat: The most common species in the tropical Indo – Pacific Ocean. It may form dense aggregations in shallow water sandy habitats, just below the tidal mark.
Distribution: Vietnam: Con Dao Isalnd, Phu Quoc Island, Nha Trang Bay…;World: East Africa, Red Sea, throughout the western Pacific to the Hawaiian Islands (Lembeh Strait, Sulawesi, Indonesia).

Scientific name: *Bohadschia graeffei* (Semper, 1868)
Vietnamese name (local name):
English name (common name):

Description:

- Size: Length: 10- 50 cm; Width: 3- 8cm; Weight: 0,2- 1,5kg.
- Shape: This species radically changes its appearance in its transition from a juvenile to an adult. Adults are beige with black spots and short, white-tipped tubercles.

Distribution: Vietnam: Nha Trang Gulf; World: Red Sea, Maldives to Australia; New Caledonia; New Guinea, Indonesia and Philippines (Batangas, Luzon, Madang), Papua New Guinea

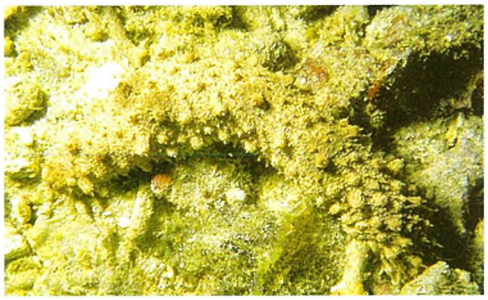
Scientific name: *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835)
Vietnamese name (local name):
English name (common name):

Description:

- Size: Length: 30- 40 cm (maybe 50cm);
- Shape: This species has a long snake-like body. It has a peculiar habit of sticking its posterior end under a stone. The anterior end projects out from the stone and keeps on moving with the ventrally directed tentacles. On being disturbed the animal throws out white sticky threads. Like *H. atra* it is uniformly black in color.

Habitat: It lives in reef flats and under stone. The anterior end projects out from the stone to the sand, its posterior end under a stone.
Distribution: Vietnam: Nha Trang Gulf, Coto- Thanhlan, Halong Bay (Quang Ninh), Cat Ba Island (Haiphong), and other coastal coral reefs; World: West Indo Ocean, Red Sea, West Pacific Ocean to Hawaii Island (Cock Island).

Scientific name: *Holothuria impatiens* (Forskal, 1775)
Vietnamese name (local name):
English name (common name):



Description: In this species, the body is bottle-shaped with a long neck and rough surface, sandy to touch. It is covered with conical warts from which filamentous appendages emerge. It is a secretive form found under dead coral stones. On disturbing the animal white sticky threads are ejected. It is an active sea cucumber. It is light brown with 4-5 dark brown transverse bands on the upper side near the anterior end.
Habitat: Often two or three specimens are found under the same coral stone. This species is commonly found in shallow water rubble habitats
Distribution: Vietnam: Con Dao, Gulf of Tonkin; World: East Africa; Red Sea to the Hawaiian Islands. This species is also known from tropical Atlantic and the Mediterranean (Batangas, Luzon, Philippines)

Scientific name: Holothuria Scabra (Jaeger, 1883)
Vietnamese name (local name): H□i sâm cát, □□n □□t cát, H□i sâm tr□ng.
English name (common name): Sandfish

Description:

- Size: Length: 40 cm; Weight: 400gr.
- Shape: The body is oval and stout with flattened ends; *H. scabra* has prominent wrinkles on its upper surface and is generally smaller and lighter than the versicolor variety. The upper side is grey in color with white or yellow horizontal bands, with 7-8 pleats. The lower side is white in color with fine black dots. Podia is tubular and small, its base is light grey. The ventral surface is white and concave with podia arranged randomly on the lower side. Mouth on the ventral side with 20 yellow-brownish tentacles in radiation. Anus at the end of the body with 5 bunches of papillae, each one has 5-8 pieces in pyramid shape. Gonad gland is small with short tentacles and without cuivier tube. This is the most widely used species after *A. Japonicus* and also the most valuable species for processing. It is gregarious in nature and is therefore easily exploited.

Habitats: It often lives near low saline areas and frequently in muddy-sandy bottoms. It spends part of the day buried in sand. It comes out of sand during feeding time. It can be found in the intertidal region to a depth of 10 m. It is found in sand and younger forms are distributed near the shore, and as they grow they migrate to deeper waters for breeding. It can adapt to conditions of varying temperature and salinity, from 25 – 310C, 20 – 34,5 ‰.

Distribution: Vietnam: Khanh Hoa (Cam Hai, Cam Thanh, Cam Phuc, Cam Ranh), Nha Trang Bay (Cua Be, Song Lo), Van Phong Bay (Van Gia), Xuan Dai Bay (Vung Trao, Vung Mam, Vung Dong and Cu Mong), Cau River (PhuYen), Phu Quoc Island.

FAMILY: Stichopolidae

Scientific name: *Thelenota ananas* (Jaeger, 1833)
Vietnamese name (local name): □□n □□t l□u, H□i sâm l□u
English name (common name): Prickly redfish

Description

- Size: Length: 75cm; Width: 11.5cm; Height: 8.5cm
- Shape: Very distinctive appearance due to numerous large pointed teats in groups of two or three all over the body surface. The body is reddish orange with 'teats' darker than the rest of the body surface. There are numerous large tube feet on the flat underside. The tube feet on the underside are bright orange (following specimens).
- Habitats: Found in 7-10m depth on sandy bottom or dead corals.

Distribution: Vietnam: Khanh Hoa (Hon Tre, Hon Khoi), Truong Sa Archipelago, Tho Chu; World: East India, West and South Pacific Ocean

Scientific name: *Stichopus chloronotus* (Brandt, 1835)
Vietnamese name (local name): D□a chu□t bi□n
English name (common name): Greenfish

Description: Roughly square in cross-section with large prominent papillae at each corner of the square. Body surface otherwise smooth. Many tube feet in three rows on underside. The body is uniformly dark green with numerous elongate papillae, each tipped with orange.
Habitats: Found in shallow water rocky and rubble habitats. Can adapt to a range of salinity above 20‰. Found commonly in coral reefs, rocks or sandy bottoms.
Distribution: Vietnam: Con Dao, Hai Phong, Quang Ninh, Chan May, Cu Lao Cham and Khanh Hoa; World: East Africa, from Madagasca to Western Pacific and Hawaiian Islands (Batangas, Luzon, Philippines).

Scientific name: *Stichopus variegatus* (Semper, 1868)
Vietnamese name (local name):
English name (common name): Curryfish

Description: Unlike other species of *Stichopus*, *S. variegates* lacks elongate tubercles. The body is burnt orange with darker low tubercles arranged in distinct rows.
Habitats: Found in shallow water rubble and sandy habitats.
Distribution: Vietnam: Tonkin Gulf; World: Western Indian Ocean; Red Sea to Australia, New Caledonia; Indonesia; Philippines; Japan and Belau (Heron Island, Great Barrier Reef, Australia).

FAMILY: Synaptidae

Scientific name: *Synapta maculata* (Chamisso & Eysenhardt, 1821)
Vietnamese name (local name):
English name (common name):

Description: Body is long and snake-like. It can reach more than 2 m in length. It is usually found on the reef flat. It shovels sand into the mouth with its relatively large tentacles. Tentacles are seen to be in active movement during feeding. It crawls along by holding on to solid objects. It is tan to brown in color with black markings. The whole body surface has small white rings that are closely arranged.
Habitats: Found in shallow sandy habitats and grass beds.
Distribution: Vietnam: Tonkin Gulf; World: Southeast Asia, Red Sea, from Western Pacific Ocean to Society Islands (Sulawesi, Indonesia).

3. Products and Utilization

3.1. Sea Cucumber Fisheries

3.1.1. Fishing status of sea cucumber:

Due to their high value in medicine and food, some Holothuroid species are subject to intensive fishing in the Vietnamese sea, such as *Holothuria scabra*, *Actinopyga echinites*, *Thelenota ananas, Holothuria nobilis,* and *Holothuria nobilis*. These species are over fished mainly in Khanh Hoa, Con Dao, and Truong Sa, and especially in Phu Quoc. This has resulted in the quantity of sea cucumbers in Phu Quoc facing depletion. Ten years ago, about 3 tons of sea cucumber were caught each day around Phu Quoc, however now the catch is only 300 kg per day.

Truong Sa Archipelago also has a high abundance of sea cucumbers and large numbers of fishermen come from Lyson Island (Quang Ngai). According to statistical data obtained by the People's Committee of Lyson District, during 1990 to 1995 one fishing boat could catch about 1,400 kg per voyage (32 days). At the time of writing, the price of 1kg of sea cucumber is 500,000 VND, so that 1,4000kg of sea cucumber is worth about 700 million VND. Thus, the average income for a labourer on a boat is about 25 - 40 million VND. It is for this reason that sea cucumbers are being increasingly exploited, as the number of fishermen targeting sea cucumbers contuinues to rise (about 30% of fishermen in Lyson fish for sea cucumbers)

Bach Long Vi Island is another area suffering from overfishing and lack of responsible planning. In the past, there existed a large population of red and white sea cucumbers, but now they have disappeared.

SCUBA diving is the main method used to catch sea cucumbers. This method places pressure on sea cucumber populations due to the crowded fishermen and high fishing volume, as sea cucumbers normally live in flocks making it easy to catch large quantities. Consequently, sea cucumber resources are in rapid decline. In addition, other fishing methods catch sea cucumbers as bycatch, simultaneously damaging sea cucumber habitat. Examples of such methods include trawl net with undersized mesh, explosives and electrical fishing gear. These fishing methods result in large deaths of sea cucumbers and other living organisms, disrupting the ecosystem balance in that area.

Several attempts to protect sea cucumber species in Vietnam have been made, including designated zones for reproduction areas, and banning trawling and the use of explosives. However, these solutions have not brought back positive results as yet.

3.1.2. Sea cucumber culture status:

From 1991-1995, Research Center III of Aquaculture implemented a national project: 'Research to build up a process to produce artifical seeds and commercial culture of sea cucumbers' (*Holothuria scabra, Actinopyga echinites*). The results showed that the average monthly growth rate of sandyfish was 1.2 – 2cm in length and 40 – 60gr in weight (Nguyen Chinh, 1996). When compared with experimental results from cultures grown in a cement tank, an earthen pond and a pond with stone walls, it was found that *H. Scabra* had an optimum growth rate in the earthen pond, and that *Actinopyga echinites* was best grown in the pond with stone walls. Culture care and management for both species was relatively simple, as they could be poly-cultured with other animals, and the sea cucumber's ability to maintain sediment cleanliness played an important role for the ecosystem in the pond. The cement tank could be used for artificial seed production and maintenance, brock stock culture of parent.

From 2000 to 2003, the Project of Sea Cucumber Rearing, which involved cooperation between ICLARM and Research Center III of Aquaculture, produced artificial seeds successfully. They also succeeded in experimentally culturing larvae in the earthern pond, cage and weir. The results revealed that sea cucumber growth rates in the pond varied depending on the size of the seed. Seeds that were initially 1.6gr grew to 60gr/indiv. after being reared for 1.5 – 2 months; seeds that were initially 5.5gr grew to 130gr/ind. after 2.5 months; seeds that were initially 28gr grew to 96gr/ind. after 1.5 months; seeds were 30gr after 3 months; they were 300gr/ind.(R. Pitt & N.D.Q.Duy, 2003). However, the survival rate of sea cucumbers was not stable (0-100%), and was dependent on many factors, especially on sediment and salinity.

From 2001 – 2003, Research Center III of Aquaculture in cooperation with SUMA (FSPS program) implemeted the project ' Study on

rearing sea cucumber (*Holothuria scabra*) in shrimp (*Penaeus monodon*) culture pond in order to improve environment'. The results suggested that at least 70% of sea cucumbers could survive in a salinity range from 20 – 400/00. A salinity in the range of 25-35‰ yielded a high survival and growth rate, while the optimal salinity condition was 30‰. (Nguyen Thi Xuan Thu, 2003). Sea cucumbers were cultured in shrimp ponds in an attempt to improve the cleanliness of the environment, however when the sea cucumbers were harvested they were only 100g/indiv. (size on market was 500gr/ind.), so it therefore took longer to culture the sea cucumbers to an appropriate size.

Generally, the experimental rearing of sea cucumbers in shrimp ponds is still limited. The majority of the sea cucumbers come from natural fishing. However, there are some commercial culturing techniques that are economically viable, such as the culturing of the sandy sea cucumber (*Holothuria scabra*) in Nha Trang – Khanh Hoa done by the Research Institute III for Aquaculture. Production volume is 2-3 tons per ha and in addition this mode of culturing employs many people in the Van Hung commune – Van Ninh District – Nha Trang City.

3.2. Local usage and processing

3.2.1. Use as a nutritious and functional food:

Experimental results show that sea cucumbers are one of the most nutrient-rich foods. For example, 100g of dry sea cucumber contains about 76gr protein, five times more than lean pork meat and 3.5 times more than beef. Sea cucumber also contains essential amino acids lysine and proline, and trace minerals P, Fe and Cu, as well as Se, which can neutralize heavy metals (Pb, Hg) that enter the body through consumption of food. In addition, it has multi vitamins, hormones, bio- active compounds (two kinds of Saponin as Rg, which can stimulate the nervous system, has anti-fatigue properties, and can strengthen health; Rh can inhibit cancer cells).

Sea cucumber's use as a nutritious food and useful medicine often involves it's being combined with other remedial dishes, as below:

- *Ulcerative colitis and stomach inflammation*: put intestine of sea cucumber on earthen tiles, dry well and then grind into powder. Use by drinking about 0.5 -1 gr. two times per day.
- *Anaemia*: Use sea cucumber and Vietnamese apple (without pip) in equal quantity, dry well, then grind into powder. Drink 9 gr. with warm water 2 times per day. Alternatively, use 1 individual sea cucumber stew with enough quantity of ear-wood and little candy, eat during day.
- *Nerve asthenia*: (Photopsia, backache, tiredness, insomnia, spermatorrhoea, premature ejaculation): 30gr sea cucumber stew with 100 gr of sticky rice and spices into gruel. Eat several times during a day.
- High blood pressure and atherosclerosis: Stew 50g sea cucumber with little candy and eat during a day.
- *Constipation*: 30gr sea cucumber with 120gr clean raw pork large intestine with 15gr black ear-wood, stew together with spices then eat in several days.
- *Backahe and amnesia*: 30gr sea cucumber and 60gr pork spine and 15gr nucleus of peach, stew with spices and eat in several days.
- *Anaphrodisia*: 20gr sea cucumber and 100gr goat meat and stew together and eat during a day.
- *Epilepsy*: Dry well the viscera, grind into powder then drink about 12gr of powder with wine in many days.

3.2.2. Extraction of sea cucumber for medicinal materials:

*3.2.2.1. Extraction of Holothurin B from black sea cucumber (*Halothuria vagabunda*)*

According to Chau Van Minh's study (2005), Holothurin B can be extracted from black sea cucumber (*Holothuria vagabunda*), and used to cure spasm disease caused by parasite, cerebral confusion, stomach inflammation, asthma, backache and high blood pressure. It is not toxic for humans, and can even be used to reduce growth of tumors. In addition, it may also be used to reduce pain, rheumatoid arthritis, osteoarthritis, strengthen flexibility of joints, and as an anti- cancer and anti-fungal agent.

Extraction method for Holothurin B: Process *Holothuria vagabunda* to eliminate inorganic salts, grease, fatty acids and other impurities, to obtain methanol solution. From the methanol solution, it is possible to extract condensed Clorofoc solution.

After chromatography, Holothurin B compound is obtained in white crystal needle shape (Chau Van Minh, 2005).

3.2.2.2. Extraction of HOLM-1 and HOLM-2 from Blackfish Holothuria martensii

Holothuria martensii is a common species in the Vietnamese sea. It is also of medicinal value, being used to cure diseases caused by parasites, and cerebral confusion, amongst other things. In an application of marine biotechnology programme (2002-2005), Chau Van Minh et al (2005) used *H. martensii* as a source of HOLM-1 (one type of Holothurin B) and HOLM-2 (one type of Holothurin A). Holothurin A is used in medicine in a similar way to Holothurin B, and it is especially effectivein cancer treatment.

Extraction method for HOLM-1 and HOLM-2: Inorganic salts are first eliminated from *H. martensii*, which is then cut into small pieces, and ultrasound and methanol are used to obtain MeOH solution. Next, Clorofoc and water extract MeOH fractionally, to become MeOH condensed solution. After chromatography of MeOH condensed solution the products are HOLM-1 (Holothuria B) and HOLM-2 (Holothurin A) (Chau Van Minh et al, 2005).

3.2.2.3. Extraction of steroid compounds from Actinopyga mauritiana

Do Tan Loi (1991) recognized that grease of sea cucumber has an effect on metabolism stimulation, increasing oxidization- deoxidization, and anti-arteriosclerosis. It was discovered that substances of bioactive compounds in sea cucumber were not protein, it could be solved into lipid. Studied team Nguyen Van Cuong, Nguyen Kim Do, Nguyen Thi Dieu Thuy, Do Thi Hong Viet, Nguyen Tai Luong (1998) started to extract bioactive compounds of sea cucumber and showed that it's originated as steroid

Extraction: Extracted sea cucumber *Actinopyga mauritiana* by immersing in 50% alcohol for 2 weeks or quickly extracted by solex. After that, the mixture was extracted fractionally with benzene and butanol. Steroid compounds were obtained by thin layer chromatography.

*3.2.2.4. Extraction of lectin and peptide from Whitefish (*Holothuria scabra*)*

Lectin:

Lectin extracted from *Holothuria scabra* can actively agglutinate erythrocyte cells of all human blood groups. It can also be used in the classification of erythrocytes, stimulation of leukocyte cell division, and cell studies in normal and pathology (Nguyen Van Cuong et al , 2000).

Lectin extraction: Dry sea cucumber was ground by homogenizator, then extracted in buffer pBS , then centrifuged 1200 round per min. would get crude solution and residue. Crude solution was extracted by ammonium sulphate precipitation and then, by ion exchange chromatography, to obtain lectin.

Peptides:

Peptide solution can increase an animal's relaxation, therefore helping it to conserve energy. This is important in the accumulation of energy materials such as ATP and glycogen. When the body becomes more active, this source will be mobilized to release energy. Nguyen Van Cuong et al (2000) tested the effects of the peptide fractional solution on white mouse and found that it enhanced relaxation and therefore also saved energy in the white mouse.

Peptide extraction: Peptides were extracted from *Holothuria scabra* by precipitation of acetone and TCA, then gel filter chromatography on Sephadex G15. Result from chromatography – electrophoresis on paper showed nerved peptide bands exist in one of eight segments of gel filter chromatography

3.2.2.5. Amorvita Sea cucumber product

One box of Amorvita sea cucumber contains two x 10 capsules. The medicine is composed of hydrolysis powder of sea cucumber: 200mg, Vitamin B1: 10mg, Vitamin B6: 10mg, and excipient equivalent 1 capsule.

Figure 1: Amorvita sea cucumber on the market in Vietnam.

- Uses: Strengthen health, maintain energy, anti muscle asthenia, anti aging, strengthen immunity, supplement amino acids, mineral traces, blood form factors, increase blood circulation, improve oxygen absorption, anti myocardium illness, catalyze enzyme reactions, enhance metabolism and nutrients absorption, reduce cholesterol in blood, increase synthesis of protein..
- Indication: to improve health, athletes, hard working people, nervous people or people under pressure, male lack of libido, after surgery, after illness, asthenic person, aged person
- Dose: Normal: 1 capsule 3times per day.
- For Libido: beginning dose (1-2 months initially): 2 capsules 2-3 times per day; maintain dose: 1 capsule 2-3times per day or following doctor's instruction.

3.3. Marketing

- Market in Vietnam: Ho Chi Minh City has the largest market for sea cucumbers. Fresh sea cucumber usually have the intestines removed, is chilled and transported to the city. However, the market for seed consumption (produced by Research Institute III for aquaculture – Nha Trang) is concentrated in places such as Quang Ngai, Ninh Thuan, Phu Yen and Khanh Hoa provinces. At the moment seed availability is still limited but may increase in the future.
- In Asian countries, sea cucumber is viewed as a high-class dish, while in European countries it is also valued and served in luxurious restaurants under the name Cucumus marinus.
- Cost: Normally, sea cucumbers that weigh from 0.3 – 0.5kg/ind. cost 17-20,000 VND/fresh kg. However, the price is also dependent upon the size, season and species (table 2).
- Furthermore, extracted products used for medicinal purposes will be more expensive, for example, a box of Amorvita sea cucumber above cost 225,000 VND.

Table 2: Cost of some commercial sea cucumber on Vietnamese market.

Scientific name	Local name	Product form	Price / kg (US$)
1. *Actinopyga echinites*			4,5-21
2. *A. mauritiana* c.f.		Steroid	5-15
3. *H. (H.) atra*			1,75-5
4. *H. (M.) nobilis, H. (M.) whitmaei*			17,5-25
5. *H. (M.) scabra*		Lectine, peptide	9-25
6. *Holothuria sp., H. (M.) leucospilota* c.f.			4,75
7. *Pearsonothuria graeffei*			1,75
8. *Stichopus chloronotus*			21,25
9. *Thelenota ananas*			12,5
10. *Holothuria martensii*		HOLM-1 and HOLM-2	-
11. *Holothuria vagabunda*		Holothurin B	

Source: information collected from Departments of Fisheries.

Distributors:
- Holothurin B, HOLM-1 and HOLM-2 products are distributed by chemical Institute of natural compounds (18- Hoang Quoc Viet Str, Ha Noi, Viet Nnam).
- Steroid compounds extracted from sea cucumber distributed by Institute of Biotechnology.
- Lectin and peptide extractions distributed by Institute of Biotechnology.
- 'Amorvita sea cucumber' distributed by Traphaco - Joint stock company (75 Yen Ninh, Ba Dinh, Ha Noi, Viet Nam).

4. Trade

Sea cucumbers are an high commercial species group so that they are being caught for sale. Some species are being overfished to satisfy market demands. However, commercial activities of sea cucumbers haven't checked clearly so that import-export statistical data (import-export yield, import-export cost, etc.) of these species is still unconnected and uncomprehensive through many years. Almost, the commercial data of sea cucumbers is selected from import-export companies of sea cucumbers or from fishmen or from traders.

Sea cucumbers are usually caught in the south of VietNam (Phu Quoc, Ly Son, Con Dao, Tho Chu and Truong Sa Archipelago). Sea cucumbers from these areas are gathered, transported to Ho Chi Minh market and exported to some countries in Asia (China, Hong Kong, Japan, Taiwan, Singapore), Canada, America and Australia. The species are usually exploited and transported to Ho Chi Minh Market including: *Holothuria scabra, Thelenota ananas, Bohadschia argus, Holothuria nobilis và Stichopus chloronotus*.

Sea cucumbers market in VietNam includes two kind of products: frozen and dried sea cucumber products. The frozen products are very rare. They are cooked, canned for export market. The dried sea cucumbers are common products in VietNam. They are provided to either domestic or overseas market. If dried products are wetted, they are usually sold at local supermarkets. Some export companies of sea cucumbers in VietNam following:

+ *HX export company*
Address: 405/2 Xo Viet Nghe Tinh St.,
Binh Thanh Dist., Ho Chi Minh City

They are exporting different kind of dried sea cucumbers such as: White teat fish, Flower teat fish, Green fish, Yellow sand fish, White sand fish, Black sand fish, Lolly fish, Curry fish, Pyhon fish,

Figure 2: some dried sea cucumber products of HX export company

Figure 3: Dried sea cucumber products of Phu Mai company ltd.

Shark's skin, Shark's fin, Fish maw (Globefish, Pangacious fism maw, Lacfish maw...) , Sea horse, etc.

Market: sea cucumber products have been exported to more than 20 countries, such as China, Japan, Korea, Singapore, United States, etc.

Phu Mai company ltd.
Address: 192 Van Kiep St., Ward 3, Binh Thanh Dist., Ho Chi Minh city
□□a ch□: 192 □□□ng V□n Ki□p, Khu 3, Qu□n Bình Th□nh, Thành ph□ H□ Chí Minh
Market: Some countries of northern America, Eastern Europe, Southeast Asia, Eastern Asia

In addition, there are some other export companies of sea cucumbers, such as: *Viet Delta industrial Co., ltd.* (20/5 Dinh Bo Linh St., Ward 24, Binh Thanh Dist., Ho Chi Minh City), *Anbai sea product company ltd.* (1 Bach Ma Street, District 10th HoChiMinh-Viet Nam), etc.

5. Conclusion and recommendation

5.1. Conclusion

- Vietnam is one of countries where has abundant resource of sea cucumber. According to statistical previous studies showed that known about 90 species. Major families and genera of sea cucumber are Family Holothuriidae (genus *Holothuria, Sticopus*), family Cucumaridae (genus *Colochirus, Cucumaria*), family Sinaptidae (genus *Protankyra*). From that, there are about 10 species, which have high nutrition and commercial value, for example: *Holothuria martensii, H. atra, H. scabra, H. echinites, H. mauritiana, H. nobilis, H. ananas*... These species have been studied to use as food, medicine and extracted bioactive compounds. However, up to now, there isn't full studied and statistic in stock capacity assessment of sea cucumber in Vietnam.
- Though, there were some studies on pilot of artificial seed production and commercial culture scheme and initial satisfactoried results were gotten. However, scale is still small, not stable, and don't satify for demand of sea cucumber market.
- Now, most of sea cucumber yield for domestic or overseas trading and consumption is contributed from mainly natural fishing. Thus, the resources now face to declination in everywhere, many commercial species are still overfished and threaten to distinct if do not act in sustainable management and utilization.
- Use of sea cucumber in functional food and medicine is great potential. Some bioactive compounds such as Holothurin B, HOLM-1, and HOLM-2, lectin, peptide and sea cucumber Amorvita are being produced but still need more specific and professional studies about sea cucumber in order to exploit effectively its resource and uses.
- Trade, process and consumption of sea cucumber in Vietnam generally is in small scale, there do not invest and manage in systematic. Sea cucumber products are consumed under raw or crude type.

5.2. Recommendation

- Need to study and statistic fully about species composition and structure, distribution, biology, stock capacity in Vietnamese water in order to be scientific witness for protection and responsible uses.
- Study and apply advanced techniques in seed production and commercial culture of some economic species to serve for trading, consumption and processing as well as material source for extraction bioactive compounds.
- Intensify scientific statistical management, monitoring, protection and reproduction of economic sea cucumber species in scope of area and countries members of CITES, SEAFDEC.
- Intensify international cooperation in protection, development and orientation in sustainable uses of sea cucumber resources among countries in ASEAN.

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Southeast Asian Fisheries Development Center (SEAFDEC)

What is SEAFDEC?
SEAFDEC is an autonomous intergovernmental body established as a regional treaty organization in 1967 to promote sustainable fisheries development in Southeast Asia.

Objectives
SEAFDEC aims specifically to develop fishery potentials in the region through training, research and information services in order to improve food supply through rational utilization of fisheries resources in the region.

Functions
To achieve its objectives the Center has the following functions:
1. To offer training courses, and to organize workshops and seminars, in fishing technology, marine engineering, extension methodology, post-harvest technology, and aquaculture;
2. To conduct research and development in fishing gear technology, fishing ground surveys, post-harvest technology and aquaculture, to examine problems related to the handling of fish at sea and quality control, and to undertake studies on the fisheries resources in the region; and
3. To arrange for the transfer of technology to the countries in the region and to make available the printed and non-printed media, which include the publication of statistical bulletins for the exchange and dissemination related to fisheries and aquaculture development.

Membership
SEAFDEC members are the ASEAN Member Countries (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam) and Japan.

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The Southeast Asian Fisheries Development Center (SEAFDEC) is an intergovernmental organization established in December 1967 to promote sustainable fisheries development in the region. Its current Member Countries are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

Representing the Member Countries is the Council of Directors, the policy-making body of SEAFDEC. The chief administrator of SEAFDEC is the Secretary-General whose office, the Secretariat is based in Bangkok, Thailand.

SEAFDEC undertakes research on appropriate fishery technologies, trains fisheries technicians, and disseminates fisheries information. Four Departments, namely Training Department, Marine Fisheries Research Department (MFRD), Aquaculture Department (AQD), and Marine Fishery Resources Development and Management Department (MFRDMD) were established in Thailand, Singapore, the Philippines and Malaysia, respectively, to pursue the objectives of the Center.

Since 1998, technical cooperation between ASEAN and SEAFDEC towards sustainable fisheries development has been initiated under the regional **ASEAN-SEAFDEC** Fisheries Consultative Group Mechanism (FCG) framework; and the promotion of sustainable fisheries development through this mechanism is well accredited within the ASEAN.

To assure that the efforts of ASEAN and SEAFDEC in tackling a number of challenges that have impacts on the development and management of the fisheries sector are sustained, and in support of various activities for the benefit of member countries, the **ASEAN-SEAFDEC Strategic Partnership (ASSP)** was formalized in November 2007. ASSP is envisaged to enhance closer cooperation between ASEAN and SEAFDEC and its member countries, paving the new phase for ASEAN-SEAFDEC collaboration in achieving long term common goals towards collective regional development and management of sustainable fisheries.