UNIVERSITI PUTRA MALAYSIA

ASPECTS OF TAXONOMY AND POPULATION PARAMETERS OF HOLOTHUROID (ASPIDOCHIROTIDA: HOLOTHUROIDEA) IN PULAU KAPAS, TERENGGANU, MALAYSIA

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FPSS 1995 2

ASPECTS OF TAXONOMY AND POPULATION PARAMETERS OF HOLOTHUROID (ASPIDOCHIROTIDA : HOLOTHUROIDEA) IN PULAU KAPAS, TERENGGANU, MALAYSIA

By

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Thesis Submitted in Fulfillment of the Requirements
for the Degree of Master of Science in the
Faculty of Fisheries and Marine Science
Universiti Pertanian Malaysia

September 1995

ACKNOWLEDGEMENT

I would like to express my greatest appreciation and most sincere gratitude to Assoc. Prof. Dr. Mohd Zaki Mohd. Said, chairman of the supervisory committee for his contribution, patience and effort, wise guidance and suggestions during the supervision of this thesis. I am also indebted to two other members of the supervisory committee, Assoc. Prof. Dr. Ridzwan Abdul Rahman, who edited and gave valuable suggestions on the scope of the study, Mr. Aziz Arshad for his advice and suggestion on the thesis. I am also grateful to Dr. Siti Aishah Orosco for editing the thesis thoroughly.

I wish to express my deep gratitude to the Agricultural Research Management Project (ARMP) of the Agency for Agricultural Research and Development (AARD) and PT INDECO/WINROCK International for providing the financial support during the study.

I am also grateful to the Agency for Agricultural Research and Development, Director of Center Research Institute for Fisheries and Director of Research Institute for Marine Fisheries for granting permission and encouraging me to pursue this Master's degree programme.

I also wish to express my gratitude to Dr. Mohd. Salleh Kamaruddin and my friend Mrs. Suhatmini Mulyadi who gave useful advice on statistical analysis.

I am greatly indebted to Mr. Mohd. Nasir Abdul Salam, Mr. Muhamad Muda and all crew members of UNIPERTAMA I for their assistance in taking samples underwater using SCUBA gears and Mrs. Kartini who assisting me in using the Scanning Electron Microscope.

Thanks are also due to all staff of the Faculty of Fisheries and Marine Science both at Serdang and Kuala Terengganu and all my friends who have given support during the conduct of this study.

Finally, my thanks to my parents for their sacrifice, my husband, Richard H. Maskat and my son, Erick for their support, patience and understanding in my absence.

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Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirement for the degree of Master of Science.

ASPECTS OF TAXONOMY AND POPULATION PARAMETERS OF HOLOTHUROID (ASPIDOCHIROTIDA : HOLOTHUROIDEA) IN PULAU KAPAS, TERENGGANU, MALAYSIA

BY

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September 1995

Chairman : Assoc. Prof. Dr. Hj. Mohd. Zaki Mohd. Said

Faculty : Faculty of Fisheries and Marine Science

This study aimed to investigate some aspects of the taxonomy of holothurian species and population parameters of the dominant species found in Pulau Kapas.

Observations by SCUBA on the density and abundance of holothurians were carried out using transect lines in five stations once a month for 11 months, from March 1993 to May 1994, except the months of October 1993 to January 1994. Data on abundance of holothurians were recorded underwater.

Ten species were identified : *Holothuria atra*, *H. edulis*, *H. hilla*, *Stichopus chloronotus*, *S. variegatus*, *Stichopus sp.*, *Actinopyga lecanora*, *A. echinetes*, *A. miliaris* and *Bohadschia marmorata*. One species of the genus *Stichopus* could not be identified to the species level.

The composition of spicules of the four dominant species did not show any significant difference in most parts of the body such as anterior, posterior, mid dorsal and mid ventral.

Of the ten species, *H. atra* was the most dominant species. It constituted 50.61% of total holothurians recorded at study sites. The next abundant species were *S. chloronotus* (27.13%) and *H. edulis* (19.51%). Other holothurians were less than 3% of the total holothurians counted in the study areas.

The mean density at the five stations showed variation. The highest mean density was recorded at inner zone of Station 3 (244.64ind.250m^{-2}), followed by middle zone of Station 5 (227.18 ind.250m^{-2}), middle zone of Station 5 (205.18 ind.250m^{-2}), inner zone of Station 5 (180.36ind.250m^{-2}) and the lowest was found at inner zone of Station 2 (2.09ind.250m^{-2})

The abundance of holothurians species, i.e *H. atra* and *S. chloronotus* was influenced by bottom substrate. *H. atra* preferred sand habitat while,

S. chloronotus preferred dead coral and sand with coral rubble. However, the two species showed lowest density in the sea grass habitat.

The density of *H. atra* and *S. chloronotus* in the transect areas showed reduction in number after monsoon. High reduction occurred at open shallow stations.

Length- weight relationships of the two dominant species, *H. atra* and *S. chloronotus* indicated that the animals grew allometrically.

Growth parameters of the Gulland and Holt Plot method, $L\infty$ and K of *H. atra* and *S. chloronotus* were estimated. $L\infty$ and K values were 35.01cm and 0.63cm $year^{-1}$ for *H. atra* and 31.22 cm and 0.82 cm $year^{-1}$ for *S. chloronotus.*

ASPEK TAKSONOMI DAN PARAMETER POPULASI MENTIMUN LAUT (ASPIDOCHIROTIDA : HOLOTHUROIDEA) DI PULAU KAPAS, TERENGGANU, MALAYSIA

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Kajian ini bertujuan untuk meneliti beberapa aspek taksonomi ke atas spesies holothurian (mentimun laut) dan parameter populasi daripada spesies dominan yang dijumpai di Pulau Kapas.

Pengamatan serta pengiraan kepadatan dan kelimpahan mentimun laut dijalankan dengan kaedah transek pada lima buah stesen dalam jangka masa 11 bulan, bermula dari bulan Mac 1993 hingga Mei 1994, kecuali bulan Oktober 1993 hingga Januari 1994. Data kelimpahan diambil melalui pengamatan dibawah air.

Sepuluh spesies telah dikenalpasti iaitu *Holothuria atra*, *H. edulis*, *H. hilla*, *Stichopus chloronotus*, *S. variegatus*, *Stichopus sp.*, *Actinopyga echinetes*, *A. miliaris*, *A. lecanora* dan *Bohadschia marmorata*. Satu spesies daripada genus *Stichopus* tidak dapat dikaji hingga ke peringkat spesies.

H. atra merupakan spesies terbanyak (50.61%) di antara sepuluh spesies yang didapati di kawasan kajian. Spesies dominan berikutnya adalah *S. chloronotus* (27.13%) dan *H. edulis* (19.51%). Spesies lainnya didapati kurang daripada 3% mentimun laut yang tercatat.

Rata-rata kepadatan mentimun laut yang tertinggi dijumpai pada kawasan dalam Stesen 3 (244.64ind.250m^{-2}), diikuti kawasan tengah Stesen 3 (227.18ind.250m^{-2}), kawasan tengah Stesen 5 (205.18ind.m^{-2}), dan kawasan dalam Stesen 5 (180.36ind.250m^{-2}), manakala kepadatan terendah terdapat di Stesen 4 (0.063ind.m^{-2}).

Taburan *H. atra* dan *S. chloronotus* di kawasan kajian dipengaruhi oleh keadaan habitat dasar. *H. atra* lebih menyukai habitat berpasir, manakala *S. chloronotus* lebih menyukai habitat karang mati dan pasir dengan serpihan karang mati.

Terdapat penurunan kelimpahan bagi spesies *H. atra* dan *S. chloronotus* di beberapa stesen kajian yang cetek dan terbuka.

Hubungan panjang-berat menunjukkan bahawa dua spesies dominan *H. atra* dan *S. chloronotus* membesar secara allometrik.

Parameter pertumbuhan Gulland dan Holt Plot bagi L_∞ dan K untuk *H. atra* dan *S. chloronotus* adalah 35.01 cm dan 0.63 cm tahun^{-1} dan 31.22cm dan 0.82 cm tahun^{-1} untuk *S. chloronotus*.

CHAPTER I

INTRODUCTION

Background of the Study

Holothurians belong to the phylum Echinodermata and are commonly called sea cucumbers. They are benthic animals occurring in most seas at all latitudes. They can be found in littoral zones to approximately 8500 m. Holothurians inhabit a wide variety of habitats. They are often gregarious. Some live in rocky substrate in which they can hide or conceal under the rock, while others live on mud or attached to seaweeds (Pawson, 1966).

In studying ecology and applied biology, the identification of the species concerned is important; without it the study is not thoroughly completed. There are considerable information relating to species identification, habitats and distribution of the Holothurians. A detailed study of the genus *Holothuria* and *Actinopyga* in the Indian Ocean was conducted by Pearson (1914a,b), while notes on the genus *Stichopus* were made by Clark (1922). Holothurians in Guam were reported by Rowe and Doty (1977), and in Northern Australia by Cannon and Silver (1986).

In Malaysia, recent study on the biology of holothurians is limited. Chan and Liew (1985) presented very general information on holothurians, while Sallehudin and Zulfigar (1993) provided relatively detailed information on the reproductive cycles of *Holothuria atra* and *Stichopus horrens* of Terengganu water. The relationships between total length and other parts of the body such as body weight, body wall weight, stomach weight, gonad weight of *H. atra* and *S. horrens* in P. Pinang were described by Rahmad and Zulfigar (1993).

A number of studies were conducted on holothurians in other tropical and temperate waters. For example, the length-weight relationships of *H. scabra*, *H. nobilis* and *Bohadschia marmorata* in Saparua, Indonesia were described by Andamari *et al.* (1989), while Aznam Aziz (1990) reported on the reproductive cycle of *H. atra* from Seribu Islands, Indonesia. Studies on biometrics and reproductive cycle of *S. variegatus*, *H. nobilis*, *H. scabra* and *Thelenota ananas* in New Caledonea have been carried out by Conand (1981, 1990 and 1993b). A study on the gonad of *H. scabra*, *H. fuscogilva*, *H. nobilis*, *A. miliaris* and *A. echinetes* in Papua New Guinea was reported by Lokani (1990), while a review on distribution and abundance of holothurians in tropical and temperate waters was described in detail by Pawson (1966) and Bakus (1968). A study on feeding types of *H. atra* and *S. chloronotus* was reported by Moriarty (1982). Bakus (1973) and Pawson (1966) reviewed on feeding habits, types, and rhythm of several species of holothurians.

Uses of Holothurian

Holothurians are used in traditional medicine. In Malaysia, the extract of the body wall of *Stichopus variegatus* is used to heal minor wounds (Rahmad and Zulfigar, 1993). In Maldives, certain species of holothurians are used to cure high blood pressure and muscular disorder (Leslie and Hassan, 1991).

Some species of holothurians are edible. For example, *Stichopus japonicus* and *Holothuria scabra* are eaten raw by people in Japan, several parts of Indonesia and certain ethnics group in Sabah, Malaysia (Leslie and Hassan, 1991; Ridzwan Hashim , 1993). The smoked and sun-dried body wall of large holothurians are called *Beche de-mer*, or known as *trepang*. They are used as ingredient in soups, noodles and other dishes by the Chinese.

Several species of holothurians namely *H. nobilis*, *H. atra*, *Actinopyga miliaris*, *A. lecanora*, *S. chloronotus*, *S. variegatus*, *T. ananas* and *B. argus* are also utilized to produce *Beche de-mer*. Market-wise they are known as black teatfish, lollyfish, blackfish, stonefish, greenfish, curryfish, pricklyfish and tigerfish.

Beche de-mer appear to be highly nutritious as well as digestible. The *Beche de-mer* of Maldives contain 43% proteins, 27% moisture, 21% minerals, 7% insoluble ash and 2% fat (Krishnasamy, 1991). *Beche de-mer* produced in Indo Pacific contain 35 to 52% protein, 23% moisture, 15 to 30% ash with little fat and no carbohydrates. While those from the Mediterranean contain 56 to 65% protein, 13 to 24% ash, 10 to 11% moisture and 0.7% fat (Hyman, 1955). *Beche de-mer* are highly digestible since

their protein are completely soluble in pepsin, a digestive enzyme found in human stomach.

Holothurian Fisheries and Trade

The statistics on productions of holothurians in Malaysia is very scarce. From 1983 to 1992, the only data on dried sea cucumber production were recorded in 1987 from Sabah where the production was quoted at 100 metric tonnes (m.t.), while Sarawak was reported to produce 16 m.t. (Malaysia, Jabatan Perikanan, 1983, 1987 and 1990).

On the other hand, data on import and export of dried sea cucumber are numerous (Malaysia, Jabatan Perikanan, 1983, 1986, 1987 and FAO, 1990). The total import of *Beche de-mer* in Malaysia had gradually declined from 940 m.t. in 1984 to 432 m.t. in 1990. However, there was a gradual increase in export of *Beche de-mer* in Malaysia from 63 m.t. in 1984 to 125 m.t. in 1990 reaching a peak of 317 m.t. in 1989 (FAO, 1990).

On the whole, Malaysia imports *Beche de-mer* from the Philippines, Singapore, Indonesia and South Pacific countries, and after reprocessesing, *Beche de-mer* are reexported to Singapore.

The trade of *Beche de-mer* is dominated by the Chinese with Hong Kong and Singapore acting as the major market. Indonesia and Philippines are the major suppliers to Hong Kong (Conand, 1993a). The total import of *Beche de-mer* in Hong Kong had gradually increased from 5,193 m.t. in 1986 to 7,716 m.t. in 1988,

but dropped to 4,193 m.t. in 1989, while in Singapore the total import of *Beche de-mer* had slightly increased from 814 m.t. in 1986 to 1,068 m.t. in 1990. The total value increased from S$9,599,000 (US$61,929) in 1986 to S$12,321,000 (US$79,490) in 1990 (Conand, 1993a).

Malaysia as the fourth major supplier and the second re-export country contributed 17% of total *Beche de-mer* exported to Singapore valued at S$959,000 (US$6,187) in 1986 and S$369,000 (US$2,380) in 1990 (Conand, 1993a). Eventhough Malaysia is dealing in import and export of *Beche de-mer* with Singapore, the dried sea cucumber itself comes from other countries (Conand, 1993a).

Recently, there is an increase in total demand for *Beche de-mer* due to the increase in incomes amongst Chinese communities in Asia. High value species are sough by the Chinese in Hong Kong, Singapore, Malaysia and Taiwan, while the lower value species are destined largely for consumption in mainland China (Mc. Elroy, 1990).

High demand of *Beche de-mer* leads to increase in the fishing of holothurians. Holothurian overfishing has been reported from many countries. In Langkawi, Malaysia, *S. variegatus*, had been reported as being heavily exploited for traditional medicine (Nasir B. Hj. Rasol, personal communication).

In order to maintain holothurians as a sustainable fishery, the Malaysian government has directed its fishery agencies to formulate policies for the management of holothurian fishery. Therefore, statistics on species harvested, catch and landings of holothurians are required. Some aspects of the biology such as species abundance, distribution, length frequency, reproduction, feeding habits and growth are also needed for a rational management of holothurians. In general this study aims to provide some of the above information. Its specific objectives are :

1. To identify and describe the external morphology and to prepare the taxonomic key of holothurians.

2. To determine variability in shape, size, composition of spicules and the relationship between weight of dominant species and spicule size.

3. To study the length weight relationships and the growth of *Stichopus chloronotus* and *Holothuria atra* using length-frequency data.

4. To study the distribution and abundance of holothurians in relation to season and types of habitat.

CHAPTER II

LITERATURE REVIEW

This review has been conducted to provide the status of knowledge and studies on holothurians within the context of the present study. The following areas are reviewed : taxonomy, distribution, size, factors influencing the population density, length-weight relationships and growth of holothurians.

Taxonomy of Holothurians

There are very limited data available on taxonomy of holothurians in Asian countries. However, there are some information on holothurians identification by Theel (1886), Pearson (1914a,b), Rowe and Doty (1977). Classification of holothurians were given by Panning and Deichman in Rowe (1969), Hyman (1955), Arnold and Birtles (1989). Clark and Rowe (1971) published the keys for identification of holothurians of the Indo West Pacific. Identification of holothurians in North Australia is reported in Cannon and Silver (1986). Taxonomic classification of holothurians found in tropical areas (Clark and Rowe, 1971; Pearson, 1914a,b; Rowe and Doty , 1977) are summarized as follow :