DIVERSITY AND ABUNDANCE OF MARINE INVERTEBRATES INCLUDING HAZARDOUS AND EDIBLE SPECIES IN SEPANGAR ISLAND

NURUL SHAHNIZA BINTI TUSIN

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NURUL SHAHNIZA BINTI TUSIN

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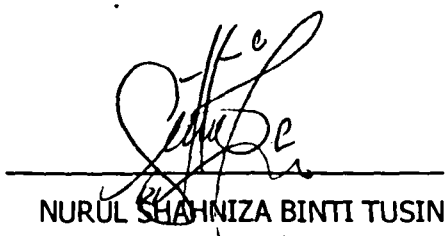

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1. SUPERVISOR
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ABSTRAK

Kelimpahan dan diversiti invertebrata adalah komponen penting dalam memastikan kesihatan ekosistem terumbu karang. Walau bagaimanapun, terdapat sebahagian daripada invertebrata marin tersebut yang mampu membahayakan manusia dan juga komuniti terumbu karang. Tambahan pula, sebahagian invertebrata turut digemari sebagai makanan yang enak. Kajian mengenai diversiti dan kelimpahan invertebrata marin termasuk spesis merbahaya dan boleh dimakan telah dijalankan di Pulau Sepangar dengan melibatkan empat lokasi dan tiga kedalaman untuk setiap lokasi tersebut. Data telah dikumpul meggunakan teknik "invertebrate belt transect" dengan panjang sebanyak 100 m dan lebar sebanyak 5 m. Sejumlah 19 spesis invertebrata marin telah dikenalpasti sepanjang tempoh kajian. Diversiti tertinggi terdapat di Lokasi 4 (15 spesis) dan kelimpahan tertinggi didapati di Lokasi 3 (66 ind/1000 m^2). Kedalaman 5 m dan 10 m mempunyai diversiti yang sama (12 spesis); namun kelimpahan invertebrata marin tertinggi adalah pada kedalaman 5 m (62 ind/1000 m^2). Daripada 19 spesis, tiga spesis diklasifikasikan sebagai merbahaya dan tujuh spesis dianggap sebagai boleh dimakan. Di samping itu, kelimpahan invertebrata marin yang merbahaya dan invertebrata yang boleh dimakan adalah tertinggi di Lokasi 3 dan pada kedalaman 5 m. Analisis statistik menunjukkan bahawa kedalaman mempengaruhi diversiti dan kelimpahan invertebrata marin termasuk spesis yang merbahaya dan boleh dimakan, manakala lokasi tidak mempengaruhi diversiti dan kelimpahan sama sekali.

ABSTRACT

Diversity and abundance of marine invertebrates are crucial component in making sure the health of reef ecosystem. Nevertheless, some of these marine invertebrates pose some dangers to humans as well as the coral community. Besides that, some invertebrates are also enjoyed as delicacies for consumption. Research of diversity and abundance of marine invertebrates including hazardous and edible species were conducted at Sepangar Island involving four locations and three depths for each location. Data was collected using invertebrate belt transect with length of 100 m and width of 5 m. A total of 19 species of marine invertebrate were identified throughout the study. Highest diversity was obtained at Site 4 (15 species) and highest abundance of marine invertebrates was obtained at Site 3 (66 ind/1000 m^2). Depth of 5 m and 10 m had the same diversity (12 species); however abundance of marine invertebrates was the highest at 5 m (62 ind/1000 m^2). Out of 19 species, three species were classified as hazardous and seven species were considered edible. Moreover, abundance of hazardous and edible marine invertebrates was highest at Site 3 and at 5 m of depth. Statistical analysis showed that depths influenced the diversity and abundance of marine invertebrates including hazardous and edible species, while locations did not affect the diversity and abundance at all.

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LIST OF SYMBOLS

m	Metre
m^2	Metre square
t	tonnes

LIST OF FORMULA

LIST OF ABBREVIATIONS

ind	individuals
N	North
CITES	Convention on International Trade in Endangered Species

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CHAPTER 1

INTRODUCTION

1.1 Marine Invertebrates

Invertebrates are animals without backbones, and marine invertebrates are a large and diverse group of at least 50,000 species (Brusca and Brusca, 2003). Many of these species are important to humans ecologically and economically, providing essential ecosystem services such as coastal protection and income from tourism and commercial and recreational fisheries. The marine invertebrates comprise over 160,000 known species. Two groups dominate which are the molluscs and crustaceans, which together contain over 90,000 species (Spalding *et al.*, 2001).

Marine invertebrates occur in the world's oceans from warm shallow waters to cold deep waters. They inhabit the seafloor and water column in all the large marine ecosystems and open ocean areas. They are important in the marine food web as prey for many higher organisms, as scavengers and recyclers of nutrients, and as habitat-forming organisms. Every sessile invertebrate is habitat-forming; in a strict sense, even many motile marine invertebrates are habitat-forming. The principal habitat-forming invertebrates are Porifera, Cnidaria, Annelida, and Mollusca (Castro and Huber, 2000).

1.2 Hazardous Marine Invertebrates

Animals are able to inflict damage to humans in three ways: by causing physical injury through biting, puncturing or cutting; by actively delivering venom or toxins into the body through mechanisms such as spines, fangs or stinging cells; and by being poisonous to eat. Classification of dangerous animals is done by the kinds of

injuries they cause. Those that injure humans through physical trauma are termed traumatogenic. Fishes generally do this by biting, or by cutting or puncturing by means of sharp spines, blades or rough scales. Lobsters and crabs do so by means of pincers, while corals can cut with their sharp skeletons. A few species of fishes use electricity to shock their prey as well as defend themselves. These are termed electrogenic. Many fishes, sea snakes and invertebrates use venom to kill prey and to defend themselves. Whether they deliver this by a spine, fang or stinging cells, all are termed venomous. Finally, many animals are entirely harmless unless eaten. They contain toxic substances or poisons and are thus termed poisonous. Some animals are dangerous in more than one way (Bergbauer *et al.,* 2009).

Marine invertebrates such as box jellyfishes, men-of-war, cone snails, and flower urchins may cause fatality upon contact. However, the more common injury caused by marine invertebrates is from embedded spines of sea urchins and crown-of-thorns starfish. For urchins' spines, victims may remove parts of the spines themselves, but for spines that broke and embedded deep inside the tissue, the victim may feel some discomfort and even pain (Adams, 2008).

1.3 Edible Marine Invertebrates

Edible marine invertebrates such as prawn, squid, cuttlefish, and jellyfish contribute to the fisheries sector of the country. The fisheries sector is vitally important to Malaysia. Apart from contributing to the national Gross Domestic Product (GDP), it is also a source of employment, foreign exchange and protein (Department of Fisheries, 1995).

The export quantity of fishery commodities in Malaysia (Table 1.1) for the year 2011 amounted to 296,053 tonnes which is an increase of 1.59% compared to 2010. The total export value was RM2,825.90 million for the year 2011, increasing by 5.54% the year before (Department of Fisheries Malaysia, 2012).

Table 1.1 Fisheries export and import value for year 2010 and 2011 (Source: Department of Fisheries Malaysia)

Export/Import	2010	2011	Change (%)
Export			
Quantity (tonnes)	291,411	296,053	+1.59
Value (RM million)	2,677.48	2,825.90	+5.54
Import			
Quantity (tonnes)	425,709	366,775	-13.84
Value (RM million)	2,570.01	3,077.55	+19.75
Balance of trade	**+ 107.47**	**-251.65**	

1.4 Research Objectives

The main objectives of this study are:

I. To determine diversity and abundance of marine invertebrates including hazardous and edible species in Sepangar Island.

II. To compare the diversity and abundance of marine invertebrates among different sampling locations and depths in Sepangar Island.

1.5 Research Hypotheses

The hypotheses of this research are:

I. H_0 : There is no significant difference between sampling locations and abundance of marine invertebrates in Sepangar Island.

H_1 : There is significant difference between sampling locations and abundance of marine invertebrates in Sepangar Island.

II. H_0 : There is no significant difference between depths and abundance of marine invertebrates in Sepangar Island.

H_1 : There is significant difference between depths and abundance of marine invertebrates in Sepangar Island.

1.6 Significance of Research

This research is important to provide a checklist of marine invertebrates including hazardous and edible marine invertebrate species that can be found in Sepangar Island and thus, to be able to provide baseline data regarding the abundance and diversity of marine invertebrates, hazardous and edible species in Sepangar Island.

CHAPTER 2

LITERATURE REVIEW

2.1 Diversity and Abundance of Marine Invertebrates

Biotic and abiotic interactions and dynamics within each phase of the life cycle have the potential to influence the distribution and abundance of the adult populations of marine invertebrates. Adult populations have specific environmental requirements and occupy habitats with particular constraints. These may be physical characteristics such as tidal gradient, exposure, habitat complexity, depth, salinity and temperature gradients. There are also biotic factors. A readily available food supply is fundamental but distribution is also influenced by competition and predation. The need for reproduction and dispersal of larvae favours clustering or at least close proximity of adults to ensure fertilization. Dispersal and recruitment of the larval stage ensures the continuance of the species but the role of the planktonic larval stage in invertebrate population dynamics is not yet fully understood (Jenkins, 2005).

Differences in recruitment vary both temporally and spatially but the extent that this effect has on adult abundance and distribution is still a matter of debate (Hughes, 1992). The influences of post settlement density related processes of predation and competition have to be considered in relation to influences affecting the larval stages of the invertebrate. In general, the number of marine invertebrate species increases toward the equator (Macpherson, 2002). The higher number of species (diversity) and abundance of marine invertebrates in coastal water habitats, compared with the open ocean, is a result of the food and protection that coastal water habitats provide (Levinton 2009).

2.2 Hazardous Marine Invertebrates Present in Malaysia

Some of the common hazardous marine invertebrates that can be found in the seas of Malaysia are summarized in Table 2.1 below.

Table 2.1 Hazardous marine invertebrates commonly found in Malaysia (Source: Bergbauer *et al.*, 2009)

Name	Description
Cone snails	Accidents usually happen when the curious picks up these cone snails. The first symptom of envenomation is severe pain. Numbness soon sets in and spreads to the entire limb. If the sting is severe, unconciousness may occur within one hour and followed by death through respiratory paralysis.
Blue-ringed octopus	All documented accidents have happened when they are handled. Its bite normally goes unnoticed and only leaves a tiny wound that is barely visible. Within a few minutes, weakness and tingling in the facial area and neck sets in. This is followed by numbness and nausea. Complete paralysis will sets in within few minutes and leads to death from asphyxiation.
Crown-of-thorns starfish	Accidents occasionally happen when a careless diver brushes up against Crown-of-thorns or foolishly attempts to handle it. Wounds result in immediate sharp pain followed by tenderness and redness. Small calcereous particles left in the wound can cause granulomas, painful cysts that never heal.
Sea urchin	Most accidents happen when barefoot swimmers or waders bump into or step on unseen urchins. Injury by the spines of long-spined urchins cause immediate, severe pain. Further symptoms are swelling and redness of the skin. Fragments of spines stuck in the wound pose the danger of becoming encapsulated by surrounding tissue, which can lead to formation of granulomas.

2.3 Economic Value of Marine Invertebrates

In the year 2011, Malaysia's three main commodities with the highest exports in terms of quantity were shrimps, prawns, live, fresh, chilled or frozen (74,762.19 tonnes), fish, fresh or chilled, frozen (73,959.70 tonnes) and squids, cuttlefish, octopus and other molluscs, live, fresh, chilled or frozen (38,287.90 tonnes). Commodity shrimps, prawns, live, fresh, chilled or frozen was exported at an average price of RM18,789 per tonne. Shrimps, prawns, live, fresh, chilled or frozen constituted 25.25% of the overall export quantity with an average price of RM18,789 per tonne. It contributed 49.71% to the total export value of the fishery commodities for the year 2011 (Department of Fisheries Malaysia, 2012).

The statistics by Department of Fisheries showed that marine invertebrates especially crustaceans and molluscs are among the main commodities for the fisheries sector in the country. They have high economic value and high demand from other countries in the East Asia, South Asia, Oceania, European Union, and African Continent.

2.4 Marine Invertebrates as Indicator of Reef Health

Some marine invertebrates are considered indicator species a concept now well established (Soule and Kleppel, 1988). 'Indicator organisms' are organisms with characteristics which make them suitable for detecting or forecasting impacts at some kind of level of biological organisation, ranging from biochemical to ecosystems (Jones and Kaly, 1996). An indicator is essentially a statistic based upon a time trend data set which is relevant to a particular issue of concern (Vandermeulen, 1998).

They react to disturbance. Disturbance in an ecological context is defined as a temporary change in average environmental conditions that causes a pronounced change in an ecosystem. In terms of the marine environment certain organisms can be used as indicators to detect pollution levels or changes in fishing or harvesting efforts and early warnings to population and community effects. Indicator species can have added value over raw data as they represent the broader significance or implications of the data. For example, an outbreak of *A. planci* is immediately obvious

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