COMPARISON OF MACROBENTHOS POPULATION BETWEEN SEAGRASS AND NON-SEAGRASS AREAS IN SULAMAN LAGOON, SABAH

CHANG KHONG YEAN

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HS2004 – 3072

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1. **SUPERVISOR**

   MR. MUHAMMAD ALI BIN SYED HUSSEIN

2. **EXAMINER 1**

   DR. SAIFULLAH A. JAAMAN

3. **EXAMINER 2**

   DR. PUSHPALATHA M. PALANIAPPAN

4. **DEAN**

   DR. SHARIFF A. KADIR S. OMANG

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CHANG KHONG YEAN

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ABSTRACT

A preliminary survey on the distribution of macrobenthic animals was carried at Sulaman Lagoon Tuaran, Kota Kinabalu from December 2007 to January 2008 by using quadrat $0.7m^2$ randomly throw in 10 throw, at two different vegetation. This survey was conducted to know the different of species and diversity at two study sites which is seagrass area and non-seagrass area. Environmental variables are recorded. There was 4 family and 4 species were found at both sites. From the survey, *Cerithium* sp was the dominant species and can be found at both study sites. They occupied more than 70% of the total macrobenthic animals found. Diversity and abundance were higher at seagrass area. The data of this study provide a valuable baseline for future use of this site.

ABSTRAK

Tinjauan awal telah dijalankan di lagun Sulaman yang terletak pada daerah Tuaran, Kota Kinabalu dari Disember 2007 sehingga Januari 2008 dengan menggunakan kuadrat sebesar 0.7m^2 yang dibuang secara rawak sebanyak 10 kali dalam dua kawasan yang berbeza tumbuhannya. Kajian ini bertujuan untuk mengetahui perbezaan jenis spesies dan kepelbagaian haiwan antara dua kawasan yang mempunyai rumput laut dan yang tidak mempunyai rumput laut. Parameter persekitaran juga direkodkan. Terdapat 4 famili dan 4 spesies dapat dijumpai dalam dua kawasan itu. Daripada kajian, *Cerithium* sp merupakan sesies dominan dan boleh dijumpai dalam 2 kawasan itu. Lebih daripada 70% daripada jumlah haiwan makrobentik yang dijumpai adalah *Cerithium* sp. Kepelbagaian dan kelimpahan adalah tinggi di kawasan yang mempunyai rumput laut. Data yang didapati daripada kajian adalah penting untuk kajian-kajian pada masa akan datang.

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LIST OF SYMBOLS

H'	Shannon – Weiner Diversity Index
E	Pielou's Evenness Index
D	Margalef's Richness Index
W	Shapiro-Wilk's Test Statistic
Σ	Total
UV	Ultra Violet
m	Metre
m^2	Metre Square
g	Gramme
gC	Gramme of Fixed Carbon
cm	Centimetre
°	Degree
′	Minute
″	Second
%	Percent
‰	Part Per Thousand
<	Less Than

CHAPTER 1

INTRODUCTION

1.1 Coastal Lagoon and Seagrass Ecosystem

The term *lagoon* is used for the region between a barrier island and the mainland, as well as any shallow estuary that is essentially isolated from the ocean (Garrison, 2005). Coastal lagoons are shallow aquatic ecosystems that develop between coastal terrestrial and marine ecosystems. Lagoon ecosystems are transition units of landscapes and waterscapes. Lagoons consists a sensitive areas known as wetlands which is the interface between the land and the water. From definition by the Ramsar Convention, wetlands exist in a wide range of local ecosystems and landscapes or waterscapes distributed over continents and at the land sea interface. They are natural, semi-natural and human-dominated ecological systems that altogether cover an average of 6% of the Earth's land surface (Gönenç and Wolflin, 2005).

Coastal lagoon ecosystems are dynamic and open systems dominated and subsidized by physical energies and characterized by particular features such as shallowness, presence of physical and ecological boundaries and isolation that distinguish them from other marine ecosystems. Shallowness usually provides an illuminated bottom and influencing wind affect, churning the entire water column, promoting resuspension of the surface sediment layer (Little, 2000).

Lagoons are one of the most valuable components of coastal areas both as an ecosystem and natural habitat. Surrounding areas of lagoons provide excellent condition for fishery, agriculture and tourism sector. Lagoons play an important role among the coastal zone ecosystems as they provide suitable breeding areas for many species. Coastal lagoons are usually among the marine habitats with the highest biological productivity. Nutrient input from both run-off and irrigated land waters and from currents through tidal channels contribute to increase in primary productivity.

Primary producers such as seagrass can develop within coastal lagoons for long time based on slowly accumulating nutrients pool which are efficiently recycled. This long-term development is also supported by self-stabilizing mechanisms. Seagrass influences the water transparency, decreasing sediment resuspension by retention sediments in the water-sediment interface. Benthic microalgae also contribute to keep sediment oxygenated through photosynthesis. Sediment mineralization usually supplies enough nutrients to benthic microalgae to make them relatively independent of nutrient concentration in the water. Sediment maintained at high oxygenation levels provides a suitable environment for both benthic filter feeders and detritivorous organisms. Benthic rooted vegetation seagrass is the main primary producer in oligotrophic lagoons, providing food to many organisms such as benthic invertebrates and fishes (Gõnenç and Wolflin, 2005).

Seagrass meadows subsidise not only the microbial webs and zooplankton community but also the benthic filter and detritus feeding organisms. These organisms also benefit from seagrass meadows by efficiently retrieving their energetic requirements from its fragmented debris. The equilibrium between stability of the substrate, refuge provided, and moderate supply of organic matter, all together favored by aerobic conditions, gives the benthic fauna community a balance between their filter feeders and detritivorous organisms. Benthic fauna may vary depending on the lagoon characteristics as they adapt to substrate, with major groups being deposit feeders and other detritivorous, filter feeders and predatory annelids, mollusks, and crustaceans. High abundance of filter feeders, including sponges, bivalves, and ascidians in lagoons, providing high filtering rates that retrieve many particles, including phytoplankton.

Benthic macrofauna play an important role, by bioturbation, in the microbial communities in sediment, directly due to burrowing and ventilating the sediments and indirectly by feeding on detritus and microorganisms (Wheatcroft, 2006). Increased transport due to ventilation of burrow water usually enhances reaction rates and solute fluxes whereas reworking during burrowing is responsible for displacement of organic particles.

1.2 Benthic Fauna

Benthos animals are divided into epifauna, which live on the surface of soft sediments and hard bottoms, and infauna, which live within soft sediments. Most benthos fauna

(80%) consist of epifaunal populations. Commonly occurring infauna are burrowing clams, polychaete worms and various gastropods. Important epifauna include barnacles, corals, mussels, bryzoans and sponges. Macrobenthos are the animals which size from 1 mm to 20 cm that can captured on 1 mm mesh sieves such as bivalves, gastropods and polychaete worms (Kennish, 2001).

1.3 Aims

The aim for this study is to provide an ecological baseline data on seagrass macrobenthos at Sulaman lagoon. As this is preliminary survey, it is hoped that by providing the data of the invertebrates in the area, this will be a reference for future studies to be carried out.

1.4 Research Objectives

The main objectives of this research are;

1. To study the abundance, diversity and distribution of macrobenthos in seagrass beds at Tuaran Sulaman lagoon.
2. To compare the abundance, diversity and distribution of macrobenthos between seagrass beds and non-seagrass beds.

1.5 Hypothesis

The hypotheses of this study are:

H_0= the distribution and diversity of macrobenthos found in seagrass beds and non-seagrass beds are the same.

H_1= the distribution and diversity of macrobenthos found in seagrass beds and non-seagrass beds are significantly different.

1.6 Significance of Study

The significance of this study is to know the distribution and diversity of macrobenthos within the seagrass and non-seagrass area in Sulaman lagoon. This will provide an ecological baseline data on seagrass macrobenthos at Sulaman lagoon. This study also provides a reference for future studies to be carried out. This study will be useful in gaining information for public education on the importance of seagrass areas as a nursery and feeding ground.

CHAPTER 2

LITERATURE REVIEW

2.1 Seagrass Ecosystem

Seagrasses dominate the low-tidal levels of sedimentary shores and may spread into the sublittoral zone. Seagrass distribution depends on several physical-chemical factors, particularly light, temperature, salinity, turbidity, wave action and currents (Kennish, 2001). They are monocotyledonous angiosperms adapted for marine life both through their physiology and morphology (McRoy and Helfferich, 1977). These marine angiosperms belong to 2 major botanical families, *Potamogetonaceae* and *Hydrocharitaceae* (Day *et al.*, 1989).

Some tropical species have average production rates of 800g dry weight/m^2 per year, and the leaves of *Thalassia* or turtle grass can grow 2 cm in a day (Little, 2000). The leaves grow from the base, while the tips erode to form detritus, and most seagrass biomass enters the food web in this form rather than being consumed directly as living material (Little, 2000). Seagrass slows water movement across the sediment, which leads to more deposition of finer particles than in the surrounding areas (Broaden and Seed, 1985; Kennish, 2001). Between this leaves and shoots, seagrasses roots help to stabilise the soft bottom and the leaves cut down wave action and currents (Castro and Huber, 2005).

Kikuchi and Pears (1970) have reviewed the fauna and flora of seagrass meadows (McRoy and Helfferich, 1977). They recognize four main sub-habitats, which are:

(1) the leaf epiphyton comprising of macroflora with associated small animals including nematodes, polychaetes and crustaceans, together with sessile fauna, such as hydroids, sea-mats and anemones, and vagile forms including snails, echinoderms and small fish,

(2) stem and rhizome biota which include various polychaetes, amphipods and bivalves;

(3) species swimming among the leaves including fish, especially wrasse, cephalopods such as S*epiola* and crustaceans; and

(4) sediment fauna, although this may differ little from that of the surrounding benthos (McRoy and Helfferich, 1977).

2.2 Ecological Importance of Seagrass

Seagrasses presence has been proven to be ecologically important (Pollard, 1984; Coston-Clements *et al.*, 1991). High density of photosynthesizing plants, seagrass beds have a higher primary production on soft bottom with values as high as 8gC/m^2/day (gC is grams of carbon fixed) (Castro and Huber, 2005).

Seagrasses are important components of soft-shore communities far in excess of their contribution to the diet of herbivores. This importance becomes apparent after even a brief examination of seagrass bed; the fauna is more diverse and abundant. Seagrass beds are able to support a diverse community of marine organisms, which includes epiphytes, invertebrates, fishes, sea turtles and dugongs. The leaves of seagrass become encrusted with sessile epiphytes ranging from algae to bryzoans, and whole mobile community of snails and amphipods to develop (Little, 2000). The marine organisms utilize the beds as habitats and feeding ground. Here a community of larger mobile animals can live, including crabs, shrimps and fish. Juveniles and sub-adult stages of many fish, crab and shrimp species take refuge in these beds and use them as nursery grounds (Pollard, 1984; Short *et al.*, 2007).

Besides shelter, seagrass beds offer a rich source of detrital food, especially because the majority of seagrass detritus usually remains within the bed. Large communities of infaunal detritivores take advantage of this supply, and the mud between the rhizomes abounds in polychaetes, bivalves, snails, and amphipods (Little, 2000).

2.3 Research on Macrobenthos

Reise (1982) did a long-term study on changes in the macrobenthic invertebrate fauna of the Wadden Sea. Out of the 101 common species he studied, 28 have decreased, chiefly because oyster beds, *Sabellaria* reefs and a subtidal seagrass bed have disappeared.

Almost all losses occurred in the subtidal region. Increases were recorded for 30 species of which inadequately high share were polychaetes.

Taxonomic composition, numerical abundance, distribution, trophic relationship and community structure of the invertebrate macrobenthos of the extensive, intertidal eel grass beds of Western Port was reported containing a diverse range of invertebrate taxa dominated by polychaetes and crustaceans (Watson *et al*., 1983).

Castel *et al.*, (1989) found 2470 individuals in 400 cm^2 of macrobenthos recorded in seagrass bed sediments. The *Zostera* induces enhancement of organic detritus provides a refuge against predation. This is because macrofauna is more sensitive to external factors such as predation, anoxia, and exposure.

The seagrass bed in Moni Bay was dominated by *Posidonia oceanica* in 1992. A total of 178 individuals of 62 species are recorded. The composition of macrofauna in 1992 was dominated by gastropods (44 %), crustaceans (22 %), bivalves (17 %), polychaetes (11 %) and echinoderms (6 %) in Moni Bay, Cyprus (Argyrou *et al*., 1999).

Overall, the study of macrobenthos in the earlier period show a significance of abundance and diverse in the soft bottom areas.

2.4 Adaptation

Seagrasses offer both a greatly increased surface area, and a relatively firm substratum (Little, 2000). Seagrasses have active roots, symbiotic partners, and high productivity. Their roots form a network underground stems to keep them anchored from turbulence (Short *et al.*, 2007; Kennish, 2001). Like the most land plants, seagrasses have roots that enable to extract nutrients directly from sediments. They can colonize both sand and mud by sending out rhizomes tuberous structures that can produce new bundles of shoots and leaves, and also store food supplies (Little, 2000). The epiphytes were the seagrass symbiotic nitrogen fixers that maintain a high rate of productivity (Milne, 1995).

2.5 Reproduction

All seagrass species are capable of asexual reproduction, producing modular units (ramets) through horizontal rhizome growth that may be physiologically independent but are genetically identical to the parent plant (genet) (Short *et al.*, 2007). Seagrasses also reproduce through pollination where the flowers are typically small and not noticeable. The Pollen, which contains the sperm, is carried by water currents. It is released in strands. Some seagrasses grain is long and some are tiny and round. The tiny seeds are dispersed by water currents and perhaps in the feces of the fish (Castro and Huber, 2005).

2.6 Geographical Distribution of Seagrass

Seagrass species are limited in their geographic range in temperate and tropical regions. Temperate regions are dominated by species in the genus *Zostera*, while the Mediterranean and the south temperate regions are dominated by species of *Posidonia* (Figure 2.1).

Temperate seagrasses exist with other important habitats. In the North Atlantic the species of *Z. marina* meadows coexist with salt marshes, kelp beds, and oyster and mussel reefs. The limitations to seagrasses diversity in temperate regions are cold temperatures, freshwater discharge and anthropogenic impacts (Short *et al.*,2007).

Tropical regions have high species diversity with the genus *Halophila*. The limitations were high temperature and radiation exposure, especially at low tide. Ultraviolet radiation (UV) exposure in the tropics can make seagrass leaves purple in color. This may reduce their productivity. Tropical seagrass ecosystems are affected by nutrient limitation in oligotrophic nature (Short *et al.*,2007).

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