UNIVERSITI PUTRA MALAYSIA

DISTRIBUTION AND DIVERSITY OF MACROBENTHOS COMMUNITY IN THE SEAGRASS ECOSYSTEM OF MERAMBONG SHOAL, JOHOR, MALAYSIA

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FP 2021 55

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfillment of the Requirements for the Degree of Master of Science

January 2020

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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Chair : Nur Leena Wong Wai Sin, PhD
Faculty : Agriculture

Merambong Shoal seagrass bed is heavily impacted by reclamation activities that has been ongoing since 2014. A monitoring survey was conducted to monitor the diversity and distribution of macrobenthos community structure in this seagrass bed along with its interaction with sediment and macrophytes composition in relation to possible environmental disturbance or habitat alteration caused by the reclamation activities. Three 200 m transects were laid across the Merambong North Stations (MNS) while another two were placed in the Merambong South Stations (MSS). Macrobenthos sediment samples were collected bi-monthly from five transects on the seagrass bed using PVC hand corer from December 2015 to June 2018. Macrophytes composition data was also collected from December 2016 to June 2018 using the same transects. Results showed that there was obvious decline in monthly mean density (6.6 – 14.6 ind per m^2) and alteration in the composition of macrobenthos dominant groups inhabiting the seagrass bed compared to other previous studies in the same area. There was also spatial difference in where MNS was recorded to have lower macrobenthos abundance (6.6 – 7.0 ind per m^2) as in comparison to MSS (10.6 – 14.6 ind per m^2). As according to Bray-Curtis similarity analysis the reclamation activities might also even created two distinctively different structure of macrobenthos communities originated from one shoal. It was recorded that there was significant difference ($p<0.05$) in silt percentage between different transects where T1, T2 and T3 were found to have higher silt percentage (2.10% - 3.01%) than T4 and T5 (0.96% - 1.12%) suggesting higher sedimentation in this part of the shoal. The reclamation activities have also resulted in spatial differentiation in macrophytes composition between different transects around the seagrass bed. MNS was mainly dominated by opportunistic macroalgae *Ulva reticulata* while MSS continued to contain higher abundance of seagrass cover. It was recorded that there is significant correlation ($p< 0.05$) between abundance of major macrobenthos groups abundance with sediment and macrophytes composition. Signs of recovery in the seagrass ecosystem were observed after

the excavation of the sand causeway separating MNS and MSS, starting August 2017 onwards where seagrass was observed to recolonize MNS area directly replacing the *Ulva reticulata* invasion. These results concluded that the reclamation activities might have damaging effects on macrobenthos community in Merambong Shoal which also significantly altered its community structure.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan Ijazah Sarjana Sains

KEPELBAGAIAN DAN PENGEDARAN KOMUNITI MAKROBENTOS DI KAWASAN RUMPUT LAUT BETING MERAMBONG, JOHOR, MALAYSIA

Oleh

KHAIRUN WAHEEDA AHMAD ISMAIL

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Hamparan rumput laut di Beting Merambong sangat tinggi dipengaruhi oleh aktiviti penambakan yang telah dijalankan di kawasan itu semenjak tahun 2014. Satu tinjauan telah dijalankan untuk memantau variasi temporal dan spatial struktur komuniti makrobentos ini di kawasan rumput laut serta interaksinya dengan komposisi sedimen dan makrofit yang mungkin terjejas dengan gangguan persekitaran atau perubahan habitat yang disebabkan oleh aktiviti penambakan. Tiga transek berukuran 200 m dihamparkan di Stesen Merambong Utara (MNS) manakala dua lagi di Stesen Merambong Selatan (MSS). Pensampelan sedimen dan makrobentos diambil setiap dua bulan di sepanjang setiap transek dengan menggunakan pengaut tangan yang diperbuat daripada PVC dari Disember 2015 hingga Jun 2018. Data komposisi makrofit juga direkodkan dari Disember 2016 hingga Jun 2018 dalam transek yang sama. Keputusan menunjukkan terdapat penurunan ketara dalam kepadatan purata bulanan makrobentos (6.6 – 14.6 ind per m^2) dan perubahan dalam komposisi kumpulan dominan makrobentos yang mendiami kawasan rumput laut berbanding dengan kajian terdahulu di kawasan yang sama. Terdapat juga perbezaan di mana MNS direkodkan mempunyai jumlah makrobentos yang lebih rendah (6.6 – 7.0 ind per m^2) berbanding dengan MSS (10.6 – 14.6 ind per m^2). Menurut analisis persamaan Bray-Curtis, aktiviti penambakan tanah ini juga didapati telah mewujudkan dua struktur komuniti makrobentos yang jelas berbeza antara satu sama lain. Terdapat perbezaan yang ketara ($p < 0.05$) dalam peratusan sedimen antara transek di mana T1, T2 dan T3 didapati mempunyai peratusan kelodak yang lebih tinggi (2.10% - 3.01%) berbanding T4 dan T5 (0.96% - 1.12%) yang berkemungkinan disebabkan oleh sedimentasi yang lebih tinggi di bahagian ini. Kegiatan penambakan juga mengakibatkan pembezaan komposisi makrofit antara transek yang berbeza di sekitar kawasan rumput laut. MNS terutamanya didominasi oleh spesies macroalga *Ulva reticulata* manakala MSS terus didominasi oleh rumput laut. Terdapat korelasi yang signifikan ($p < 0.05$) direkodkan antara kelimpahan kumpulan utama makrobentos dengan komposisi sedimen dan makrofit. Tanda-tanda pemulihan dalam ekosistem

rumput laut dapat diperhatikan selepas pembuangan penambakan pasir di antara MNS dan MSS bermula pada Ogos 2017 di mana rumput laut diperhatikan mula pengkolonian semula kawasan MNS secara langsung menggantikan *Ulva reticulata* di kawasan tersebut. Kajian ini dapat menyimpulkan bahawa aktiviti penambakan tanah menyebabkan kesan yang mampu merosakkan komuniti makrobentos di kawasan Beting Merambong dan turut mengubah struktur komunitinya di kawasan itu.

ACKNOWLEDGEMENTS

In the name of God, for He is the best of planner. Without His permission, I would not have been able to have the courage to go through my Master's journey and actually completing it by finally producing this thesis. For every hardship, there is ease. Alhamdulillah.

I would like to express my utmost gratitude to my supervisory committee members: Dr. Nur Leena Wong Wai Sin and Prof. Aziz Arshad for giving me the opportunity to conduct this study under their supervision. Thank you sharing the knowledge, guidance, patience and motivation throughout the entire period upon completion of my research study. Without their supervision, I would definitely lost my way.

I would also like to thank UPM staffs especially in International Institute of Aquaculture and Aquatic Sciences (I-AQUAS) for their technical skills, professionalism and helpfulness. Not to forget my fellow postgraduate mates Lim Saoi May and Nawwar Zawani for their support and help along the way.

Lastly, I must dedicate my deepest gratitude to my family members who has always been there to motivate and encourage me throughout the duration of my study and research. Especially my brother in law, Dr. Fareedzul Hareez who dedicated his efforts to guide me upon the completion of this thesis. This accomplishment would never been easy without them by my side.

This chapter of my life was a complete roller coaster ride and I really learnt a lot. Not just about research, but about life in general. I'll definitely treasure this forever, a chapter I'll always keep close to my heart.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

km	kilometer
mm	millimetre
MSL	mean sea level
m	meter
ind/m^2	individual per meter square
cm	centimeter
µm	micrometer
UV	Ultra-violet
ml	mililitre
km^2	kilometer square
CO_2	carbon dioxide

CHAPTER 1

INTRODUCTION

1.1 Background of study

Seagrasses are marine angiosperms with its own ecosystem which comprised of the interaction between biotic and abiotic factors normally found in coastal areas. The seagrass ecosystem functions as the coastal nursery and habitat for variety associated marine fauna, participates in nutrient cycling, stabilizing sediments, shoreline protection and improving coastal water (Satumanatpan *et al*., 2011). Most importantly, its significant role as shelter as well as food source to benthic invertebrates and fishes has long been recognized (Stoner, 1980).

However, seagrass meadows have been declining due to natural causes, direct human-derived physical disturbances as well as indirect impacts such as global warming and sea level rise. Human-derived direct physical impact such as land reclamation has been one of the ultimate cause in the global declining of seagrass meadows majorly due to deterioration water and sediment quality to support seagrass growth (Duarte, 2002). These conditions may seriously affect the health of marine environment and cause disturbances to biological groups such as the alteration of macrobenthic community structure (Lu *et al*., 2002).

Land reclamation has always been practiced especially for maritime countries such as Hong Kong and Singapore to enhance urban development and infrastructure in the coastal areas to cope with the current growing population (Ramly, 2008). The same situation is extensively happening in Malaysia too, and a project is currently on going particularly near the seagrass beds of Merambong Shoal which is located on the western side of Straits of Johor.

1.2 Problem statement

In its geographical range, benthic community often exhibit distinct pattern in distribution, which were evidence in both spatial and temporal scale (Cob *et al*., 2014). This generally varies considerably according to environmental conditions such as its surrounding sediment composition (Gaudencio and Cabral, 2007). In seagrass ecosystem the physical setting of seagrass is suggested to affect the diversity of the interactive communities in that ecosystem which one of them consists of macrobenthic community such as molluscs (Teh *et al*., 2014). Seagrass ecosystem often requires adequate light penetration and optimum

sediment condition in order to grow, thus it is always affected by any changes especially disturbances that alter their surrounding water and sediment qualities. Anthropogenic activities such as land reclamation and dredging are known to remove seagrass habitat not only directly but also alter the surrounding biological, chemical and physical conditions of the ecosystem (Duarte, 2002). The present ongoing reclamation activities in the area of Merambong Shoal were suspected to change the hydrology in the seagrass ecosystem and it was suggested that the macrobenthos composition in the ecosystem will also be impacted by these activities, thus directly alter the community structure of macrobenthos in this ecosystem. The study aims to monitor the changes in macrobenthic community in a two-year duration by investigating the composition of associated macrobenthic fauna in the seagrass ecosystem that is presently impacted by human pressure through an ongoing land reclamation project.

1.3 Justification of study

The study on temporal and spatial changes for macrobenthos community provides valuable information about the impact of reclamation activities on the overall ecosystem health of seagrass in Merambong Shoal. It provides baseline monitoring data in the area during the reclamation period which is useful for future reference. The results obtained will enhance better understanding on how biotic and abiotic components affect each other in an ecosystem that is influenced by ongoing reclamation activities, narrowing the perspective on the macrobenthos community relationship with sediment composition and macrophytes cover.

1.4 Objectives of the study

The objectives of this study are:

1) To determine the diversity and distribution of macrobenthos community structure in the seagrass bed in response to land reclamation activities
2) To determine the relationship between macrobenthic infauna composition and sediment particle size
3) To determine the relationship between macrobenthic infauna composition and seagrass percentage cover

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BIODATA OF STUDENT

Khairun Waheeda was born in Kuala Lumpur on 20th September 1993. She grew up in Kajang, Selangor. This is where she received her early education. She spent approximately three years of high school studying in Sekolah Menengah Kebangsaan Sultan Aziz Shah (SAAS) and another two years in Mara Junior Science College (MJSC) Langkawi. She then furthered Foundation of Science in Universiti Teknologi Mara (UiTM) Puncak Alam for two semesters when later she got an offer to pursue degree. She spent three years doing Bachelor of Science (Marine Biology) in Universiti of Malaysia Terengganu. This is when she found her interest in this field. She got involved actively towards learning more about this field by taking scuba diving courses and volunteering in beach clean up activities. During her last semester, she applied on completing her internship in I-AQUAS where she was exposed to learning about marine culture. Upon completion of her degree graduation, she worked as a research assistant in UPM doing coastal monitoring works and enrolled as full time Master of Science (Marine Ecology and Biodiversity) research program in Faculty of Agriculture. Her research works focuses mainly on impacts of human induced environmental stressors on macrobenthos community structure in seagrass ecosystem and she hopes that her efforts through this research could raise awareness especially on the importance of seagrass ecosystem and the ecological functions it serves.

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